

**SECTION 00 01 01 - PROJECT MANUAL**

**FOR**

**EDINBURG CONSOLIDATED INDEPENDENT SCHOOL DISTRICT**

**CTE BARRIENTES**

**1100 EAST EBONY LN**

**EDINBURG, TEXAS 78539**

**PBK PROJECT NUMBER: 20217**

**ISSUE FOR CONSTRUCTION**

**JUNE 4, 2024**

**PREPARED BY:**

**PBK ARCHITECTS, INC.**

**601 NW LOOP 410, SUITE 400**

**SAN ANTONIO, TEXAS 78216**

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## **SECTION 00 01 03 - PROJECT DIRECTORY**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
1. Identification of project team members and their contact information.

#### **1.2 SCHOOL DISTRICT:**

- A. Name: Edinburg Consolidated Independent School District.
1. Address: 411 N 8th Ave., N/A.
  2. City, State ZIP: Edinburg, Texas 78539.
  3. Telephone: 956-289-2300.
- B. Owner's Designated Representative (ODR): All correspondence from the Contractor to the Architect will be through this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
1. Name: To Be Determined.
  2. Telephone: \_\_\_\_\_.
  3. Email: \_\_\_\_\_.

#### **1.3 CONSULTANTS:**

- A. Architect: Design Professional of Record. All correspondence from the Contractor regarding construction documents authored by Architect's consultants will be through this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
1. Company Name: PBK Architects, Inc..
    - a. Address: 601 NW Loop 410, Suite 400.
    - b. City, State ZIP: San Antonio, Texas 78216.
    - c. Telephone: 210-829-0123.
  2. Primary Contact:
    - a. Name: Elissa Villareal.
    - b. Telephone: 210-829-0123.
    - c. Email: elissa.villareal@pbk.com.
- B. Building Envelope Consultant:
1. Company Name: BEAM Professionals.
    - a. Address: 601 NW Loop 410, Suite 400.
    - b. City, State ZIP: San Antonio, Texas 78216.
    - c. Telephone: 210-638-7240.
  2. Primary Contact:
    - a. Name: Ed Saeger.
    - b. Telephone: 830-557-7989.
    - c. Email: ed.saeger@pbk.com.
- C. Civil Engineering Consultant:
1. Company Name: Melden & Hunt, Inc..
    - a. Address: 115 W. McIntyre Street.
    - b. City, State ZIP: Edinburg, Texas 78541.
    - c. Telephone: 956-381-0981.
  2. Primary Contact:
    - a. Name: Kelley A. Heller-Vela.
    - b. Telephone: 956-381-0981.
- D. Landscape Architecture Consultant:
1. Company Name: Edgeland Group.
    - a. Address: 11 Greenway Plaza.
    - b. City, State ZIP: Houston, Texas 77046.

- c. Telephone: \_\_\_\_\_.
- 2. Primary Contact:
  - a. Name: \_\_\_\_\_.
  - b. Telephone: \_\_\_\_\_.
  - c. Email: \_\_\_\_\_.
- E. Structural Engineering Consultant:
  - 1. Company Name: Chanin Engineering.
    - a. Address: 400 Nolana, Suite H2.
    - b. City, State ZIP: McAllen, Texas 78504.
    - c. Telephone: 956-637-9421.
  - 2. Primary Contact:
    - a. Name: Cristian Guajardo.
    - b. Telephone: 956-637-9421.
- F. Mechanical, Electrical, and Plumbing Engineering Consultant:
  - 1. Company Name: Sigma HN Engineers, PLLC.
    - a. Address: 701 S. 15th Street.
    - b. City, State ZIP: McAllen, Texas 78501.
    - c. Telephone: 956-332-3206.
  - 2. Primary Contact:
    - a. Name: Gabriel Hinojosa.
    - b. Telephone: 956-332-3206.
    - c. Email: \_\_\_\_\_.
- G. Technology Consultant:
  - 1. Company Name: Sigma HN Engineers, PLLC.
    - a. Address: 701 S. 15th Street.
    - b. City, State ZIP: McAllen, Texas 78501.
    - c. Telephone: 956-332-3206.
  - 2. Primary Contact:
    - a. Name: Tony Hinojosa.
    - b. Telephone: 956-332-3206.

**PART 2 PRODUCTS**

**NOT USED**

**PART 3 EXECUTION**

**NOT USED**

**END OF SECTION 00 01 03**

**SECTION 00 01 07 - SEALS PAGE**

**CIVIL ENGINEER (C)**

**COMPANY NAME: MELDEN & HUNT, INC.**

Texas Registered Engineering Firm F-1435.  
Engineer of Record: Kelley A. Heller-Vela, P.E. #97421.  
Address: 115 W McIntyre Ave..  
City, State ZIP: Edinburg, Texas 78541.  
Telephone Number: 956-381-0981.



**STRUCTURAL ENGINEER (S)**

**COMPANY NAME: CHANIN ENGINEERING, LLC.**

Texas Registered Engineering Firm F-9369.  
Engineer of Record: Cristian Guajardo, P.E. #145212.  
Address: 400 W. Nolana Ave., Suite H2.  
City, State ZIP: McAllen, Texas 78504.  
Telephone Number: 956-687-9421.



**ARCHITECT (A)**

**COMPANY NAME: PBK ARCHITECTS, INC.**

Texas Registered Firm BR-1608.  
Registered Architect: Clifford Whittingstall, R.A. #18585.  
Address: 601 NW Loop 410, Suite 400.  
City, State ZIP: San Antonio, Texas 78216.  
Telephone Number: 210-829-0123.



**ROOFING / BUILDING ENVELOPE (R)**

**COMPANY NAME: BEAM PROFESSIONALS**

Registered Roof Designer: Shawn LeCrone, IIBEC #0889.  
Address: 601 NW Loop 410, Suite 400.  
City, State ZIP: San Antonio, Texas 78216.  
Telephone Number: 210-638-7240.



**MECHANICAL AND PLUMBING ENGINEER (M P)**

**COMPANY NAME: SIGMA HN ENGINEERS.**

Texas Registered Engineering Firm F-14767.  
Engineer of Record: Jesus Gabriel Hinojosa, PE #96585.  
Address: 701 S 15th St..  
City, State ZIP: McAllen, Texas 78501.  
Telephone Number: 956-332-3206.



**ELECTRICAL ENGINEER (E)**

**COMPANY NAME: SIGMA HN ENGINEERS**

Texas Registered Engineering Firm F-14767.  
Engineer of Record: Jose Antonio Nicanor, PE #108783.  
Address: 701 S 15th St..  
City, State ZIP: McAllen, Texas 78501.  
Telephone Number: 956-332-3206.



**FOOD SERVICE (F)**

**COMPANY NAME: FOODSERVICE DESIGN PROFESSIONALS**

Address: 25317 Interstate 45.  
City, State ZIP: The Woodlands, Texas 77380.  
Telephone Number: 281-350-2323.  
No Seal Required

**DOOR HARDWARE (H)**

**COMPANY NAME: ALLEGION, PLC**

Product Representative: RB Sontag.  
Address: 9330 Corporate Drive, Suite 806.  
City, State ZIP: Selma, Texas 78154.  
No Seal Required

**END OF SECTION 00 01 07**

## **SECTION 00 01 10 - TABLE OF CONTENTS**

### **GENERAL**

#### **RESPONSIBILITY**

Each section is the responsibility of the discipline indicated by the letter in parenthesis following the section name as indicated in Section 00 01 07 - Seals Page with the following exceptions:

(O): Section provided by School District.

#### **DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS**

- 00 01 03 - Project Directory (A)
- 00 01 07 - Seals Page (A)
- 00 01 10 - Table of Contents (A)
- 00 11 19 - Request for Proposal (A)
- 00 21 16 - Instructions to Proposers (CSP) (A)
- 00 40 01 - Proposal Bond (A)
- 00 40 11 - Felony Conviction Notification (A)
- 00 40 12 - List of Subcontractors (A)
- 00 40 13 - Affidavit of Non-Discriminatory Employment (A)
- 00 40 14 - Affidavit of Non-Asbestos, Lead, and PCB Use (A)
- 00 40 17 - Certification of Criminal History Record Information Review by Contractor-Employer (A)
- 00 40 18 - Conflict of Interest Questionnaire (A)
- 00 40 20 - Certificate of Interested Parties (A)
- 00 42 00 - Proposal Forms (A)
- 00 45 00 - Selection Criteria and Contractor Information (A)
- 00 45 19 - Non-Collusion Affidavit (A)
- 00 50 00 - Texas Statutory Performance Bond (A)
- 00 50 01 - Texas Statutory Payment Bond (A)
- 00 52 00 - Agreement Forms (Draft AIA A101-2017) (A)
- 00 65 01 - Proposal Evaluation Waiver (A)
- 00 65 19.16 - Affidavit of Release of Liens Form (A)
- 00 70 00 - Conditions of the Contract (A)
- 00 72 00 - General Conditions (AIA A201) (A)
- 00 73 43 - Wage Rate Requirements (Texas) (A)
- 00 73 46 - Wage Determination Schedule (A)

#### **DIVISION 01 - GENERAL CONDITIONS**

- 01 10 00 - Summary (A)
- 01 21 00 - Allowances (A)
- 01 22 00 - Unit Prices (A)
- 01 23 00 - Alternates (A)
- 01 25 13 - Product Substitution Procedures (A)
- 01 25 13.01 - Request for Substitution Form (A)
- 01 26 00 - Contract Modification Procedures (A)

- 01 29 00 - Payment Procedures (A)
- 01 29 73 - Schedule of Values (A)
- 01 31 00 - Project Management and Coordination (A)
- 01 32 00 - Construction Progress Documentation (A)
- 01 32 33 - Photographic Documentation (A)
- 01 33 00 - Submittal Procedures (A)
- 01 35 16 - Alteration Project Procedures (A)
- 01 35 43.13 - Environmental Procedures for Hazardous Materials (A)
- 01 35 46 - Indoor Air Quality Procedures (A)
- 01 40 00 - Quality Requirements (A)
- 01 42 00 - References (A)
- 01 42 16 - Definitions (A)
- 01 45 23 - Testing and Inspecting Services (A)
- 01 50 00 - Temporary Facilities and Controls (A)
- 01 55 00 - Vehicular Access and Parking (A)
- 01 56 00 - Temporary Barriers and Enclosures (A)
- 01 57 13 - Temporary Erosion and Sediment Control (A)
- 01 60 00 - Product Requirements (A)
- 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions (A)
- 01 73 00 - Execution (A)
- 01 73 29 - Cutting and Patching (A)
- 01 74 19 - Construction Waste Management and Disposal (A)
- 01 77 00 - Closeout Procedures (A)
- 01 77 01 - Closeout Form A - Subcontractor's Affidavit of Release of Lien (A)
- 01 77 02 - Closeout Form B - Subcontractor Hazardous Material Certificate (A)
- 01 77 03 - Closeout Form C - Subcontractor Warranty (A)
- 01 77 04 - Closeout Form D - Certification of Project Compliance (A)
- 01 78 23 - Operation and Maintenance Data (A)
- 01 78 39 - Project Record Documents (A)
- 01 79 00 - Demonstration and Training (A)
- 01 91 13 - General Commissioning Requirements (A)

**DIVISION 02 - EXISTING CONDITIONS**

- 02 41 00 - Demolition (A)
- 02 82 00 - Asbestos Remediation (A)

**DIVISION 03 - CONCRETE**

- 03 10 00 - Concrete Forms and Accessories (S)
- 03 20 00 - Concrete Reinforcing (S)
- 03 30 00 - Cast-in-Place Concrete (S)
- 03 35 00 - Concrete Finishing (A)
- 03 35 00 - Concrete Finishing (S)



- 03 39 00 - Concrete Curing (S)
- 03 54 00 - Cast Underlayment (A)
- 03 60 00 - Grouting (S)

**DIVISION 04 - MASONRY**

- 04 01 20 - Maintenance of Unit Masonry (A)
- 04 05 00 - Common Work Results for Masonry (A)
- 04 05 14 - Masonry Mortar and Grout (S)
- 04 20 00 - Unit Masonry (A)
- 04 20 16 - Reinforced Unit Masonry Assemblies (S)

**DIVISION 05 - METALS**

- 05 12 00 - Structural Steel (S)
- 05 21 00 - Steel Joist Framing (S)
- 05 31 23 - Steel Roof Decking (S)
- 05 40 00 - Cold Formed Metal Framing (S)
- 05 50 00 - Metal Fabrications (A)
- 05 75 00 - Decorative Formed Metal (A)

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

- 06 10 00 - Rough Carpentry (A)
- 06 16 00 - Sheathing (A)
- 06 20 00 - Finish Carpentry (A)
- 06 83 16 - Fiberglass Reinforced Paneling (A)

**DIVISION 07 - THERMAL AND MOISTURE PROTECTION**

- 07 16 00 - Below Grade Waterproofing (A R)
- 07 21 00 - Thermal Insulation (A)
- 07 27 26 - Fluid-Applied Air Barrier System (A R)
- 07 41 13 - Prefinished Metal Roofing (A R)
- 07 51 10 - Built-Up Roofing Repair (A R)
- 07 54 19 - Modified Bitumen "Cool Roof" Membrane Roofing System (A R)
- 07 62 00 - Roof Related Sheet Metal (A R)
- 07 65 00 - Flexible Flashing (A R)
- 07 71 23 - Manufactured Gutters and Downspouts (A)
- 07 72 00 - Roof Accessories (A R)
- 07 72 33 - Roof Scuttle & Cross Over (A R)
- 07 84 13 - Penetration Firestopping (A)
- 07 84 43 - Joint Firestopping (A)
- 07 92 00 - Joint Sealants (A)

**DIVISION 08 - OPENINGS**

- 08 11 13 - Hollow Metal Doors and Frames (A)
- 08 14 16 - Flush Wood Doors (A)
- 08 33 23 - Overhead Coiling Doors (A)

08 43 13 - Aluminum-Framed Storefronts (A)

08 71 00 - Finish Hardware (H)

08 80 00 - Glazing (A)

08 87 23 - Safety and Security Films (A)

08 91 19 - Fixed Louvers (A)

**DIVISION 09 - FINISHES**

09 05 00 - Common Work Results for Finishes (A)

09 05 61 - Common Work Results for Flooring Preparation (A)

09 21 16 - Gypsum Board Assemblies (A)

09 30 00 - Tiling (A)

09 51 00 - Acoustical Ceilings (A)

09 65 13 - Resilient Base and Accessories (A)

09 68 00 - Carpeting (A)

09 81 00 - Acoustic Insulation (A)

09 90 00 - Painting and Coating (A)

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10 11 00 - Visual Display Units (A)

10 14 00 - Signage (A)

10 21 13.16 - Plastic-Laminate-Clad Toilet Compartments (A)

10 21 23 - Cubicle Curtains and Track (A)

10 26 00 - Wall and Door Protection (A)

10 28 00 - Toilet, Bath, and Laundry Accessories (A)

10 43 00 - Emergency Aid Specialties (A)

10 44 00 - Fire Protection Specialties (A)

10 51 13 - Metal Lockers (A)

10 56 13 - Metal Storage Shelving (A)

10 56 17 - Wall-Mounted Standards and Shelving (A)

10 56 26 - Mobile Storage Shelving (A)

10 73 16.13 - Metal Canopies (A)

**DIVISION 11 - EQUIPMENT**

11 21 73 - Commercial Laundry and Dry Cleaning Equipment (A)

11 30 13 - Residential Appliances (A)

11 40 00 - Foodservice Equipment (F)

11 46 83 - Ice Machines (A)

11 90 00 - Miscellaneous Equipment (A)

**DIVISION 12 - FURNISHINGS**

12 21 13 - Horizontal Louver Blinds (A)

12 36 00 - Countertops (A)

**DIVISION 13 - SPECIAL CONSTRUCTION**

NOT USED

**DIVISION 14 - CONVEYING EQUIPMENT**

NOT USED

**DIVISION 21 - FIRE SUPPRESSION**

NOT USED

**DIVISION 22 - PLUMBING**

- 22 05 17 - Sleeves and Sleeve Seals for Plumbing Piping (P)
- 22 05 18 - Escutcheons For Plumbing Piping (P)
- 22 05 23.12 - Ball Valves For Plumbing Piping (P)
- 22 05 23.14 - Check Valves For Plumbing Piping (P)
- 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment (P)
- 22 05 53 - Identification for Plumbing Piping and Equipment (P)
- 22 05 93 - Testing, Adjusting, And Balancing For Plumbing (P)
- 22 07 19 - Plumbing Piping Insulation (P)
- 22 11 16 - Domestic Water Piping (P)
- 22 11 19 - Domestic Water Piping Specialties (P)
- 22 11 23.21 - Inline, Domestic-Water Pumps (P)
- 22 13 16 - Sanitary Waste and Vent Piping (P)
- 22 13 19 - Sanitary Waste Piping Specialties (P)
- 22 13 23 - Sanitary Waste Interceptors (P)
- 22 15 13 - General-Service Compressed-Air Piping (P)
- 22 33 00 - Electric, Domestic-Water Heaters (P)
- 22 42 13.13 - Commercial Water Closets (P)
- 22 42 13.16 - Commercial Urinals (P)
- 22 42 16.13 - Commercial Lavatories (P)
- 22 42 16.16 - Commercial Sinks (P)
- 22 45 00 - Emergency Plumbing Fixtures (P)
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**DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)**

- 23 05 00 - Mechanical General Requirements (M)
- 23 05 13 - Common Motor Requirements for HVAC Equipment (M)
- 23 05 17 - Sleeves and Sleeve Seals for HVAC Piping (M)
- 23 05 18 - Escutcheons For HVAC Piping (M)
- 23 05 19 - Meters and Gauges for HVAC Piping (M)
- 23 05 23.12 - Ball Valves For HVAC Piping (M)
- 23 05 23.13 - Butterfly Valves For HVAC Piping (M)
- 23 05 29 - Hangers and Supports for HVAC Piping and Equipment (M)
- 23 05 48.13 - Vibration Controls For HVAC (M)
- 23 05 53 - Identification for HVAC Piping and Equipment (M)
- 23 05 93 - Testing, Adjusting, and Balancing for HVAC (M)
- 23 07 13 - Duct Insulation (M)

- 23 07 19 - HVAC Piping Insulation (M)
- 23 08 00 - Commissioning of HVAC (M)
- 23 09 00 - Instrumentation and Control for HVAC (M)
- 23 09 23 - Direct-Digital Control (DDC) System for HVAC (M)
- 23 09 23.11 - Control Valves (M)
- 23 09 23.12 - Control Dampers (M)
- 23 09 23.14 - Flow Instruments (M)
- 23 09 23.16 - Gas Instruments (M)
- 23 09 23.19 - Moisture Instruments (M)
- 23 09 23.21 - Motion Instruments (M)
- 23 09 23.22 - Position Instruments (M)
- 23 09 23.23 - Pressure Instruments (M)
- 23 09 23.27 - Temperature Instruments (M)
- 23 09 93.11 - Sequence Of Operations For HVAC DDC (M)
- 23 21 13 - Hydronic Piping (M)
- 23 21 16 - Hydronic Piping Specialties (M)
- 23 25 13 - Water Treatment For Closed-Loop Hydronic Systems (M)
- 23 29 23 - Variable Frequency Drives (M)
- 23 31 13 - Metal Ducts (M)
- 23 33 00 - Air Duct Accessories (M)
- 23 33 46 - Flexible Ducts (M)
- 23 34 23 - HVAC Power Ventilators (M)
- 23 35 33 - Listed Kitchen Ventilation System Exhaust Ducts (M)
- 23 36 00 - Air Terminal Units (M)
- 23 37 13.13 - Air Diffusers (M)
- 23 37 13.23 - Registers And Grilles (M)
- 23 38 13 - Commercial-Kitchen Hoods (M)
- 23 74 16.13 - Packaged, Large-Capacity, Rooftop Air-Conditioning Units (M)
- 23 81 26 - Split-System Air Conditioners (M)
- 23 82 39.16 - Propeller Unit Heaters (M)

**DIVISION 25 - INTEGRATED AUTOMATION**

NOT USED

**DIVISION 26 - ELECTRICAL**

- 26 00 10 - Electrical General Requirements (E)
- 26 05 19 - Low-Voltage Electrical Power Conductors and Cables (E)
- 26 05 26 - Grounding and Bonding for Electrical Systems (E)
- 26 05 29 - Hangers and Supports for Electrical Systems (E)
- 26 05 33 - Raceway and Boxes for Electrical Systems (E)
- 26 05 33.01 - Plug-In Raceway System (E)
- 26 05 44 - Sleeves and Sleeve Seals for Electrical Raceways and Cablin (E)

- 26 05 53 - Identification for Electrical Systems (E)
- 26 05 73.16 - Coordination Studies (E)
- 26 22 00 - Low Voltage Transformers (E)
- 26 24 16 - Panelboards (E)
- 26 25 00 - Track Busway System (E)
- 26 27 26 - Wiring Devices (E)
- 26 27 26.43 - Special-Purpose Power Outlet Assemblies (E)
- 26 27 33 - Power Distribution Units (E)
- 26 28 16 - Enclosed Switches and Circuit Breakers (E)
- 26 43 13 - Surge Protective Devices for Service Entrance and Branch Panels (E)
- 26 51 19 - LED Interior Lighting (E)
- 26 56 19 - LED Exterior Lighting (E)

**DIVISION 27 - COMMUNICATIONS**

- 27 00 00 - Structured Cabling (E)
- 27 51 23 - eSeries End Point Intercom, Paging, and Emergency Messaging System (E)

**DIVISION 28 - SAFETY AND SECURITY**

- 28 05 13 - Conductors And Cables For Electronic Safety And Security (E)
- 28 05 28 - Pathways For Electronic Safety And Security (E)
- 28 13 00 - Access Control And Camera Surveillance (E)
- 28 16 00 - Intrusion Detection (E)
- 28 31 11 - Voice Evacuation Fire Alarm (E)

**DIVISION 31 - EARTHWORK**

- 31 05 13 - Soils for Earthwork (S)
- 31 10 00 - Site Clearing (C)
- 31 10 00 - Site Clearing (S)
- 31 14 00 - Earthwork (C)
- 31 20 00 - Aggregate Materials (C)
- 31 21 00 - Rock Removal (C)
- 31 22 00 - Excavation Backfill Pavement (C)
- 31 22 13 - Rough Grading (C)
- 31 23 00 - Excavation Backfill Utilities (C)
- 31 22 13 - Rough Grading (S)
- 31 23 00 - Excavation and Fill (S)
- 31 31 16 - Termite Control (S)
- 31 32 00 - Soil Stabilization (C)
- 31 35 00 - Slope Protection And Erosion Control (C)
- 31 36 00 - Retainage Systems (C)

**DIVISION 32 - EXTERIOR IMPROVEMENTS**

- 32 11 00 - Paving Base Course (C)
- 32 12 00 - Asphaltic Concrete Paving (C)

32 13 00 -Portland Cement Concrete (C)

32 16 00 - Curb And Sidewalks (C)

32 17 23 - Pavement Markings (C)

**DIVISION 33 - UTILITIES**

33 11 00 - Water Distribution Systems (C)

33 31 00 - Sanitary Sewer System (C)

33 39 00 - Sewer Structures (C)

33 41 00 - Storm Sewer Systems (C)

**DIVISION 34 - TRANSPORTATION**

NOT USED

**DIVISION 35 - WATERWAY AND MARINE CONSTRUCTION**

NOT USED

**DIVISION 40 - PROCESS INTEGRATION**

NOT USED

**DIVISION 41 - MATERIAL PROCESSING AND HANDLING EQUIPMENT**

41 22 13.13 - Bridge Cranes

41 22 13.19 - Jib Cranes

**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**

NOT USED

**DIVISION 45 - INDUSTRY-SPECIFIC MANUFACTURING EQUIPMENT**

NOT USED

**DIVISION 46 - WATER AND WASTEWATER EQUIPMENT**

NOT USED

**1.1 DIVISION 48 ELECTRICAL POWER GENERATION**

**END OF SECTION 00 01 10**

## **SECTION 00 11 19 - REQUEST FOR PROPOSAL**

### **GENERAL INFORMATION**

#### **GENERAL**

Competitive Proposals for the work identified below in accordance with Proposal Documents and addenda that may be issued prior to date of proposal opening will be received by the Construction Manager and the School Board of Edinburg Consolidated Independent School District, until proposal closing date and time, identified below.

#### **PROJECT**

Name: CTE Barrientes.  
Address: 1100 East Ebony Ln.  
City, State ZIP: Edinburg, Texas78539.

#### **SCHOOL DISTRICT**

Owner: Edinburg Consolidated Independent School District.  
Address: 411 N 8th Ave..  
City, State ZIP: Edinburg, Texas78539.  
Owner's Designated Representative: To Be Determined.  
Phone: 956-289-2300.

#### **ARCHITECT**

Name: PBK Architects, Inc.  
Address: 601 NW Loop 410, Suite 400.  
City, State ZIP: San Antonio, Texas78216.  
Phone: 210-829-0123.

### **PROPOSAL INFORMATION**

#### **PRE-PROPOSAL CONFERENCE**

- A. Date and Time: June 6, 2024 at 10:00 am.
- B. Location: ECISD Facilities Department, 1305 E. Schunior, Edinburg, Texas.
- C. Representatives of the Architect, the School District, the Construction Manager, and the School District's Designated Representative will be present at this meeting. All Offerors are encouraged to attend.

#### **2.2 PROPOSAL SUBMISSION**

- A. Date and Time: June 12, 2024 at 3:00 pm.
- B. Location:
  - 1. Location Name: Purchasing Office, Edinburg CISD Administration Building.
  - 2. Address: 411 North 8th Ave., 2nd Floor.
  - 3. Address: Edinburg, Texas 78541.

#### **2.3 PROPOSAL OPENING**

- A. Date and Time: June 12, 2024 at 3:00 pm.
- B. Location:
  - 1. Location Name: Purchasing Office, Edinburg CISD Administration Building.
  - 2. Address: 411 North 8th Ave., 2nd Floor.
  - 3. Address: Edinburg, Texas 78541.

**2.4 PROPOSAL REQUIREMENTS**

- A. Offerors submitting a proposal are encouraged to visit the site. All Offerors submitting a proposal are encouraged to attend the proposal opening.

**2.5 PROPOSAL DOCUMENTS**

**2.6 SUBMITTAL OF PROPOSAL**

Submit Proposal to the School District no later than the date and time specified. Submit proposals in duplicate in a sealed envelope in accordance with Section 00 21 16 - Instructions to Proposers (CSP).

Provide the following information on the envelope:

1. Name of Offeror.
  2. CTE Barrientes.
  3. Edinburg Consolidated Independent School District.
  4. Attn: To Be Determined.
- B. No proposal shall be withdrawn within 45 days after the proposal opening without the specific consent of the School District.
- C. School District reserves the right to reject any and all proposals and to waive any informality in the Proposal process.

**2.7 PAYMENT BOND AND PERFORMANCE BOND**

- A. A Payment Bond and Performance Bond, each in an amount equal to 100% of the Contract Sum conditioned upon the faithful performance of the Contract will be required. Please note that all bonding companies presented must be acceptable to the School District.

**END OF SECTION 00 11 19**



## **SECTION 00 21 16 - INSTRUCTIONS TO PROPOSERS (CSP)**

### **GENERAL**

#### **QUALIFIED OFFERORS**

Competitive Sealed Proposals will be accepted from qualified Offerors (Contractor) only for the entire scope of work described in the Contract Documents. As a prerequisite to an Offeror's qualifying for the award of contract on this work, the Offeror must complete each item of Section 00 45 00 - Selection Criteria and Contractor Information. In addition to the information contained in Section 00 45 00 - Selection Criteria and Contractor Information, Offerors shall address the selection criteria issues specified for Determination of Successful Respondent and Award of Contract. Submit the Statement and other requested information with the Proposals in four copies; three of which will be retained by School District and one retained by Architect. Qualification statements submitted by facsimile transmission will not be accepted.

The primary purposes of the evaluation process will be to:

- Gather information for the School District's evaluation procedure.
- Enable School District and/or Architect to evaluate the Offeror's qualifications.

After review of Proposals and Contractor's qualifications evaluation School District will make its decision and each Offeror will be notified.

In arriving at its opinion concerning the Offeror's qualifications, Architect will use the same criteria that School District will use in determination of the successful Offeror as specified.

In the event a proposed Offeror fails to submit the specified Contractor's Qualification Statement at time of receipt for Proposals, noncompliance shall be considered by School District and Architect as a negative factor in the determination of the successful Offeror.

#### **OFFEROR'S PRESENTATION**

In making its Proposal, the Offeror represents that the Offeror:

- Has read and understands the Propose Documents and the Proposal is made in accordance with the drawings and specifications.
- Has thoroughly familiarized itself with Division 01 General Requirements as applicable to subsequent specification sections.
- Has visited the site, familiarized itself with local conditions under which the work will be performed and has correlated observations with the requirements of the proposed Contract Documents.
- Agrees to comply with requirements. An Offeror who subsequently does not agree to comply with the requirements will automatically disqualify itself from proposing or receiving award of the contract.

If the proposal is accepted, the Offeror agrees that:

- Work on the project will begin immediately upon receipt of signed Contract or Notice to Proceed.
- It will participate as a team member in cooperation with Architect, Engineers, School District, and School District's agents and/or consultants.
- It will assign a competent full time superintendent, to the project, and that superintendent shall remain on the project for the duration of the project, subject only to continuous employment.
- It provide a proposal bond in the amount of ten percent of the contract amount.
- If awarded, it shall furnish and pay for a Performance Bond and a Payment Bond each in the full contract amount.
- It shall carry and keep in full force for the duration of the Project, insurance coverage for Builder's Risk, Workmen's Compensation, Comprehensive General Liability, and Automobile Liability required by the A201 General Conditions and the Agreement.
- By making its Proposal represents that the Proposal includes material and equipment specified in the Proposal Documents and supplemented, if necessary, for a complete and operating system.

Where subcontract work is involved and where Acceptable Subcontractors are designated for particular portions or phases of the Work, by making the Proposal, Contractor represents that its Proposal includes only firms designated as Acceptable Subcontractors. That no asbestos PCBs or lead building materials shall be used, and that the Offeror and subofferors and suppliers submitting a proposal to a Offeror, shall submit an affidavit at Project Close Out stating that no asbestos, PCB, or lead building materials has been used on the Project.

### **PROPOSAL DOCUMENTS**

Proposal Documents include the Request for Competitive Sealed Proposals, Instructions to Offerors, the Proposal Form, and the proposed Contract Documents, including Addenda issued prior to receipt of proposals.

Contract Documents for the work consist of the AIA A101 Owner-Contractor Agreement as modified by the Owner, the AIA Document A201 General Conditions modified by School District, Drawings, Specifications, and Addenda issued prior to receipt of proposals. Should there be a conflict between the terms of proposal and terms of AIA A101 and AIA A201, as amended by School District, terms of AIA A101 and AIA A201 control.

### **PROPOSAL PROCEDURES**

A proposal is invalid if it has not been received at the designated location prior to the time and date for receipt of proposals indicated in the Request for Competitive Sealed Proposals, or prior to any extension thereof issued to the Offerors by Addenda.

Requested Alternates shall be proposed. If no change in the Base Proposal is required, enter "No Change".

Prior to the receipt of Proposals, Addenda will be forwarded by Architect and will be available for inspection wherever the proposal documents are kept available for that purpose.

Proposals will be received in duplicate only on the School District's Form of Proposal for the work as indicated by the Proposal Documents, filled in, and enclosed in a sealed envelope addressed as follows:

Name of Offeror: \_\_\_\_\_  
Project Name: CTE Barrientes  
School District: Edinburg Consolidated Independent School District  
Attn: To Be Determined

Proposal shall be accompanied by Proposal Bond or Certified Check in the amount of 10% of the proposal.

Deliver proposals in duplicate in a sealed envelope to the location specified at or before the established time and date. Proposal submitted using the U.S. Postal System shall be sent as Registered Mail.

A proposal may be withdrawn upon request by the Offeror or its duly authorized representative, provided the request is received by School District at the location designated for receipt of proposals and prior to the time fixed for the opening of proposals. A withdrawal of a proposal shall not be effective unless a written confirmation of the withdrawal is received by School District at the location of the bid opening within 48 hours before the time established for the opening of proposals. Proposal Bond will be returned if the proposal is withdrawn in accordance with specified procedures. Withdrawal of a proposal does not prejudice the right of the Offeror to file a new proposal at the time and place stated. No proposal may be withdrawn for 30 days after the time fixed for the opening of proposals.

### **INTERPRETATION OF PROPOSAL DOCUMENTS**

Offerors and subofferors requiring clarification or interpretation of the Proposal Documents shall make a written or verbal request which shall reach Architect at least ten days prior to the date for receipt of proposals.

Interpretation, correction, or change of the Proposal Documents will be made by Addendum. Interpretations, corrections, or changes of the Proposal Documents made in any other manner are not binding.

#### **SUBSTITUTIONS OF MATERIALS AND EQUIPMENT**

Materials, products and equipment described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. Materials and equipment named in, and procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an addendum as a substitution prior to the submission of proposals.

Substitutions will not be considered prior to receipt of proposals unless written request for approval has been received by Architect at least seven days prior to the date established for receipt of proposals and the substitution request complies with requirements of Section 01 25 13 - Product Substitution Procedures. Proposer shall complete the Substitution Request Form and submit with complete supporting data including drawings, catalogue cuts, performance and test data, and other technical data necessary for an evaluation. Architect's decision of a proposed substitution shall be final.

If Architect accepts a proposed substitution prior to receipt of proposals, notice of acceptance shall be by Addenda.

No substitutions will be considered after the Contract award.

#### **REJECTION OF PROPOSALS**

School District reserves the right to reject any or all proposals and to reject a proposal that is not accompanied by the required proposal security or other data required by the Proposal Documents, and to reject a proposal which School District considers incomplete or irregular.

School District reserves the right to reject any or all proposals and to waive any formalities or irregularities and to make the award of the contract in the best interest of School District.

School District reserves the right to reject a proposal if the evidence submitted by, or investigation of, the offeror fails to satisfy School District that the offeror is properly qualified to carry out the obligations of the contract and to complete the work. Award of the Contract may be made to other than the low dollar offeror and may be awarded to the Offeror proposing the best value to School District, in addition to the purchase price, based on the published selection criteria and on its ranking evaluation.

Do not submit voluntary alternates. School District reserves the right to reject proposals accompanied by conditional or qualifying statements, or voluntary alternates.

#### **INSURANCE**

Each Offeror shall include in its proposal the cost of insurance and shall carry and keep insurance in full force for the duration of the project. Provide insurance coverage required under the AIA Document A201 General Conditions modified by School District and included herein under Section 00 70 00 - Conditions of the Contract.

#### **PERFORMANCE BOND AND PAYMENT BOND**

Each Offeror shall include in its proposal the cost for the premium for 100% Performance Bond and 100% Payment Bond. The bonds shall cover the faithful performance of the contract and payment of obligations arising thereunder in such form as School District may prescribe. Bonding companies must be acceptable to School District. Selected Offeror shall deliver the required bonds to School District no later than the date of execution of Contract.

#### **PROPOSAL SECURITY**

No proposal will be considered unless it is accompanied by a Certified or Cashier's Check or Proposal Bond executed on attached form. In either case the amount shall be not less than ten

percent of the greatest amount proposed (considering alternates, if any). Proposal security shall insure the execution of the contract and the furnishing of an acceptable Performance Bond and Payment Bond by the successful Offeror within ten days after notification of award to Offeror and that its proposal shall not be withdrawn for a period of 30 days after date of opening of proposals without the consent of School District. Proposal Bond shall be prepared in identical form of AIA Document A310.

#### **SUBMISSION OF POST PROPOSAL INFORMATION**

Apparent Selected Offeror shall, within three days after proposals are received, submit the following:

A designation of the work to be performed by Offeror with his own forces.

An experience profile of the selected Offeror's superintendent scheduled to work on this project. In addition, apparent selected Offeror shall cooperate with School District, supplying requested information to substantiate qualifications of the superintendent. If, in the opinion of School District, the superintendent does not qualify, School District may request the submission of another superintendent and more information. School District reserves the right to reject the apparent selected Offeror if an acceptable superintendent is not presented.

Selected Offeror shall, within five (5) days thereafter, submit the following:

A statement of costs for each major item of work included in the proposal described in Section 01 29 00 - Payment Procedures. Each portion of work identified in specifications shall be considered a major item of work and shall be shown as a separate cost item.

#### **AWARD OF CONTRACT**

Selected Offeror will be notified within 45 days from the date on which proposals are opened. Offerors shall hold their offer open for 45 days after the submission deadline. If School District is unable to negotiate a contract with the first selected offeror, School District shall formerly end negotiations with that offeror and proceed to the next offeror in the order of the selection ranking until a contract is reached or each proposal is rejected.

Offeror will be required to (a) submit its Proposal and Proposal Bond, (b) execute Contract and Performance and Payment Bonds, and (c) submit Certificates of required insurances, using School District's respective forms.

Proposal Bond is forfeited if proposal is withdrawn after the proposal opening, or Contract Documents are not executed in accordance with specified procedures or time period.

#### **NOTICE TO PROCEED**

Offeror shall not commence work under this Contract until it receives a written Notice to Proceed or Contract is duly signed by School District.

#### **COMPLETION TIME**

Offerors shall familiarize themselves with School District's requirements concerning the project schedule. Project is to be substantially complete no later than mm-dd-yyyy.

Having thoroughly familiarized itself with the conditions as they exist at the building site and acquainted itself with the labor supply and the material market, the Offeror shall state in its proposal that it agrees to be substantially complete with the work within the calendar days stated in its Proposal.

The definition of Substantial Completion is found in Article 9.8.1 of the AIA Document A201 General Conditions of the Contract for Construction modified by School District and included under Section 00 70 00 - Conditions of the Contract.

#### **FELONY CONVICTION NOTIFICATION**

Section 44.034, of Texas Education Code requires a person or business entity that enters into a contract with a school district give advance notice to the district if the person or an owner or operator of the business entity has been convicted of a felony. The notice must include a general description of the conduct resulting in the conviction of a felony. Subsection (b) states

“a school district may terminate a contract with a person or business entity if the district determines that the person or business entity failed to give notice as required by Subsection (a) or misrepresented the conduct resulting in the conviction. The district must compensate the person or business entity for services performed before the termination of the contract.” Subsection (c) states “this section does not apply to a publicly held corporation.”

The Offeror shall execute Section 00 40 11 - Felony Conviction Notification and submit with proposal.

#### **AFFIDAVIT OF NON-DISCRIMINATORY EMPLOYMENT**

Offeror and subofferors agree to refrain from discrimination in terms and conditions of employment to the basis of race, color, religion, sex, or national origin, and agrees to take affirmative action as required by Federal Statutes and Rules and Regulations issued in order to maintain and insure non-discriminatory employment practices.

Offerors shall execute Section 00 40 13 - Affidavit of Non-Discriminatory Employment and submit with Proposal. Subofferors shall execute Section 00 40 13 - Affidavit of Non-Discriminatory Employment prior to commencing work on Project. Offerors and subofferors who do not execute Section 00 40 13 are not be eligible to work on the project.

#### **SUBCONTRACTOR LISTING**

Offeror shall supply a listing of the primary subcontractors using Section 00 40 12 - List of Subcontractors:

- Mechanical.
- Electrical.
- Plumbing.
- Masonry.
- Concrete.
- Steel.
- Any other prudent subcontractor.

#### **AFFIDAVIT OF NO ASBESTOS, LEAD, AND PCB USE IN PROJECT**

Use of a construction process or the installation of asbestos, lead, and PCBs or material containing asbestos, lead, and PCBs is strictly prohibited.

Prior to submitting a proposal, Offerors shall notify Architect, in writing, if a specified material is known to contain or is likely to contain asbestos, lead, or PCBs.

Offeror and subofferors agree to refrain from using products which are known to contain asbestos, lead, and PCB containing materials as applicable to Project. They shall affirm that lead or materials containing lead have not been incorporated into potable water systems, and that lead sheet flashing used in through roof plumbing penetration applications is the only lead on Project.

Selected Offeror and its subofferors shall execute Section 00 40 14 - Affidavit of Non-Asbestos, Lead, and PCB Use and submit at Project Closeout.

#### **PROPOSAL EVALUATION WAIVER**

By submitting a proposal, each offeror agrees to waive claims it has or may have against School District, Program Manager, and their respective employees, Architect and consultants, and their respective employees, arising out of or in connection with the administration, evaluation, or recommendation of any proposal; waiver of any requirements under the Proposal Documents, acceptance or rejection of any proposals; and award of the contract.

Offerors shall execute Section 00 65 01 - Proposal Evaluation Waiver and submit with the Proposal.

#### **CONFLICT OF INTEREST QUESTIONNAIRE**

According to Local Government Code, Chapter 176, a person or an agent of a person who contracts or seeks to contract for the sale or purchase of property, goods, or services with any

local government agency must file a completed Conflict of Interest Questionnaire (CIQ) with the records administrator of the local government not later than the seventh business day after the date that the person begins contract discussions or negotiations with School District or submits to School District an application, response to a request for proposals or bids, correspondence, or another writing related to a potential agreement with School District.

Offerors and subofferors proposing to do work with School District shall execute Section 00 40 18 - Conflict of Interest Questionnaire and submit to School District's Legal Department within seven (7) days of the Proposal Date. This requirement will be waived if Offeror or sub-offeror has previously submitted such document to School District within the last year. In such case, provide written notification and attach to Proposal.

#### **CRIMINAL HISTORY RECORDS**

Prior to commencing any work on this Project, Contractor shall certify, on the form provided herein as Section 00 40 17 - Certification of Criminal History Record Information Review by Contractor-Employer, that, for each of its employees and those of its Subcontractors who will have direct contact with students, Contractor has obtained, as required by Texas Education Code Section 22.0834:

national criminal history record information from a law enforcement or criminal justice agency for each employee of Contractor or Subcontractor hired before January 1, 2008 who will have direct contact with students; and  
national criminal history record information from the Texas Department of Safety for each employee of Contractor or Subcontractor hired on or after January 1, 2008 who will have direct contact with students; Fingerprinting is required and shall be provided by Contractor (applicant) and administered through FAST (Fingerprint Applicant Services of Texas) which will be recorded by the District in the FACT (Fingerprint-based Applicant Clearinghouse of Texas). Currently applicant must obtain fingerprinting from L-1 Identity Solutions Company, 888-467-2080, or schedule an appointment online at: <https://tx.ibtfingerprint.com/>.

Any personnel who will have direct contact with students must not have been convicted of an offense identified in Texas Education Code Section 22.085.

Contractor shall execute and submit Section 00 40 17 - Certification of Criminal History Record Information Review by Contractor-Employer along with required Schedule 'A' documenting proposed employees to be working on site, within 10 days after receipt of Notice To Proceed and prior to commencement of Work.

Furthermore, an updated Schedule 'B' shall be submitted weekly to School District indicating changes to contractor personnel with accompanying certifications and criminal history records. Any fingerprinting and photographing required by the aforementioned code will be the responsibility of Contractor.

#### **AVAILABILITY OF MATERIALS AND SYSTEMS**

A serious effort has been made to select materials that are systems that are readily available. To the extent known at proposal time specified items are available or within a relatively short period of time. If during the proposal period, should an Offeror become aware of an availability or delivery issue with the specified systems or materials, it should notify Architect immediately. Architect will promptly explore possibilities for selecting other systems or materials which would eliminate the issue and notify Offerors of changes by addendum. It shall be understood that only specified systems and materials that are readily available are included in the proposal.

#### **DETERMINATION OF SUCCESSFUL RESPONDENT AND AWARD OF CONTRACT**

In determining Selected Offeror, a Selection Committee will evaluate the information derived from Section 00 45 00 - Selection Criteria and Contractor Information.

Selection Committee consisting of School District's administrators, program managers, Architects, consultants and other staff will make an initial evaluation of the proposals. Committee's recommendation will be considered by School District's Board of

\_\_\_\_\_ (“Board”). School District reserves the right to review the recommendation with Director of Maintenance and Operations and others deemed appropriate by School District prior to review by entire Board. Final decision-making authority on the proposals rests with full Board. Decision-making authority has not been delegated to any person or entity other than Board.

School District will make such investigations as it deems necessary to determine the ability of the offeror to perform the Work, and the offeror shall furnish all such information and data for this purpose as may be requested. School District reserves the right to reject any proposal if the evidence submitted by, or investigation of, such offeror fails to satisfy School District that such offeror is properly qualified to carry out the obligations of the Contract and to complete the Work contemplated therein.

School District reserves the right to reject any or all proposals and to waive any formalities or irregularities and to make the award of the contract in the best interest of School District.

A decision regarding determination of the successful Offeror will be made by School District as soon as practical.

#### **USE OF ASBESTOS FREE MATERIALS, PRODUCTS AND SYSTEMS**

Offeror shall consider the use of asbestos free material requirements in preparing its Proposal including requirements during performance of the work regarding the use of asbestos free materials, products, and systems in Project.

Since many materials, products and systems are proprietary, it is not possible to know the specific materials or components that produce each material, product or system without the manufacturer divulging trade secrets or patent information. Every effort has been made to specify materials, products, or systems, which do not contain asbestos.

It is Contractor’s responsibility to submit an affidavit from the manufacturer to ascertain that every material, product or system used in the Project does not contain asbestos. In the event a material, product, or system is found to contain asbestos, Contractor shall offer for Architect’s consideration a substitution which it knows does not contain asbestos. Although a material, product, or system is specified or a specification is based on a specific material, product, or system, Contractor is not to be relieved from its responsibility to ascertain that materials, products, and systems used in Project do not contain asbestos. Under no circumstances shall a material, product, or system which is known, suspected, or found to contain asbestos be used in Project.

If a material, product, or system containing asbestos is used, Contractor shall remove and replace the material, product, or system with a comparable or better asbestos free material at no expense to School District, including removal and replacement of other materials affected by the removal of the asbestos containing material, product or system, i.e. removal, replacement, and finishing of gypsum board due to removal of asbestos insulation.

#### **COMPLIANCE WITH TEXAS GOVERNMENT CODE 552.372**

Contractor or vendor agrees contract can be terminated if Contractor or vendor knowingly or intentionally fails to comply with a requirement of that subchapter, including the preservation of all “contracting information” (as defined in 552.003) and the provision, upon request of the governmental entity with whom you are contracting, of all contracting information. Contracting information includes, but is not limited to, records, communications and other documents related to the bid process, contract, payments, receipts, scope of work/services, and performance.

**END OF SECTION 00 21 16**

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**SECTION 00 40 01 - PROPOSAL BOND**

**GENERAL**

**KNOW ALL MEN BY THESE PRESENTS,**

that we \_\_\_\_\_, as Principal, and \_\_\_\_\_, as Surety, are held and firmly bound unto the Edinburg Consolidated Independent School District, Edinburg, Texas, hereinafter called "the School District", in the penal sum of \_\_\_\_\_ Dollars (\$\_\_\_\_\_) lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors jointly and severally, firmly by these presents.

**THE CONDITION OF THIS OBLIGATION IS SUCH,**

that whereas the Principal has submitted the accompanying Proposal, dated \_\_\_\_\_, 20\_\_, for CTE Barrientes, the kind and extent of work involved being set forth in detail in the proposed Contract Documents cited herein.

**THEREFORE,**

If the Principal shall not withdraw the accompanying proposal within 45 days after the date set for opening thereof, and shall within ten days after the prescribed forms are presented for signature, enter into a written contract with School District in accordance with the Proposal as accepted; and give Bond and good and sufficient surety for the faithful performance and proper fulfillment of the contract including payment of persons supplying labor or materials therefor, or in the event of the withdrawal of the proposal within the period specified, or the failure to enter into a contract and give the bond within the time specified, if the Principal shall pay to School District the difference between the aggregate amount for which the School District may enter into a contract for the same work with another Respondent; if the latter amount be in excess of the former, then the above obligation shall be void and of no effect, otherwise to remain in full force and virtue.

**IN WITNESS WHEREOF,**

the above bonded parties have executed this instrument under their respective seals this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_, the name and Corporate Seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representatives, pursuant to authority of its governing body.

\_\_\_\_\_  
Business Address Individual Principal  
\_\_\_\_\_  
Business Address Individual Principal

**ATTEST:**

\_\_\_\_\_  
Secretary President By: \_\_\_\_\_  
\_\_\_\_\_  
Business Address Corporate Surety

**ATTEST:**

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

**END OF SECTION 00 40 01**

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**SECTION 00 40 11 - FELONY CONVICTION NOTIFICATION**

**NOTE: STATEMENT OF AFFIRMATION MUST BE NOTARIZED**

**SCHOOL DISTRICT'S NAME: EDINBURG CONSOLIDATED INDEPENDENT SCHOOL DISTRICT**

**PROJECT NAME: CTE BARRIENTES**

**PROJECT ADDRESS:**

1100 East Ebony Ln.  
Edinburg, Texas 78539.

**STATEMENT OF AFFIRMATION**

"The undersigned affirms that he/she is duly authorized to provide this information by the person(s) or business entity making the proposal, and the information provided below concerning felony convictions has been personally and thoroughly reviewed, and verified, and is, therefore, current, true and accurate to the best of my knowledge."

Firm's Name: \_\_\_\_\_

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

a. \_\_\_ My firm is a publicly held corporation, therefore, this reporting requirement is not applicable.

b. \_\_\_ My firm is not owned nor operated by anyone who has been convicted of a felony.

c. \_\_\_ My firm is owned or operated by the following individual(s) who has/have been convicted of a felony:

Name of Felon(s): \_\_\_\_\_

\_\_\_\_\_

Details of Conviction(s): \_\_\_\_\_

**CHECK A, B, OR C ABOVE AND SIGN BELOW**

Offeror's Name \_\_\_\_\_

Position/Title \_\_\_\_\_

Offeror's Signature \_\_\_\_\_

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

**NOTARIZATION**

Subscribed and sworn to before me this \_\_\_\_ day of \_\_\_\_\_, 20\_\_.

Notary Public: \_\_\_\_\_

State of \_\_\_\_\_

Commission expiration: \_\_\_\_\_

Seal

**END OF SECTION 00 40 11**

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**SECTION 00 40 12 - LIST OF SUBCONTRACTORS**

**PROJECT**

**SCHOOL DISTRICT: EDINBURG CONSOLIDATED INDEPENDENT SCHOOL DISTRICT**

**NAME: CTE BARRIENTES**

**ADDRESS:**

1100 East Ebony Ln.  
Edinburg, Texas 78539.

**ARCHITECT:**

**PBK ARCHITECTS, INC.**

**ADDRESS:**

601 NW Loop 410, Suite 400.  
San Antonio, Texas 78216.

**PROJECT NO. 20217**

**INFORMATION BELOW TO BE COMPLETED BY THE CONTRACTOR AND RETURNED TO THE ARCHITECT. SUBMIT THIS DOCUMENT WITH PROPOSAL FORM.**

**DATE:** \_\_\_\_\_

**CONTRACTOR:**

**NAME:** \_\_\_\_\_

**ADDRESS:**  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**LIST SUBCONTRACTORS AND OTHERS PROPOSED TO BE EMPLOYED ON THE PROJECT REQUIRED BY THE PROPOSAL DOCUMENTS.**

<b>WORK/DIVISION</b>	<b>FIRM</b>	<b>ADDRESS</b>	<b>PHONE</b>	<b>EMAIL</b>	<b>REPRESENTATIVE</b>
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
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_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

**(PROVIDE ADDITIONAL SHEETS AS REQUIRED.)**  
**END OF SECTION 00 40 12**

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**SECTION 00 40 13 - AFFIDAVIT OF NON-DISCRIMINATORY EMPLOYMENT**

**STATE OF TEXAS**

**COUNTY OF \_\_\_\_\_**

**AFFIDAVIT**

This Company, Contractor, or Subcontractor agrees to refrain from discrimination in terms and conditions of employment to the basis of race, color, religion, sex, or national origin, and agrees to take affirmative action as required by Federal Statutes and rules and Regulations issued pursuant thereto in order to maintain and insure non-discriminatory employment practices.

\_\_\_\_\_  
Company

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Signature

**STATE OF TEXAS**

**COUNTY OF \_\_\_\_\_**

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

Notary Public: \_\_\_\_\_

State of \_\_\_\_\_

Commission expiration: \_\_\_\_\_

Seal

**NOTE: THIS DOCUMENT MUST BE SUBMITTED WITH PROPOSAL  
END OF SECTION 00 40 13**

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**SECTION 00 40 14 - AFFIDAVIT OF NON-ASBESTOS, LEAD, AND PCB USE**

**UPON COMPLETION OF THIS FORM, RETURN TO THE ARCHITECT AT PROJECT CLOSEOUT.**

**PROJECT:**

School District's Name: Edinburg Consolidated Independent School District  
Project Name: CTE Barrientes  
Project Address:  
1100 East Ebony Ln.  
Edinburg, Texas 78539.

**ARCHITECT:**

PBK Architects, Inc.  
601 NW Loop 410, Suite 400.  
San Antonio, Texas 78216.  
Architect's Project No. 20217.

**CONTRACTOR:**

Contractor: \_\_\_\_\_  
Company Address:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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

**AFFIDAVIT**

Undersigned affirms and certifies that "to the best of their knowledge and belief asbestos, lead, and PCB-containing materials have not been used or incorporated into the Work and lead or lead bearing materials have not been incorporated into potable water systems", including, but not limited to those water systems for drinking fountains, all sinks, showers, bath tubs, residential and commercial kitchen equipment, ice machines, and hose bibbs, as applicable to the project, and that lead sheet flashing used in through roof plumbing penetration applications is the only lead on the Project.

\_\_\_\_\_  
Company  
\_\_\_\_\_  
Printed Name  
\_\_\_\_\_  
Signature

**STATE OF TEXAS**

**COUNTY OF \_\_\_\_\_**

Subscribed and sworn to before me this \_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

Notary Public: \_\_\_\_\_

State of \_\_\_\_\_

Commission expiration: \_\_\_\_\_

Seal

**NOTE: THIS DOCUMENT MUST BE EXECUTED AND SUBMITTED AT PROJECT CLOSE-OUT**

**END OF SECTION 00 40 14**

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**SECTION 00 40 17 - CERTIFICATION OF CRIMINAL HISTORY RECORD INFORMATION REVIEW BY CONTRACTOR-EMPLOYER**

**GENERAL**

**CERTIFYING AFFIDAVIT SUBMITTED TO:**

School District: Edinburg Consolidated Independent School District

School District's Address:

411 N 8th Ave..

Edinburg, Texas 78539.

Project Name: CTE Barrientes

Project Address:

1100 East Ebony Ln.

Edinburg, Texas 78539.

The completion of Conflict of Interest Questionnaire is not needed if the person is an employee of a governmental entity and is acting in the employee's official capacity.

**STATE OF TEXAS**

**COUNTY OF \_\_\_\_\_**

(1) Undersigned representative, on behalf of the contracting firm identified below, swears and affirms to Edinburg Consolidated Independent School District (the School District) that such firm has obtained, reviewed and verified, from a law enforcement or criminal justice agency or a private entity that is consumer reporting agency governed by the Fair Credit Reporting Act (15 U.S.C. §§ 1681 et seq.) the criminal history record information of all employees hired **before January 1, 2008**, who (a) have or will have continuing duties related to the contracted services, and (b) have or will have direct contact with students. Such employees are identified by name on Schedule A (the Contractor shall provide and attach hereto). Undersigned further swears and affirms no employees who meet the requirements of (a) and (b) herein and/or identified on Schedule A have been convicted of any offense identified in Section 22.085 of the Texas Education Code.

(2) Undersigned representative, on behalf of the contracting firm identified below, swears and affirms to the School District, that such firm has obtained, reviewed and verified, from Texas Department of Public Safety criminal clearinghouse, the national criminal history record information of all employees hired **on or after January 1, 2008**, who (a) have or will have continuing duties related to the contracted services, and (b) have or will have direct contact with students. Such employees are identified by name on Schedule B (the Contractor shall provide and attach hereto). Undersigned further swears and affirms no employees who meet the requirements of (a) and (b) herein and/or identified on Schedule B have been convicted of any offense identified in Section 22.085 of the Texas Education Code.

(3) Undersigned firm swears and covenants that no present or future employee will provide services to the Project that involve direct contact with students unless and until such employee's national criminal history record information has been reviewed and cleared as required by Paragraph (2) above, and an updated Certification has submitted by the contracting firm to the School District with an updated Schedule B identifying such employees. In the event of an emergency, an employee who has not been previously certified may only provide services that involve direct contact with students if such employee is escorted by a representative of the School District .

(4) Undersigned firm swears and covenants that, upon receipt of information, directly or indirectly, that any employee of the contracting firm has been convicted of an offense identified in Section 22.085 of the Texas Education Code, the contracting firm will immediately remove such employee from the Project and notify the School District.

(5) Furthermore, if requested by the School District, the name, driver's license number, and any other information required by the DPS will be submitted to School District for any person on either Schedule A or Schedule B.

\_\_\_\_\_, being duly sworn, affirms and certifies that they are the \_\_\_\_\_ (position) of \_\_\_\_\_ (contracting firm), and that all statements and acknowledgements contained herein are true and correct, and that they have the authority to bind such firm to the covenants set out above.

Signature: \_\_\_\_\_

**NOTARIZATION**

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

Notary Public: \_\_\_\_\_

State of \_\_\_\_\_

Commission expiration: \_\_\_\_\_

Seal

**END OF SECTION 00 40 17**

## SECTION 00 40 18 - CONFLICT OF INTEREST QUESTIONNAIRE

### GENERAL

#### INSTRUCTIONS

According to Texas Local Government Code, Chapter 176, Section 176.006 (176 LGC 176.006), a person or an agent of a person who contracts or seeks to contract for the sale or purchase of property, goods, or services with Edinburg Consolidated Independent School District, as a Local Government Entity (i.e. county, municipality, school district, charter school, or junior college district) must file a completed Conflict of Interest Questionnaire with the School District's Legal Department not later than the seventh business day after the date that the person begins contract discussions or negotiations with the School District or submits to the School District an application, response to a request for proposals or bids, correspondence, or another writing related to a potential agreement with the School District.

Conflict of Interest Questionnaire is required to be filed annually by September 1 as long as the person or the agent of the person continues to contract or seek to contract for the sale or purchase of property, goods, or services with the School District or not later than the 7th business day after the date the originally filed questionnaire becomes incomplete or inaccurate.

The completion of Conflict of Interest Questionnaire is not needed if the person is an employee of a governmental entity and is acting in the employee's official capacity.

#### EXPLANATION OF THE CONFLICT OF INTEREST QUESTIONNAIRE:

1. Name of person doing business with the School District.
2. Check the box if you are filing an update to a previously filed questionnaire.
3. Describe each affiliation or business relationship with an employee or contractor of the School District who makes recommendations to an officer of the School District with respect to expenditure of money. If no affiliation or business relationship exists, state "NONE."

Examples:

If your spouse, parent, or child is the School District's Director of Purchasing and a bid is being submitted to the Purchasing Department, this relationship must be reported.

If your spouse, parent, or child is the Principal at a school and your business may sell items directly to that school, this relationship must be reported.

If you or your spouse, parent, or child is in business with an employee of the School District who would be making a recommendation concerning a purchase or sales transaction involving you, the relationship must be reported.

If you employ or do business with a spouse, parent, or child of an employee of the School District who would be making a recommendation concerning a purchase or sales transaction involving you, the relationship must be reported.

If you are an employee of the School District and would be making a recommendation concerning a purchase or sales transaction involving you, the relationship must be reported.

If your spouse, parent, or child is a teacher that does not make recommendations concerning purchasing or sales transactions, this relationship should **not** be reported.

If your spouse, parent, or child is a Principal at a school and a bid is being considered by a separate department such as Facilities Planning (Construction Department), this relationship should **not** be reported.

4. Describe each affiliation or business relationship with a person who is an officer of the School District and who appoints or employs an officer of the School District that is the subject of this questionnaire. If no affiliation or business relationship exists, state "NONE."

Example:

If you or your spouse, parent, or child is related to, employs, or is in business with an officer of the School District or their spouse, parent, or child, this relationship must be

reported.

5. Name of officer with whom you have an affiliation or business relationship.

For each person listed under question #4, complete page 2. If answers to A, B, and C are NO, indicate the name of the School District's officer, but do not complete section D.

Describe other affiliation or business relationship that might cause a conflict of interest.

Example:

If your neighbor or friend is an employee of the School District that would be making a recommendation concerning a purchase or sales transaction involving you and you feel that your relationship with this employee could affect their recommendation, this relationship must be reported.

If any other situation exists that would result in a conflict of interest, the relationship must be reported.

7. Sign and date this form.

**SUBMIT THE COMPLETED FORM TO THE SCHOOL DISTRICT. IF ANY DISCLOSURES ARE INDICATED UNDER QUESTIONS #3 OR #4, THE FORM WILL BE POSTED ON THE SCHOOL DISTRICT'S WEBSITE.**

**END OF SECTION 00 40 18**

**CONFLICT OF INTEREST QUESTIONNAIRE**

**FORM CIQ**

**For vendor or other person doing business with local governmental entity**

This questionnaire is being filed in accordance with chapter 176 of the Local Government Code by a person doing business with the governmental entity.

By law this questionnaire must be filed with the records administrator of the local government not later than the 7th business day after the date the person becomes aware of facts that require the statement to be filed. See Section 176.006, Local Government Code.

A person commits an offense if the person violates Section 176.006, Local Government Code. An offense under this section is a Class C misdemeanor.

**OFFICE USE ONLY**

Date Received

**1 Name of person doing business with local governmental entity.**

**2**

**Check this box if you are filing an update to a previously filed questionnaire.**

(The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than September 1 of the year for which an activity described in Section 176.006(a), Local Government Code, is pending and not later than the 7th business day after the date the originally filed questionnaire becomes incomplete or inaccurate.)

**3 Describe each affiliation or business relationship with an employee or contractor of the local governmental entity who makes recommendations to a local government officer of the local governmental entity with respect to expenditure of money.**

**4 Describe each affiliation or business relationship with a person who is a local government officer and who appoints or employs a local government officer of the local governmental entity that is the subject of this questionnaire.**

**CONFLICT OF INTEREST QUESTIONNAIRE**

**FORM CIQ**

**For vendor or other person doing business with local governmental entity**

**Page 2**

**5** Name of local government officer with whom filer has affiliation or business relationship. (Complete this section only if the answer to A, B, or C is YES.)

This section, item 5 including subparts A, B, C & D, must be completed for each officer with whom the filer has affiliation or business relationship. Attach additional pages to this Form CIQ as necessary.

A. Is the local government officer named in this section receiving or likely to receive taxable income from the filer of the questionnaire?

Yes       No

B. Is the filer of the questionnaire receiving or likely to receive taxable income from or at the direction of the local government officer named in this section AND the taxable income is not from the local governmental entity?

Yes       No

C. Is the filer of this questionnaire affiliated with a corporation or other business entity that the local government officer serves as an officer or director, or holds an ownership of 10 percent or more?

Yes       No

D. Describe each affiliation or business relationship.

**6** Describe any other affiliation or business relationship that might cause a conflict of interest.

**7**

\_\_\_\_\_  
Signature of person doing business with the governmental entity

\_\_\_\_\_  
Date



**SECTION 00 40 20 - CERTIFICATE OF INTERESTED PARTIES**

**CERTIFICATE OF INTERESTED PARTIES – FORM 1295**

**GENERAL**

Edinburg Consolidated Independent School District, as a public school district, is required to comply with Texas Government Code Section 2252.908, Disclosure of Interested Parties. Section 2252.908 prohibits Edinburg Consolidated Independent School District from entering into a contract resulting from a Request For Proposals (RFP) with a business entity unless the business entity submits a Disclosure of Interested Parties (Form 1295) to Edinburg Consolidated Independent School District at the time business entity submits the signed contract. The Texas Ethics Commission has adopted rules requiring the business entity to file Form 1295 electronically with the Texas Ethics Commission.

**DEFINITIONS (AS DEFINED IN TEXAS GOVERNMENT CODE SEC. 2252.908):**

"Business entity" means any entity recognized by law through which business is conducted, including a sole proprietorship, partnership, or corporation.

"Governmental entity" means a municipality, county, public school district, or special-purpose district or authority.

"Interested party" means a person who has a controlling interest in a business entity with whom a governmental entity or state agency contracts or who actively participates in facilitating the contract or negotiating the terms of the contract, including a broker, intermediary, adviser, or attorney for the business entity.

"State agency" means a board, commission, office, department, or other agency in the executive, judicial, or legislative branch of state government. The term includes an institution of higher education as defined by Section 61.003, Education Code.

**INSTRUCTIONS**

Electronically complete and submit using the Texas Ethics Commission's online filing application. Print a copy of Form 1295, sign, have notarized, and, with a copy of the Certificate of Filing, submit with Proposal documentation.

As a business entity, each vendor must electronically complete, print, sign, notarize, and submit Form 1295 and the Certification of Filing with their proposals even if no interested parties exist.

File Form 1295 with the Texas Ethics Commission (TEC) using the online filing application, which can be found at [https://www.ethics.state.tx.us/whatsnew/elf\\_info\\_form1295.htm](https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm). Proposers must use the filing application on the Texas Ethics Commission's website to enter the required information on Form 1295. Proposers must print a copy of the completed form, which includes a certification of filing containing a unique certification number. Form 1295 shall be signed by an authorized agent of the business entity and notarized.

Submit the completed Form 1295 with the certification of filing with Edinburg Consolidated Independent School District by attaching the completed form to the vendor's solicitation response.

Edinburg Consolidated Independent School District must acknowledge the receipt of the filed Form 1295 by notifying the Texas Ethics Commission of the receipt of the filed Form 1295 no later than the 30th day after the date the contract binds the parties to the contract. After Edinburg Consolidated Independent School District acknowledges the Form 1295, the Texas Ethics Commission will post the completed Form 1295 to its website within seven business days after receiving notice from Edinburg Consolidated Independent School District.

**END OF SECTION 00 40 20**

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**SECTION 00 42 00 - PROPOSAL FORMS**

**CTE BARRIENTES**

**SUBMITTED BY:** \_\_\_\_\_

**DATE:** \_\_\_\_\_ **PHONE NO.:** \_\_\_\_\_

**TO:**

Owner's Designated Representative: To Be Determined

School District:

Edinburg Consolidated Independent School District.  
411 N 8th Ave..  
Edinburg, Texas 78539.

Having examined Proposal and Contract Documents prepared by PBK Architects, Inc., dated June 4, 2024 and having examined site conditions, the undersigned proposes to furnish all labor, equipment and materials and perform all work for the completion of the above-named project for sum indicated below.

**IN SUBMITTING THIS PROPOSAL, UNDERSIGNED AGREES TO THE FOLLOWING:**

1. Hold proposal open for acceptance 45 days after the date on which proposals are opened.
2. Accept right of School District to reject any or all proposals, to waive formalities and to accept proposal which School District considers most advantageous.
3. Enter into and execute the contract, if awarded, for the Base Proposal and accepted Alternate Proposals.
4. Complete work in accordance with the Contract Documents within the stipulated contract time.
5. By signing, undersigned affirms that, to the best of their knowledge, Proposals have been arrived at independently and are submitted without collusion with anyone to obtain information or gain any favoritism that would in any way limit competition or give an unfair advantage over respondents in award of this proposal.

**I. BASE PROPOSAL**

Undersigned agrees to complete the Work for the lump sum amount as follows:

Cost (Written Out): \_\_\_\_\_ U.S. Dollars

Cost (Numerical): \$ \_\_\_\_\_ U.S. Dollars

Note: Amount written in words governs.

**II. ALLOWANCES**

Undersigned certifies that allowances in 01 21 00 - Allowances are included in the Base Proposals and agrees that unexpended balance of allowance sums, including Contractor's markup for the remaining sums, will revert to School District in final settlement of the contract.

\$(Amount)

\$(Amount)

**III. UNIT PRICES**

Note: Amount written in words governs.

Unit Price No. \_\_\_\_\_:

Description: \_\_\_\_\_

Cost (Written Out): \_\_\_\_\_

Cost (Numerical): \$ \_\_\_\_\_ U.S. Dollars per \_\_\_\_\_ (units)

Unit Price No. \_\_\_\_\_:

Description: \_\_\_\_\_

Cost (Written Out): \_\_\_\_\_  
Cost (Numerical): \$ \_\_\_\_\_ U.S. Dollars per \_\_\_\_\_ (units)

**IV. ALTERNATES**

Should School District accept Alternates, undersigned agrees to modify Base Proposal as stipulated below:

Note: Amount written in words governs.

Alternate No. \_\_\_\_\_:

Description: \_\_\_\_\_

Add/Deduct (Written Out): \_\_\_\_\_ U.S. Dollars

Add/Deduct (Numerical): \$ \_\_\_\_\_ U.S. Dollars

Alternate No. \_\_\_\_\_:

Description: \_\_\_\_\_

Add/Deduct (Written Out): \_\_\_\_\_ U.S. Dollars

Add/Deduct (Numerical): \$ \_\_\_\_\_ U.S. Dollars

**V. ADDENDA**

Undersigned acknowledges receipt of Addenda Nos. \_\_\_\_\_  
dated \_\_\_\_\_, 20\_\_\_\_.

**VI. CHANGES IN THE WORK**

Undersigned understands that changes in the Work shall be performed in accordance with Supplementary Conditions.

**ACKNOWLEDGEMENT**

It is understood that the right is reserved by School District to reject any or all proposals, or waive any informalities in proposal process.

\_\_\_\_\_  
Authorized Signature

\_\_\_\_\_  
Title

\_\_\_\_\_  
Name of Contracting Firm

\_\_\_\_\_  
Address

\_\_\_\_\_  
City, State, ZIP

\_\_\_\_\_  
Telephone

\_\_\_\_\_  
Date

Seal, if a Corporation

State whether Corporation, Partnership, or individual

**END OF SECTION 00 42 00**

## SECTION 00 45 00 - SELECTION CRITERIA AND CONTRACTOR INFORMATION

### GENERAL

#### SELECTION CRITERIA

Proposals are to include information requested in this Section in sequence and format prescribed. In addition to and separate from requested information, offerors submitting proposals may provide supplementary materials further describing their capabilities and experience.

Following deadline for receipt, School District's staff will receive, publicly open, and read aloud the names of the offerors and, if any are required to be stated, all prices stated in the proposals. School District's staff will recommend that School District select a construction contractor from the respondents to this Request for Proposals or reject all proposals.

Recommended ranking shall be based on data furnished by Offerors in response to Request for Proposals. The following is a list of criteria and weight for each criterion. Unless modified by addendum prior to opening of proposals, following listing of criteria and weight of criteria shall be utilized by School District pursuant to Texas Government Code Chapter 2269, Subchapter D:

WEIGHT	CRITERIA
30%	Price
30%	Offeror's experience and reputation
15%	Quality of Offeror's services
15%	Whether Offeror's financial capability is appropriate to size and scope of Project
10%	Safety record

All responses in proposal may be used to help School District select Contractor based on these criteria. School District reserves the right to verify accuracy and completeness of all responses by utilizing any information available to School District without regard to whether such information appears in proposal.

#### CONTRACTOR INFORMATION

Please provide the following information concerning your firm:

##### A. Offeror Information

1. Name of firm
2. Business address
3. Telephone number
4. Fax number
5. Type of organization (individual, partnership, corporation, association).
6. Number of permanent employees. (Employees hired for the duration of a specific project or under a fixed-term contract are not considered permanent employees for purposes of this proposal).
  - i. Home office
  - ii. Field
7. Primary contact person for Owner inquiries.
8. Main office location (if different than above).

Describe any substantial changes in ownership of your firm during the past five (5) years. How many years has your firm operated under its current form of business organization? List all professional or industry organizations in which your firm or its principals are members.

In order to assist the Owner in determining whether any conflicts of interest exist, please describe any business or family relationships between any member of the School District's Board of \_\_\_\_\_ and:

1. Your firm;

2. Any principal of your firm;
3. Any subcontractor you are considering using to perform any portion of the project work; or
4. Any principal of such subcontractor.
5. List all Mechanical, Electrical, and Plumbing subcontractors that your firm intends to use for this project.

**B. Personnel Information**

Provide brief resumes (two page limit) for the individuals listed below:

1. Principals/ Corporate Officers:
  - i. President
  - ii. Vice President
  - iii. Partners
2. Project Management Candidates
  - i. Project Manager
  - ii. Superintendent

For the Project Manager and Superintendent candidates, please list up to two (2) people you consider qualified for each position. Please also provide a list of the principal duties and responsibilities you anticipate assigning to the Project Manager and to the Superintendent.

**C. K-12 Projects**

List all K-12 building projects your firm has completed within the past five (5) years, and for each project list the following information:

1. Project owner
2. Brief description of the project
3. Client, client contact person, and telephone number
4. Date construction completed
5. Managing Principal
6. Project Architect or Engineer

For the ten (10) largest projects please also provide the following information:

1. Original contract amount
2. Final contract amount
3. Number of change orders

**D. Non-K-12 Projects (Optional)**

List up to five (5) major non-K-12 building projects your firm has completed within the past five years, and for each project list:

1. Name and location of the project
2. Brief description of the project
3. Client, client contact, and telephone number
4. Final contract amount
5. Date construction completed
6. Managing Principal
7. Project Architect or Engineer

**E. Claims and Litigation**

1. Identify any claims or suits, if any, brought against your firm within the last five (5) years.
2. Describe all instances in which your firm was unable to complete the work under a contract.
3. Identify any judgments, claims arbitration proceedings or suits pending or outstanding against your firm or its officers.
4. Identify any lawsuits filed or arbitration requested by your firm with respect to construction contracts of your firm.

**F. Current Work Load**

Provide the following information for the five (5) largest projects you currently have under contract:

1. Project name
2. Location
3. Owner
4. Architect
5. Current contract amount
6. Percent complete
7. Specified contract completion date

**G. Financial Information**

Provide the following financial information regarding your firm:

1. Total amount of work performed as general contractor for each of the past five (5) years.
2. Bonding capacity
  - i. Per project
  - ii. Aggregate
3. Bank reference(s)
  - i. Individual, title
  - ii. Name of bank
  - iii. Address
  - iv. Telephone
4. Bonding company reference(s).
  - i. Individual, title
  - ii. Name of bonding company
  - iii. Address
  - iv. Telephone
5. Dunn & Bradstreet rating, if available

**H. Safety Record**

Describe your organization's safety program and provide your worker's compensation experience modification factor. List any safety awards your organization has received within the past five (5) years.

**I. Execution**

The foregoing is true and correct. School District, or any authorized representative of School District, is authorized by the undersigned to contact any firm, institution, or person listed above to obtain information about our firm's services, financial condition, and any other information which School District might determine as being desirable.

Offeror: \_\_\_\_\_

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

Signature: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Title: \_\_\_\_\_

**END OF SECTION 00 45 00**

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**SECTION 00 45 19 - NON-COLLUSION AFFIDAVIT**

**STATE OF TEXAS**

**COUNTY OF \_\_\_\_\_**

**AFFIDAVIT**

By submission of this proposal, the undersigned certifies that:

- a. This proposal has been independently arrived at without collusion with any other offeror or with any other competitor;
- b. This proposal has not been knowingly disclosed and will not be knowingly disclosed, to any other offeror competitor or potential competitor, prior to the opening of proposals for this project;
- c. No attempt has been or will be made to induce any other person, partnership or corporation to submit or not submit a proposal;
- d. The undersigned certifies that he is fully informed regarding the accuracy of the statements contained in this certification, and that the penalties herein are applicable to the offeror as well as to any person signing in his behalf.

Company: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Signature: \_\_\_\_\_

**NOTARIZATION**

Sworn to and subscribed before me at \_\_\_\_\_, Texas, this the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

Notary Public in and for \_\_\_\_\_ County, Texas

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

**NOTE: THIS FORM MUST BE EXECUTED AND SUBMITTED WITH PROPOSAL**

**END OF SECTION 00 45 19**

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**SECTION 00 50 00 - TEXAS STATUTORY PERFORMANCE BOND**

**BOND NO.:** \_\_\_\_\_

**(PENALTY OF THIS BOND MUST BE 100% OF CONTRACT AMOUNT)**

**KNOW ALL MEN BY THESE PRESENTS, THAT:**

that \_\_\_\_\_ (hereinafter called the Principal), as principal, and \_\_\_\_\_ a corporation organized and existing under the laws of the State of \_\_\_\_\_ authorized and admitted to do business in the State of Texas and licensed by the State of Texas to execute bonds as Surety (hereinafter called the Surety), as Surety, are held and firmly bound unto

\_\_\_\_\_ (hereinafter called the Obligee) in the amount of \_\_\_\_\_ U.S. Dollars (\$) for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

**WHEREAS,**

the Principal has entered into a certain written contract with the Obligee, dated the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_, for

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

Project Name: CTE Barrientes

School District's Name: Edinburg Consolidated Independent School District

Attn: To Be Determined

which contract is hereby referred to and made a part hereof as fully and the same extent as if copied at length herein.

**NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH,**

that if the said Principal shall faithfully perform the work in accordance with the plans, specifications and contract documents, then this obligation shall be void; otherwise to remain in full force and effect.

**PROVIDED, HOWEVER,**

that this bond is executed pursuant to the provisions of Chapter 22.53 of the Texas Government Code and all liabilities on this bond shall be determined in accordance with the provisions of said Chapter to the same extent as if it were copied at length herein.

**IN WITNESS WHEREOF,**

the said Principal and Surety have signed and sealed this Instrument this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

Principal: \_\_\_\_\_

Witness: \_\_\_\_\_

Witness: \_\_\_\_\_

Attorney-in-Fact: \_\_\_\_\_

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

Surety City, State, ZIP: \_\_\_\_\_

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

**END OF SECTION 00 50 00**

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**SECTION 00 50 01 - TEXAS STATUTORY PAYMENT BOND**

**BOND NO.:** \_\_\_\_\_

**(PENALTY OF THIS BOND MUST BE 100% OF CONTRACT AMOUNT)**

**KNOW ALL MEN BY THESE PRESENTS,**

that: \_\_\_\_\_ (hereinafter called the Principal), as principal, and \_\_\_\_\_ a corporation organized and existing under the laws of the State of \_\_\_\_\_ authorized and admitted to do business in the State of Texas and licensed by the State of Texas to execute bonds as Surety (hereinafter called the Surety), as Surety, are held and firmly bound unto

\_\_\_\_\_ (hereinafter called the Oblige) in the amount of \_\_\_\_\_ U.S. Dollars (\$ \_\_\_\_\_) for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

**WHEREAS,**

the Principal has entered into a certain written contract with the Oblige, dated the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_ for:

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

Project Name: CTE Barrientes

School District's Name: Edinburg Consolidated Independent School District

Attn: To Be Determined

which contract is hereby referred to and made a part hereof as fully and the same extent as if copied at length herein.

**NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH,**

that if the said Principal shall pay all claimants supplying labor and material to him or a Subcontractor in the prosecution of the work provided for in said contract, then this obligation shall be void; otherwise to remain in full force and effect.

**PROVIDED,**

that the bond is executed pursuant to the provisions of Chapter 22.53 of the Texas Government Code and liabilities on this bond to claimants shall be determined in accordance with the provisions of said Chapter to the same extent as if it were copied at length herein.

**IN WITNESS WHEREOF,**

**END OF SECTION 00 50 01**

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# AIA<sup>®</sup> Document A101<sup>®</sup> – 2017

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

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

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

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

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

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

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

The parties should complete A101<sup>®</sup>-2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement.

AIA Document A201<sup>®</sup>-2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

The Owner and Contractor agree as follows.

**TABLE OF ARTICLES**

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

**EXHIBIT A INSURANCE AND BONDS**

**ARTICLE 1 THE CONTRACT DOCUMENTS**

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

**ARTICLE 2 THE WORK OF THIS CONTRACT**

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

**ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION**

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

*(Check one of the following boxes.)*

- The date of this Agreement.
- A date set forth in a notice to proceed issued by the Owner.
- Established as follows:  
*(Insert a date or a means to determine the date of commencement of the Work.)*

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

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

**§ 3.3 Substantial Completion**

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

*(Check one of the following boxes and complete the necessary information.)*

- Not later than ( ) calendar days from the date of commencement of the Work.



By the following date:

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date
-----------------	-----------------------------

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

#### ARTICLE 4 CONTRACT SUM

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

#### § 4.2 Alternates

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

Item	Price
------	-------

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement. (Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance
------	-------	---------------------------

§ 4.3 Allowances, if any, included in the Contract Sum:  
(Identify each allowance.)

Item	Price
------	-------

§ 4.4 Unit prices, if any:  
(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)

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

§ 4.5 Liquidated damages, if any:  
(Insert terms and conditions for liquidated damages, if any.)

§ 4.6 Other:  
(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

## ARTICLE 5 PAYMENTS

### § 5.1 Progress Payments

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

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the        day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the        day of the month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than        (    ) days after the Architect receives the Application for Payment.

*(Federal, state or local laws may require payment within a certain period of time.)*

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

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

§ 5.1.6 In accordance with AIA Document A201™–2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

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

- .1 That portion of the Contract Sum properly allocable to completed Work;
- .2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and
- .3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

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

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

### § 5.1.7 Retainage

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

*(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)*

**§ 5.1.7.1.1** The following items are not subject to retainage:  
*(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)*

**§ 5.1.7.2** Reduction or limitation of retainage, if any, shall be as follows:  
*(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)*

**§ 5.1.7.3** Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:  
*(Insert any other conditions for release of retainage upon Substantial Completion.)*

**§ 5.1.8** If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

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

## **§ 5.2 Final Payment**

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

- .1 the Contractor has fully performed the Contract except for the Contractor’s responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a final Certificate for Payment has been issued by the Architect.

**§ 5.2.2** The Owner’s final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect’s final Certificate for Payment, or as follows:

## **§ 5.3 Interest**

Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

*(Insert rate of interest agreed upon, if any.)*

\_\_\_\_\_ %

## **ARTICLE 6 DISPUTE RESOLUTION**

### **§ 6.1 Initial Decision Maker**

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.

*(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)*

**§ 6.2 Binding Dispute Resolution**

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:

*(Check the appropriate box.)*

- Arbitration pursuant to Section 15.4 of AIA Document A201–2017
- Litigation in a court of competent jurisdiction
- Other *(Specify)*

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

**ARTICLE 7 TERMINATION OR SUSPENSION**

**§ 7.1** The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

**§ 7.1.1** If the Contract is terminated for the Owner’s convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:  
*(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner’s convenience.)*

**§ 7.2** The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

**ARTICLE 8 MISCELLANEOUS PROVISIONS**

**§ 8.1** Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

**§ 8.2** The Owner’s representative:  
*(Name, address, email address, and other information)*

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

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

**§ 8.5 Insurance and Bonds**

**§ 8.5.1** The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

**§ 8.5.2** The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

**§ 8.6** Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:

*(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)*

**§ 8.7** Other provisions:

**ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS**

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

- .1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor
- .2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds
- .3 AIA Document A201™–2017, General Conditions of the Contract for Construction
- .4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:  
*(Insert the date of the E203-2013 incorporated into this Agreement.)*

.5 Drawings

Number	Title	Date
--------	-------	------

.6 Specifications

Section	Title	Date	Pages
---------	-------	------	-------

.7 Addenda, if any:

Number	Date	Pages
--------	------	-------

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

.8 Other Exhibits:

*(Check all boxes that apply and include appropriate information identifying the exhibit where required.)*

- AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:  
*(Insert the date of the E204-2017 incorporated into this Agreement.)*

The Sustainability Plan:

Title	Date	Pages
-------	------	-------

Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages
----------	-------	------	-------

.9 Other documents, if any, listed below:

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

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

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

\_\_\_\_\_  
CONTRACTOR (Signature)

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

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

**SECTION 00 65 01 - PROPOSAL EVALUATION WAIVER**

**GENERAL**

**NOTICE:**

By submitting a Proposal, the proposer indicated below agrees to waive any claim it has or may have against the School District, the Architect, the Engineers, the Consultants, and their respective employees, arising out of or in connection with the administration, evaluation, or recommendation of any proposal. The proposer further agrees the School District reserves the right to waive any requirements under the proposal documents or the Contract Documents, with regards to acceptance or rejection of any proposals, and recommendation or award of the contract.

NOTE: The Statement of Affirmation Must Be Notarized.

**STATEMENT OF AFFIRMATION**

"The undersigned affirms that he/she is duly authorized to execute this waiver by the person(s) or business entity making the proposal.

Firm's Name: \_\_\_\_\_

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

Proposer's Name: \_\_\_\_\_ Position/Title: \_\_\_\_\_

Proposer's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

**NOTARIZATION**

Subscribed and sworn to me on this \_\_\_\_ day of \_\_\_\_\_

Notary Public: \_\_\_\_\_

Commission Expiration: \_\_\_\_\_

**NOTE: THIS DOCUMENT MUST BE SUBMITTED WITH PROPOSAL**

**END OF SECTION 00 65 01**

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## **SECTION 00 65 19.16 - AFFIDAVIT OF RELEASE OF LIENS FORM**

### **GENERAL**

#### **SUMMARY**

Document Includes: Applicability and use of statutory Waiver and Release of Lien forms promulgated by the Legislature of the State of Texas for construction projects in Texas.

#### **STATUTORY REGULATIONS**

Texas Property Code, Chapter 53, Subchapter L, Sections 53.281 through 53.287 (includes the standard forms attached herewith immediately following this section):

Form 1: Conditional Waiver and Release on Progress Payment.

Form 2: Unconditional Waiver and Release on Progress Payment.

Form 3: Conditional Waiver and Release on Final Payment.

Form 4: Unconditional Waiver and Release on Final Payment.

#### **SELECTION AND USE OF WAIVER AND RELEASE OF LIENS FORM**

Submit the applicable form, legally executed (filled out, signed, and dated) and notarized, for each occasion required. Refer to the Agreement and Section 01 29 00 - Payment Procedures.

The wording of these forms is prescribed by the State of Texas. Questions regarding the use, execution, etc. should be directed to user's own attorney experienced in construction or lien law. This document does not render legal advice.

If the Contract Documents do not explicitly require submittal of Waivers and Releases of Liens for each payment, School District reserves the right, at its sole discretion, to require applicable Waivers and Releases of Liens, executed and notarized, for payment applications.

NOTE: The attached forms are duplicated verbatim (without editing) from Chapter 53 Property Code Sec. 53.284 (b), added by Acts 2011, 82nd Leg., R.S., Ch. 271 (H.B. 1456), Sec. 3, effective January 1, 2012.

**FORM 1: CONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT**

**PROJECT: CTE BARRIENTES**

**SCHOOL DISTRICT: EDINBURG CONSOLIDATED INDEPENDENT SCHOOL DISTRICT**

**ARCHITECT'S PROJECT NUMBER: 20217**

On receipt by the signer of this document of a check from \_\_\_\_\_ (maker of check) in the sum of \$\_\_\_\_\_ payable to \_\_\_\_\_ (payee or payees of check) and when the check has been properly endorsed and has been paid by the bank on which it is drawn, this document becomes effective to release any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the property of Edinburg Consolidated Independent School District (the School District) located at (1100 East Ebony Ln, Edinburg, Texas 78539 to the following extent: \_\_\_\_\_ (job description).

This release covers a progress payment for all labor, services, equipment, or materials furnished to the property or to \_\_\_\_\_ (person with whom signer contracted) as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

Before any recipient of this document relies on this document, the recipient should verify evidence of payment to the signer.

The signer warrants that the signer has already paid or will use the funds received from this progress payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

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

Company Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Title: \_\_\_\_\_

**FORM 2: UNCONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT**

**NOTICE:**

This document waives rights unconditionally and states that you have been paid for giving up those rights. It is prohibited for a person to require you to sign this document if you have not been paid the payment amount set forth below. If you have not been paid, use a conditional release form.

**PROJECT: CTE BARRIENTES**

**SCHOOL DISTRICT: EDINBURG CONSOLIDATED INDEPENDENT SCHOOL DISTRICT**

**ARCHITECT'S PROJECT NUMBER: 20217**

The signer of this document has been paid and has received a progress payment in the sum of \$ \_\_\_\_\_ for all labor, services, equipment, or materials furnished to the property or to \_\_\_\_\_ (person with whom signer contracted) on the property of Edinburg Consolidated Independent School District (the School District) located at 1100 East Ebony Ln, Edinburg, Texas 78539 to the following extent:

\_\_\_\_\_ (job description).

The signer therefore waives and releases any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the above referenced project to the following extent: \_\_\_\_\_

This release covers a progress payment for all labor, services, equipment, or materials furnished to the property or to \_\_\_\_\_ (person with whom signer contracted) as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

The signer warrants that the signer has already paid or will use the funds received from this progress payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

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

Company Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Title: \_\_\_\_\_

**FORM 3: CONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT**

**PROJECT: CTE BARRIENTES**

**SCHOOL DISTRICT: EDINBURG CONSOLIDATED INDEPENDENT SCHOOL DISTRICT**

**ARCHITECT'S PROJECT NUMBER: 20217**

On receipt by the signer of this document of a check from \_\_\_\_\_ (maker of check) in the sum of \$ \_\_\_\_\_ payable to: \_\_\_\_\_ (payee or payees of check) and when the check has been properly endorsed and has been paid by the bank on which it is drawn, this document becomes effective to release any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the property of Edinburg Consolidated Independent School District (the School District) located at 1100 East Ebony Ln, Edinburg, Texas 78539 to the following extent:

\_\_\_\_\_ (job description).

This release covers the final payment to the signer for all labor, services, equipment, or materials furnished to the property or to \_\_\_\_\_ (person with whom signer contracted).

Before any recipient of this document relies on this document, the recipient should verify evidence of payment to the signer.

The signer warrants that the signer has already paid or will use the funds received from this final payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project up to the date of this waiver and release.

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

Company Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Title: \_\_\_\_\_

**FORM 4: UNCONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT**

**NOTICE:**

This document waives rights unconditionally and states you have been paid for giving up those rights. It is prohibited for a person to require you to sign this document if you have not been paid the payment amount set forth below. If you have not been paid, use a conditional release form.

**PROJECT: CTE BARRIENTES**

**SCHOOL DISTRICT: EDINBURG CONSOLIDATED INDEPENDENT SCHOOL DISTRICT**

**ARCHITECT'S PROJECT NUMBER: 20217**

The signer of this document has been paid in full for all labor, services, equipment, or materials furnished to the property or to \_\_\_\_\_ (person with whom signer contracted) on the property of Edinburg Consolidated Independent School District (the School District) located at 1100 East Ebony Ln, Edinburg, Texas 78539 to the following extent:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (job description).

The signer therefore waives and releases any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position.

The signer warrants that the signer has already paid or will use the funds received from this final payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project up to the date of this waiver and release.

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

Company Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Title: \_\_\_\_\_

**END OF SECTION 00 65 19.16**

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**SECTION 00 70 00 - CONDITIONS OF THE CONTRACT**

**I. CONSTRUCTION CONTRACT AGREEMENT**

**1.1 GENERAL**

- A. Contract for the construction of the project shall be executed by the successful Offeror on the 2017 Edition of AIA Document A101 Standard Form of Agreement Between Owner and Contractor (Stipulated Sum). Said contract, fully executed, shall be delivered to School District within ten (10) days of receipt of said contract.

**II. CONDITIONS OF THE CONTRACT**

**2.1 GENERAL AND SUPPLEMENTARY CONDITIONS**

- A. AIA Document A201 The General Conditions of the Contract for Construction 2017 Edition, as modified by Section 00 73 00 - Supplementary Conditions, is made a part of the Contract Documents.

**2.2 REQUIREMENTS**

- A. Contractor is specifically directed, as a condition of the Contract, to acquaint themselves with the Articles of the General Conditions and to notify and apprise its subcontractors and other entities of the conditions governing the Contract for Construction.
- B. No contractual adjustments shall be due for failure of each entity to fully acquaint itself with the General Conditions.
- C. Provisions of General and Supplementary Conditions and Division 01 General Requirements apply to work specified in each Section of the Contract Specifications and indicated on Contract Drawings.

**III. AVAILABILITY**

**3.1 GENERAL**

- A. Failure to obtain and examine these documents in no way relieves Contractor, Subcontractors, Sub-subcontractors, and material suppliers of responsibilities incorporated in the Agreement.

**3.2 DOCUMENTS SOURCES**

- A. A.I.A. Documents may be obtained from the nearest local chapter of the American Institute of Architects. Copies may also be obtained from local architects' supplies stores.

**END OF SECTION 00 70 00**

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# AIA® Document A201® – 2017

## General Conditions of the Contract for Construction

for the following PROJECT:  
*(Name and location or address)*

**THE OWNER:**  
*(Name, legal status and address)*

**THE ARCHITECT:**  
*(Name, legal status and address)*

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

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## **ARTICLE 1 GENERAL PROVISIONS**

### **§ 1.1 Basic Definitions**

#### **§ 1.1.1 The Contract Documents**

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

#### **§ 1.1.2 The Contract**

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

#### **§ 1.1.3 The Work**

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

#### **§ 1.1.4 The Project**

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

#### **§ 1.1.5 The Drawings**

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

#### **§ 1.1.6 The Specifications**

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

#### **§ 1.1.7 Instruments of Service**

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

#### **§ 1.1.8 Initial Decision Maker**

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

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

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

**§ 1.2.1.1** The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining

provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

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

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

**§ 1.3 Capitalization**

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

**§ 1.4 Interpretation**

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

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

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

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

**§ 1.6 Notice**

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

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

**§ 1.7 Digital Data Use and Transmission**

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

**§ 1.8 Building Information Models Use and Reliance**

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building

information model, and each of their agents and employees.

## **ARTICLE 2 OWNER**

### **§ 2.1 General**

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

**§ 2.1.2** The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

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

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

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

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

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

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

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

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

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

**§ 2.3.4** The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the

site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

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

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

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

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

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

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

### **ARTICLE 3 CONTRACTOR**

#### **§ 3.1 General**

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

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

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

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

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

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

capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

**§ 3.2.3** The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

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

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

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

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

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

### **§ 3.4 Labor and Materials**

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

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

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

### **§ 3.5 Warranty**

**§ 3.5.1** The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes

remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

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

### **§ 3.6 Taxes**

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

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

**§ 3.7.1** Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

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

**§ 3.7.3** If the Contractor performs Work knowing it to be 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.

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

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

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

### **§ 3.8 Allowances**

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

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

- .1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- .2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and

- .3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

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

**§ 3.9 Superintendent**

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

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

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

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

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

**§ 3.10.2** The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

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

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

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

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

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

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

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

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

**§ 3.12.5** The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

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

**§ 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 by the Architect.

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

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

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

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

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



time and in the form specified by the Architect.

### **§ 3.13 Use of Site**

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

### **§ 3.14 Cutting and Patching**

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

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

### **§ 3.15 Cleaning Up**

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

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

### **§ 3.16 Access to Work**

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

### **§ 3.17 Royalties, Patents and Copyrights**

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

### **§ 3.18 Indemnification**

**§ 3.18.1** To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense 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 Section 3.18.

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

## **ARTICLE 4 ARCHITECT**

### **§ 4.1 General**

**§ 4.1.1** The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

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

### **§ 4.2 Administration of the Contract**

**§ 4.2.1** The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

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

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

### **§ 4.2.4 Communications**

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

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

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

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

Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

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

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

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

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

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

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

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

## **ARTICLE 5 SUBCONTRACTORS**

### **§ 5.1 Definitions**

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

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

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

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

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

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the

Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

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

### **§ 5.3 Subcontractual Relations**

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

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

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

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

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

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

**§ 5.4.3** Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

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

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

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

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

**§ 6.1.3** The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate

Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

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

## § 6.2 Mutual Responsibility

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

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

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

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

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

## § 6.3 Owner's Right to Clean Up

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

## ARTICLE 7 CHANGES IN THE WORK

### § 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

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

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

### § 7.2 Change Orders

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

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

### **§ 7.3 Construction Change Directives**

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

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

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

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

**§ 7.3.4** If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

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

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

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

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

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

**§ 7.3.9** Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The

Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

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

#### **§ 7.4 Minor Changes in the Work**

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

### **ARTICLE 8 TIME**

#### **§ 8.1 Definitions**

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

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

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

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

#### **§ 8.2 Progress and Completion**

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

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

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

#### **§ 8.3 Delays and Extensions of Time**

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

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

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

### **ARTICLE 9 PAYMENTS AND COMPLETION**

#### **§ 9.1 Contract Sum**

**§ 9.1.1** The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable

by the Owner to the Contractor for performance of the Work under the Contract Documents.

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

### **§ 9.2 Schedule of Values**

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

### **§ 9.3 Applications for Payment**

**§ 9.3.1** At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

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

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

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

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

### **§ 9.4 Certificates for Payment**

**§ 9.4.1** The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

**§ 9.4.2** The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The



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

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

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

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

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

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

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

#### **§ 9.6 Progress Payments**

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

**§ 9.6.2** The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

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

**§ 9.6.4** The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers

to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

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

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

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

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

#### **§ 9.7 Failure of Payment**

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

#### **§ 9.8 Substantial Completion**

**§ 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 so that the Owner can occupy or utilize the Work for its intended use.

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

**§ 9.8.3** Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

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

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

**§ 9.9 Partial Occupancy or Use**

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

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

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

**§ 9.10 Final Completion and Final Payment**

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

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

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

constitute a waiver of Claims.

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

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

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

## **ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY**

### **§ 10.1 Safety Precautions and Programs**

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

### **§ 10.2 Safety of Persons and Property**

**§ 10.2.1** The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

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

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

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

**§ 10.2.5** The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

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

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

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

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

### **§ 10.3 Hazardous Materials and Substances**

**§ 10.3.1** The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. 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 notify the Owner and Architect of the condition.

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

**§ 10.3.3** To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

**§ 10.3.4** The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

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

**§ 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 reimburse the Contractor for all cost and expense thereby incurred.

### **§ 10.4 Emergencies**

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

## **ARTICLE 11 INSURANCE AND BONDS**

### **§ 11.1 Contractor's Insurance and Bonds**

**§ 11.1.1** The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the

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

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

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

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

#### § 11.2 Owner's Insurance

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

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

§ 11.2.3 **Notice of Cancellation or Expiration of Owner's Required Property Insurance.** Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

#### § 11.3 Waivers of Subrogation

§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The

Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

**§ 11.3.2** If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

#### **§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance**

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

#### **§ 11.5 Adjustment and Settlement of Insured Loss**

**§ 11.5.1** A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

**§ 11.5.2** Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

### **ARTICLE 12 UNCOVERING AND CORRECTION OF WORK**

#### **§ 12.1 Uncovering of Work**

**§ 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, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

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

#### **§ 12.2 Correction of Work**

##### **§ 12.2.1 Before Substantial Completion**

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

Contractor's expense.

#### **§ 12.2.2 After Substantial Completion**

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

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

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

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

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

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

#### **§ 12.3 Acceptance of Nonconforming Work**

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

### **ARTICLE 13 MISCELLANEOUS PROVISIONS**

#### **§ 13.1 Governing Law**

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

#### **§ 13.2 Successors and Assigns**

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

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



### **§ 13.3 Rights and Remedies**

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

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

### **§ 13.4 Tests and Inspections**

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

**§ 13.4.2** If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

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

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

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

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

### **§ 13.5 Interest**

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

## **ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT**

### **§ 14.1 Termination by the Contractor**

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

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

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

**§ 14.1.3** If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

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

#### **§ 14.2 Termination by the Owner for Cause**

**§ 14.2.1** The Owner may terminate the Contract if the Contractor

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

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

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

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

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

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

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

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

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

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

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

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

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

**§ 14.4.3** In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

**ARTICLE 15 CLAIMS AND DISPUTES**

**§ 15.1 Claims**

**§ 15.1.1 Definition**

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

**§ 15.1.2 Time Limits on Claims**

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

**§ 15.1.3 Notice of Claims**

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

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

**§ 15.1.4 Continuing Contract Performance**

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

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

**§ 15.1.5 Claims for Additional Cost**

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

**§ 15.1.6 Claims for Additional Time**

**§ 15.1.6.1** If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section

15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

**§ 15.1.6.2** If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

**§ 15.1.7 Waiver of Claims for Consequential Damages**

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

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

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

**§ 15.2 Initial Decision**

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

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

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

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

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

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

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

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

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

### **§ 15.3 Mediation**

**§ 15.3.1** Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

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

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

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

### **§ 15.4 Arbitration**

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

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

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

**§ 15.4.3** The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly

consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

**§ 15.4.4 Consolidation or Joinder**

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

**§ 15.4.4.2** Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

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

Sample

## **SECTION 00 73 43 - WAGE RATE REQUIREMENTS (TEXAS)**

### **GENERAL**

#### **REGULATIONS**

The following information is from Chapter 2258 Texas Government Code:  
Effective March 01, 2016.

#### **2258.021. RIGHT TO BE PAID PREVAILING WAGE RATES.**

(a) A worker employed on a public work by or on behalf of the state or a political subdivision of the state shall be paid:

- (1) not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the work is performed; and
- (2) not less than the general prevailing rate of per diem wages for legal holidays and overtime work.

(b) Subsection (a) does not apply to maintenance work.

(c) A worker is employed on public work for the purposes of this section if the worker is employed by a contractor or subcontractor in the execution of a contract for the public work with the state, a political subdivision of the state, or any officer or public body of the state or a political subdivision of the state.

#### **2258.023. PREVAILING WAGE RATES TO BE PAID BY CONTRACTOR AND SUBCONTRACTOR; PENALTY.**

(a) The contractor who is awarded a contract by a public body or a subcontractor of the contractor shall pay not less than the rates determined under Section 2258.022 to a worker employed by it in the execution of the contract.

(b) A contractor or subcontractor who violates this section shall pay to the state or a political subdivision of the state on whose behalf the contract is made, \$60 for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated in the contract. A public body awarding a contract shall specify this penalty in the contract.

(c) A contractor or subcontractor does not violate this section if a public body awarding a contract does not determine the prevailing wage rates and specify the rates in the contract as provided by Section 2258.022.

(d) The public body shall use any money collected under this section to offset the costs incurred in the administration of this chapter.

(e) A municipality is entitled to collect a penalty under this section only if the municipality has a population of more than 10,000.

#### **2258.051. DUTY OF PUBLIC BODY TO HEAR COMPLAINTS AND WITHHOLD PAYMENT.**

A public body awarding a contract, and an agent or officer of the public body, shall:

- (1) take cognizance of complaints of all violations of this chapter committed in the execution of the contract; and
- (2) withhold money forfeited or required to be withheld under this chapter from the payments to the contractor under the contract, except that the public body may not withhold money from other than the final payment without a determination by the public body that there is good cause to believe that the contractor has violated this chapter.

### **WAGE RATES**

Refer to Section 00 73 46 - Wage Determination Schedule for applicable Wage Rates.

**END OF SECTION 00 73 43**

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**SECTION 00 73 46 - WAGE DETERMINATION SCHEDULE**

Prevailing Wage Rates - Construction Trades  
Hidalgo County

<b>CLASSIFICATION</b>	<b>HOURLY RATES</b>	<b>FRINGES</b>
Boilermaker	\$29.47	\$24.10
Bricklayer	\$16.17	---
Carpenter	\$14.21	\$2.22
Cement Mason / Concrete Finishers	\$12.46	---
Electrician	\$18.44	\$4.53
Insulator – Mechanical (Duct, Pipe & Mechanical System Insulation)	\$11.54	\$2.17
Ironworkers, Reinforcing	\$12.01	---
Ironworker, Structural	\$15.04	\$4.34
Ironworker, Ornamental	\$26.01	\$7.56
Laborer, Common or General	\$8.00	---
Laborer, Mason Tender - Brick	\$10.00	---
Laborer, Mason Tender – Cement/Concrete	\$10.89	\$0.96
Laborer, Pipelayer	\$11.00	\$3.47
Laborer, Roof Tearoff	\$10.06	---
Operator, Backhoe/Excavator/Trackhoe	\$14.04	\$1.01
Operator, Bobcat/Skid Steer/Skid Loader	\$13.93	---
Operator, Bulldozer	\$18.29	\$1.31
Operator, Drill	\$16.22	\$0.34
Operator, Forklift	\$14.83	---
Operator, Grader/Blade	\$10.00	---
Operator, Loader	\$12.87	\$0.70
Operator, Mechanic	\$17.00	---
Operator, Paver (Asphalt, Aggregate, and Concrete)	\$16.03	---
Operator, Roller	\$12.70	---
Painter (Brush, Roller, and Spray)	\$11.27	---
Pipefitter	\$15.22	\$3.16
Power Equipment Operator Tower Crane	\$32.85	\$13.10
Power Equipment Operator Cranes with Pile Driving or Caisson Attachment and Hydraulic Crane 60 Tons and Above	\$28.75	\$10.60
Power Equipment Operator Hydraulic Cranes 59 Tons and under	\$32.35	\$13.10

<b>CLASSIFICATION</b>		
Plumber	\$31.14	\$12.43
Roofer	\$11.42	---
Sheet Metal Worker, Excludes HVAC Duct Installation	\$21.13	\$6.53
Sheet Metal Worker (HVAC Duct Installation Only)	\$18.40	\$2.12
Tile Finisher	\$11.22	---
Tile Setter	\$12.15	---
Truck Driver, Dump Tuck	\$12.39	\$1.18
Truck Driver, Flatbed Truck	\$19.65	\$8.57
Truck Driver, Semi-Trailer Truck	\$12.50	---
Truck Driver, Water Truck	\$12.00	\$4.11

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

### **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: Requirements including, but not limited to:
  1. Project information.
  2. Work covered by Contract Documents.
  3. Type of Contract.
  4. Work by School District.
  5. Work under separate contracts.
  6. School District-furnished products.
  7. School District-furnished, Contractor-installed products.
  8. Access to site.
  9. Coordination with occupants.
  10. Work restrictions.
  11. Specification and Drawing conventions.
  12. Construction Schedule.

#### **1.3 PROJECT INFORMATION**

- A. Project Name: CTE Barrientes
- B. Project Location:
  1. 1100 East Ebony Ln
  2. Edinburg, Texas
- C. School District: Edinburg Consolidated Independent School District.
- D. Architect: PBK Architects, Inc..
- E. Additional Project contact information is specified in Section 00 01 03 - Project Directory.

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

- A. The Work of Project is defined by the Contract Documents and consists of the demolition, construction, and alteration of \_\_\_\_\_.

#### **1.5 TYPE OF CONTRACT**

- A. Project will be constructed under a Competitive Sealed Proposal (CSP) contract.

#### **1.6 WORK BY OWNER AND UNDER SEPARATE CONTRACTS**

- A. Cooperate fully with School District so Work may be carried out smoothly, without interfering with or delaying the work or work by School District. Coordinate the Work with Work performed by School District.
- B. School District reserves the right to let separate contract for Work outside of the scope of this Contract. 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.
- C. Purchase Contracts: School District reserves the right to negotiate purchase contracts with suppliers of material and equipment that may be incorporated into the Work. School District will assign these purchase contracts to Contractor. Include costs for purchasing, receiving, handling, storage if required, and installation of material and equipment in the Contract Sum, unless otherwise indicated.
  1. Contractor's responsibilities are same as if Contractor had negotiated purchase contracts, including responsibility to renegotiate purchase and to execute final purchasing

agreements.

- D. Owner-Furnished, Contractor-Installed Products (OFCl): School District will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing School District furnished products and making building services connections when applicable.
- E. Owner Furnished Products: Coordinate with School District.

### **1.7 ACCESS TO SITE**

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. General: 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: Limit use of Project site to Work in areas and areas within the Contract limits indicated. Do not disturb portions of site beyond areas in which the Work is indicated.
  - 1. Limits:
    - a. Drawings indicate the limits of the construction operations.
    - b. Limit site disturbance, including earthwork and clearing of vegetation, to 40 feet (12.2 m) beyond building perimeter; 10 feet (3 m) beyond surface walkways, patios, surface parking, and utilities less than 12 inches (300 mm) in diameter; 15 feet (4.5 m) beyond primary roadway curbs and main utility branch trenches; and 25 feet (7.6 m) beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities, and playing fields) that require additional staging areas in order to limit compaction in the constructed area.
  - 2. Driveways, Walkways, and Entrances: Keep driveways, parking areas, drop off points, loading areas, and entrances serving premises clear and available to School District, School District'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 by construction operations.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- D. Condition of Existing Building: Maintain portions of existing building affected by construction operations in weathertight condition throughout construction period. Repair damage caused by construction operations.

### **1.8 COORDINATION WITH OCCUPANTS**

- A. Full School District Occupancy: School District will occupy site and adjacent building(s) during entire construction period. Cooperate with School District during construction operations to minimize conflicts and facilitate School District usage. Perform Work to prevent interference with School District's day to day operations. Maintain existing exits unless otherwise indicated.
  - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from School District and approval of authorities having jurisdiction.
  - 2. Notify School District not less than 72 hours in advance of activities that will affect School District's operations.
- B. Limited School District Occupancy of Completed Areas of Construction: School District 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 occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
  - 1. Architect shall prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to School District acceptance of the completed Work.

2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited School District occupancy.
3. Before limited School District occupancy, ensure mechanical and electrical systems are fully operational, and required tests and inspections and start up procedures are successfully completed. On occupancy, School District shall operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. Upon occupancy, School District shall assume responsibility for maintenance and custodial service for occupied portions of Work.

#### **1.9 WORK RESTRICTIONS**

- A. Work Restrictions: Comply with restrictions on construction operations. Comply with limitations on use of public streets and with other requirements of Authorities Having Jurisdiction (AHJ).
- B. On-Site Work Hours: Limit Work in the existing building to normal working hours, Monday through Friday, unless otherwise indicated. Coordinate with School District when it is necessary to extend working hours or Work on weekends.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by School District or others unless permitted under the following conditions and after providing temporary utility services according to requirements indicated:
  1. Notify School District not less than two weeks in advance of proposed utility interruptions.
  2. Obtain School District's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that result in high levels of noise and vibration, odors, or other disruption to School District occupancy with School District.
  1. Notify School District not less than two weeks in advance of proposed disruptive operations.
  2. Obtain School District's written permission before proceeding with disruptive operations.
- E. Controlled Substances, Firearms, and Explosive Devices: Use of tobacco products, controlled substances, firearms, and explosive devices on the site is not permitted.
- F. Employee Identification: Provide identification tags for Contractor personnel working on site. Require personnel to use identification tags at all times.
- G. Employee Screening: Comply with School District's requirements for drug and background screening of Contractor personnel working on site.
  1. Maintain list of approved screened personnel with Owner's Designated Representative.

#### **1.10 SPECIFICATION AND DRAWING CONVENTIONS**

- A. Specification Content: Specifications use certain conventions for style of language and 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 Specifications. The words "shall," "shall be," or "shall comply with," depending on 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. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of each Specification section.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in 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.

**PART 2 PRODUCTS**

**NOT USED**

**PART 3 EXECUTION**

**3.1 CONSTRUCTION SCHEDULE**

- A. School District has a critical need for the Work to begin upon Notice to Proceed and shall be Substantially Complete by Month, DD, YYYY. There will be no Extensions of Time due to weather except in cases of extreme weather (hurricane, tornado, etc.). The impact of each extreme weather event on schedule shall be discussed by the Architect, School District, and Contractor.

**END OF SECTION 01 10 00**

## **SECTION 01 21 00 - ALLOWANCES**

### **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 governing allowances.
  - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include:
  - 1. Lump sum allowances.
  - 2. Unit cost allowances.
  - 3. Quantity allowances.
  - 4. Contingency allowances.
  - 5. Testing and inspecting allowances.

#### **1.3 COORDINATION**

- A. Coordinate allowance items with other portions of the Work.

#### **1.4 LUMP SUM, UNIT COST, AND QUANTITY ALLOWANCES**

- A. Allowance shall include cost to Contractor of specific products and materials ordered by School District or selected by Architect under allowance and shall include taxes, freight, and delivery to site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by School District or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to School District, after installation has been completed and accepted.
  - 1. If requested by Architect, retain and prepare unused material for storage by School District. Deliver unused material to School District's storage space as directed.

#### **1.5 CONTINGENCY ALLOWANCES**

- A. Use the contingency allowance only as directed by Architect for School District's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Contractor's related costs for products and equipment ordered by School District under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to School District by Change Order.

#### **1.6 TESTING AND INSPECTING ALLOWANCES**

- A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.
- B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.

- C. Costs of services not required by the Contract Documents are not included in the allowance.
- D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to School District by Change Order.

### **1.7 ADJUSTMENT OF ALLOWANCES**

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
  - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
  - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
  - 3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit cost allowances.
  - 4. School District reserves the right to establish the quantity of Work in place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
  - 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
  - 2. No change to Contractor's indirect expense is permitted for selection of higher or lower priced materials or systems of the same scope and nature as originally indicated.

## **PART 2 PRODUCTS**

**NOT USED**

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

### **3.2 PREPARATION**

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related Work.

### **3.3 SCHEDULE OF ALLOWANCES**

**END OF SECTION 01 21 00**



## **SECTION 01 22 00 - UNIT PRICES**

### **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 unit prices.

#### **1.3 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  - 1. Unit Price.

#### **1.4 PROCEDURES**

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

### **PART 2 PRODUCTS**

#### **NOT USED**

### **PART 3 EXECUTION**

#### **3.1 SCHEDULE OF UNIT PRICES**

- A. Unit Price No. \_\_\_\_\_: \_\_\_\_\_
  - 1. Description: This Unit Price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new cement stabilized sand and lean concrete material delivered, spread, and compacted per plans and specs. Cost shall include all materials and labor for complete installation. Enter unit cost on Proposal Form.
  - 2. Unit of Measure: U.S. Dollars (\$) per Linear Foot (LF)

**END OF SECTION 01 22 00**

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**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:
  - 1. Description of Alternates.
  - 2. Procedures for pricing Alternates.
  - 3. Documentation of changes to Contract Price and Contract Time.

**1.3 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  - 1. Alternate

**1.4 ACCEPTANCE OF ALTERNATES**

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at School District's option. Accepted alternates will be identified in the Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work to integrate the Work of each alternate.

**1.5 SCHEDULE OF ALTERNATES**

- A. Alternate No. 01 - Roofing:
  - 1. Base Bid Item: Existing roofing to remain. Patch and repair as needed..
  - 2. Alternate Item: Provide new roofing as indicated on Drawings.

**PART 2 PRODUCTS**

**NOT USED**

**PART 3 EXECUTION**

**NOT USED**

**END OF SECTION 01 23 00**

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## **SECTION 01 25 13 - PRODUCT 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:
  - 1. Specified product compliance, and product quality assurance.
  - 2. Specific administrative and procedural requirements for handling requests for substitutions made prior to award of Contract.
  - 3. Requirements for product delivery, storage, and handling.

#### **1.3 RELATED SECTIONS**

- A. Instructions to Offerors: Product options and procedures for submittal of requests for substitutions during the Proposal period.

#### **1.4 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  - 1. Product
  - 2. Materials
  - 3. Equipment

#### **1.5 PRODUCT QUALITY ASSURANCE**

- A. Source Limitations: To the fullest extent possible, provide products of the same generic kind, from a single source, for each unit of work.
  - 1. When it is discovered that specific products are available only from sources that do not or cannot produce an adequate quantity to complete project requirements in a timely manner, consult with the Architect for a determination of what product quantities are most important before proceeding. The Architect will designate those qualities, such as visual, structural, durability, or compatibility, that are most important. When the Architect's determination has been made, select products from those sources that produce products that possess the most important qualities, to the fullest extent possible.
- B. Compatibility of Options: Compatibility of products is a basic requirement of product selection. When the Contractor is given the option of selecting between two (2) or more products for use on the project, the product selected must be compatible with other products previously selected, even if the products previously selected were also Contractor options. The complete compatibility between the various choices available to the Contractor is not assured by the various requirements of the Contract Documents, but must be provided by the Contractor.
- C. Or Equal:
  - 1. Where the phrase "or equal", "or equivalent", "or Architect-approved equal", or similar phrasing, occurs in the Contract Documents, do not assume that materials, equipment, or methods of construction will be acceptable by the Architect unless the item has been specifically reviewed for this Work by the Architect.
  - 2. The decision of the Architect shall be final.
- D. Where a proposed substitution involves the work of more than one (1) trade, the Contractor shall coordinate the work so as to provide uniformity and consistency and to assure the compatibility of products.
- E. Standards: Refer to Section 01 40 00 - Quality Requirements for the applicability of industry standards to the products specified for the Project, and for the acronyms used in the text of the Specification Sections.

## 1.6 SUBSTITUTIONS OF PRODUCTS

- A. Products described in Contract Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution. Materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability, or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by Architect at least seven (7) days prior to the date for receipt of proposals. Each such request shall include name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, product information/data sheets, performance and test data, and any other information necessary for an evaluation. Architect's decision of approval or disapproval of a proposed substitution shall be final.
- C. If Architect approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. Architect and School District reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- E. The following are not considered as substitutions:
  - 1. Revisions to the Contract Documents, when requested by the School District, the Architect, or any of their consultants are considered as "changes" not substitutions.
  - 2. Specified Contractor options on products and construction methods included in Contract Documents are choices made available to the Contractor and are not subject to the requirements specified in this Section for substitutions.
  - 3. Except as otherwise provided in the Contract Documents, the Contractor's determination of and compliance with governing authorities do not constitute "substitutions" and do not constitute a basis for change orders.
- F. The following may be considered as a reason for a request for substitution:
  - 1. The request is directly related to an "or approved equal" clause or similar language in the Contract Documents.
  - 2. The specified product or method of construction cannot be provided within the Contract Time in accordance with paragraph below concerning availability of specified items.
  - 3. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
  - 4. A substantial advantage is offered to School District, in terms of cost, time, energy conservation or other consideration of merit, after deducting offsetting responsibilities School District may be required to bear. These additional responsibilities may include such considerations as additional compensation to the Architect for redesign and evaluation services, the increased cost of other work by the School District or separate contractors, and similar considerations.
  - 5. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where Contractor certifies that substitution will overcome the incompatibility.
  - 6. The specified product or method of construction cannot be coordinated with other materials, and where Contractor certifies that the proposed substitution can be coordinated.
  - 7. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where Contractor certifies that the proposed substitution provides the required warranty.
- G. Availability of specified items:

1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.
  2. In the event specified items will not be so available, notify the Architect prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.
  3. The request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or coordinate activities properly.
  4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the School District.
- H. A request constitutes a representation that the Offeror:
1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
  2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.
  3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to the School District.
  4. Waives claims for additional costs or time extension which may subsequently become apparent.
  5. Will reimburse School District and pay for all costs, including the Architect's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.
- I. No substitutions will be considered after Award of Contract.

#### **1.7 SUBSTITUTION REQUEST SUBMITTAL**

- A. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related Specifications Section and Drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate, with each request, the following information:
1. Product data, drawings and descriptions of products, fabrication and installation procedures.
  2. Samples, where applicable or requested.
  3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect, where applicable.
  4. Coordination information, including a list of changes or modifications needed by other parts of the work and to construction performed by the School District and separate contractors that will become necessary to accommodate the proposed substitution.
  5. A statement indicating the effect the substitution will have on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
  6. Cost information, including a proposal of the net change, if any in the Contract Sum.
  7. Certification by Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
  8. A statement indicating the Contractor will reimburse the School District and pay for all costs, including Architect's re-design and evaluation costs resulting from the use of the proposed substitution.
- B. Work-Related Submittals: The Contractor's submittal of, and the Architect's acceptance of, Shop Drawings, Product Data, or Samples which are related to work not complying with the Contract Documents, does not constitute an acceptance or valid request for a substitution, nor

approval thereof.

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

- A. General: Deliver, store, and handle products in accordance with manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft. Control to prevent overcrowding of construction spaces or overloading of structure. In particular, coordinate delivery and installation to ensure minimum holding or storage times for items known or recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other sources of loss.
1. Deliver products to the site in the manufacturer's sealed containers or other packaging system, complete with labels intact, and instructions for handling, storage, unpacking, installing, cleaning and protecting.
  2. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of product.
  3. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
  4. Store products at the site or in a bonded and insured off-site storage facility or warehouse in a manner that will facilitate inspection and measurement of quantity or counting of units. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
  5. Store heavy materials away from the project structure or in a manner that will not endanger the supporting construction.

## **PART 2 PRODUCTS**

### **2.1 GENERAL PRODUCT COMPLIANCE**

- A. General: Requirements for individual products are indicated in the Contract Documents; compliance with these requirements is in itself a contract requirement. These requirements may be specified in any one (1) of several different specifying methods, or in any combination of these methods. These methods include the following:
1. Proprietary.
  2. Descriptive.
  3. Performance.
  4. Compliance with Reference Standards.
- B. Compliance with codes, compliance with graphic details, allowances, and similar provisions of the Contract Documents also have a bearing on the selection process.
- C. Procedures for Selecting Products: Contractor's options in selecting products are limited by requirements of the Contract Documents and governing regulations. They are not controlled by industry traditions or procedures experienced by Contractor on previous construction projects. Required procedures include, but are not limited to the following for the various indicated methods of specifying:
1. Proprietary and Semi-Proprietary Specification Requirements:
    - a. Single Product Name: Where only a single product or manufacturer is named, provide the product indicated, unless the specification indicates the possible consideration of other products. Advise the Architect before proceeding, when it is discovered that the named product is not a reasonable or feasible solution.
    - b. Two (2) or More Product Names: Where two (2) or more products or manufacturers are named, provide one (1) of the products named, at Contractor's option. Exclude products that do not comply with specification requirements. Do not provide or offer to provide an unnamed product, unless specification indicates possible consideration of other products. Advise the Architect before proceeding where none of the named products comply with specification requirements, or are not feasible for use. Where products or manufacturers are specified by name, accompanied by the term "or approved equal" or similar language, comply with this Section regarding "substitutions" to obtain approval from Architect for use of an unnamed product.



2. Non-Proprietary Specification Requirements: Where specifications name products or manufacturers that are available and may be submitted for incorporation in the Work, but do not restrict the Contractor to use of these products only, the Contractor may, at their option, use any available product that complies with Contract requirements.
  3. Descriptive Specification Requirements: Where the specifications describe a product or assembly generically, in detail, listing the exact characteristics required, but without use of a brand name, provide products or assemblies that provide the characteristics indicated and otherwise comply with Contract requirements.
  4. Performance Specification Requirements: Where the specifications require compliance with indicated performance requirements, provide products that comply with the specific performance requirements indicated, and that are recommended by the manufacturer for the application indicated. Manufacturer's recommendations may be contained in published product literature, or by manufacturer's individual certification of performance. General overall performance of a product is implied where product is specified for specific performances.
  5. Compliance with Standards, Codes, and Regulations: Where specifications require only compliance with an imposed standard, code, or regulation, the Contractor has option of selecting a product that complies with specification requirements, including standards, codes, and regulations.
  6. Visual Matching: Where matching an established sample is required, final judgement of whether a product proposed by the Contractor matches sample satisfactorily will be determined by the Architect. Where there is no product available within specified product category that matches sample satisfactorily and also complies with other specified requirements, comply with provisions of this Section regarding "substitutions" and other Contract Documents for "change orders" for selection of a matching product in another product category, or for non-compliance with specified requirements.
  7. Visual Selection: Except as otherwise indicated, where specified product requirements include the phrase "...as selected from the manufacturer's standard colors, patterns, textures..." or similar phrases, the Contractor has option of selecting product and manufacturer, provided selection complies with other specified requirements. The Architect is subsequently responsible for selecting color, pattern, and texture from product line selected by the Contractor.
  8. Allowances: Refer to individual sections of the specifications and Section 01 25 13 - Product Substitution Procedures, Allowances for an indication of product selections that are controlled by established allowances, and for the procedures required for processing such selections.
- D. Producer's Statement of Applicability: Where individual specification sections indicate products that require a "Statement of Applicability" from the manufacturer or other producer, submit a written-certified statement from the producer stating that the producer has reviewed the proposed application of the product on the project. This statement shall state that the producer agrees with or does not object to the Architect's specification and the Contractor's selection of the product on the project is suitable and proper.

## **2.2 SUBSTITUTIONS**

- A. Condition: The Contractor's request for substitution will be received and considered when extensive revisions to Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented and properly submitted, and when one (1) or more of the above conditions are satisfied, all as judged and determined by the Architect; otherwise the requests will be returned without action except to record non-compliance with these requirements.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION OF PRODUCTS**

- A. General: Except as otherwise indicated in individual sections of these specifications, comply with the manufacturer's instructions and recommendations for installation of the products in the

applications indicated.

- B. Anchor each product securely in place, accurately located and aligned with other work.
- C. Clean exposed surfaces and protect surfaces as necessary to ensure freedom from damage and deterioration at time of acceptance.
- D. Products and assemblies shall be installed complete, in-place, watertight and structurally sound.

### **3.2 INSTALLATION OF APPROVED SUBSTITUTIONS**

- A. Coordinate all approved substitutions with adjacent work.
- B. Comply with the manufacturer's and/or supplier's instructions and recommendations for installation of the products in the applications indicated.
- C. Provide all items required by manufacturer and/or supplier regarding installation, i.e. supplemental supports, anchors, fasteners, painting, etc. whether or not indicated or specified.

**END OF SECTION 01 25 13**

**SECTION 01 25 13.01 - REQUEST FOR SUBSTITUTION FORM**

**PROJECT INFORMATION**

**PROJECT NAME AND NUMBER:** \_\_\_\_\_

**CONTRACT AWARD DATE:**  
\_\_\_\_\_

**TO:** \_\_\_\_\_

**SUBSTITUTION REQUESTED BY:** \_\_\_\_\_

**REQUEST MADE DURING:**

- Bidding
- Construction Period

**CAUSE FOR REQUEST:** \_\_\_\_\_

**SUBSTITUTION INFORMATION**

**SUBMIT IN ACCORDANCE WITH SECTION 01 33 00 - SUBMITTAL PROCEDURES.**

1. Technical data, cost, and time information relating to changes to Construction Documents required by proposed substitution.
2. Detailed comparison of proposed substitution and specified product including but not limited to warranty, significant variations, qualifications of manufacturers, and maintenance.
3. Complete technical data, detailed shop drawings, samples, installation procedures, warranty, and substantiating data marked to indicate equivalent quality and performance to that specified. Manufacturer sell sheets are not acceptable submittals.

**BASIS OF DESIGN**

Specified Manufacturer: \_\_\_\_\_

Specified Product: \_\_\_\_\_

Where Specified:

Drawing (Sheet Number and Detail/Schedule): \_\_\_\_\_

Specification: (Section Number and Paragraph): \_\_\_\_\_

**PROPOSED SUBSTITUTION**

We submit for consideration the following manufacturer / product in lieu of the specified item for the above referenced project:

Proposed Manufacturer: \_\_\_\_\_

Proposed Product: \_\_\_\_\_

**COST AND TIME**

Does proposed substitution affect adjacent work, Construction Documents, Cost, Schedule, Quality, or related submittals?

- No
- Yes

Contractor is responsible for costs and additional time associated with proposed substitution including costs incurred by Architect for evaluation of substitution and changes to the documents. Describe costs for changes to design, including engineering and detailing costs caused by requested substitution.

\_\_\_\_\_

\_\_\_\_\_

Cost Savings Realized by School District (\$ US):  
\_\_\_\_\_

**WARRANTY**

Is warranty for proposed substitution the same as for specified product?

Yes

No

If No, Explain Differences: \_\_\_\_\_  
\_\_\_\_\_

**CONTRACTOR CERTIFICATION:**

In making this request for substitution, Contractor certifies that:

1. Proposed substitution has been thoroughly researched and evaluated and determined as equivalent or superior to specified product or material, will fit into space provided, and is compatible with adjacent materials.
2. Proposed substitution will provide the same or better warranty at no additional cost to the School District.
3. Cost data is complete and includes related costs under the Contract. Claims for additional costs related to the proposed substitution that may subsequently become apparent are waived.
4. Contractor will assume responsibility for delays and costs caused by acceptance proposed substitution, if approved, are accepted by the Contractor unless delays and costs are specifically mentioned and approved in writing by School District and Architect.
5. Contractor will assume liability for performance of the substitution.
6. Installation of the proposed substitution is coordinated with the Work and with changes required to the Work.
7. Contractor will reimburse School District and Architect for evaluation and redesign services associated with the substitution request and, when required, for approval by authorities having jurisdiction.

**PREVIOUS USE**

Has the proposed substitute manufacturer / product been installed on previous PBK Architects, Inc. projects within the past two years?

No

Yes

If Yes, list project(s):

Project: \_\_\_\_\_

School

District: \_\_\_\_\_

Contact: \_\_\_\_\_

Project: \_\_\_\_\_

School District:

\_\_\_\_\_

Contact: \_\_\_\_\_

**SUBMITTED BY:**

Contractor's Signature: \_\_\_\_\_

Signature shall be by the individual authorized to legally bind the Contractor to the above terms. Failure to provide legally binding signature will result in retraction of acceptance.

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

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

**SUBSTITUTION EVALUATION**

**FOR USE BY ARCHITECT:**

Accepted  Accepted as Noted  Not Accepted  Received too Late

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

Remarks: \_\_\_\_\_  
\_\_\_\_\_

**FOR USE BY SCHOOL DISTRICT:**

\_\_\_\_ Accepted \_\_\_\_ Not Accepted

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

Remarks: \_\_\_\_\_  
\_\_\_\_\_

**END OF SECTION 01 25 13.01**

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## **SECTION 01 26 00 - CONTRACT MODIFICATION 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 handling and processing Contract modifications.
- B. Related Work:
  - 1. Section 01 25 13 - Product Substitution Procedures

#### **1.3 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 AIA G710 Architect's Supplemental Instructions.

#### **1.4 PROPOSAL REQUESTS**

- A. School District Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop Work in progress or to execute the proposed change.
  - 2. After receipt of Proposal Request, submit quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include 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.
- B. Contractor Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
  - 1. Include statement outlining reasons for the change and the effect of the change on the Work. Provide complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
  - 2. Include 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 13 - Product Substitution Procedures if the proposed change requires substitution of one product or system for product or system

specified.

7. Proposal Request Form: Use AIA Document AIA G709.
- C. Contractor has ten (10) business days to submit pricing or submit resubmittal pricing to the Architect after issuance of a Change Proposal Request (CPR) or Change Proposal.
- D. Regardless of initiated change request pricing, a fully developed and completed change pricing to be submitted.

### **1.5 ADMINISTRATIVE CHANGE ORDERS**

- A. Allowance Adjustment: When an allowance is specified, refer to 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.
  1. Allowance Adjustment: To adjust allowance amounts, base each Change Proposal Request (CPR) on the difference between purchase amount and the allowance, multiplied by final measurement of Work in place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
    - a. Include installation costs in purchase amount only where indicated as part of the allowance.
    - b. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
    - c. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit cost allowances.
    - d. School District reserves the right to establish the quantity of Work in place by independent quantity survey, measure, or count.
  2. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within 7 days of receipt of the Change Order authorizing work to proceed. School District will reject claims submitted later than 7 days after authorization.

### **1.6 CHANGE ORDER PROCEDURES**

- A. On School District's approval of a Work Changes Proposal Request, Architect will execute a Change Order also requiring signatures of School District and Contractor on AIA Document AIA G701.

### **1.7 CONSTRUCTION CHANGE DIRECTIVE**

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document AIA G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  1. Construction Change Directive contains a complete description of change in the Work and designates the method 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 01 26 00**



## **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. Section Includes: Administrative and procedural requirements necessary to prepare and process Applications for Payment.

#### **1.3 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  - 1. Schedule of Values.
  - 2. Pencil Copy.

#### **1.4 SCHEDULE OF VALUES**

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
  - 1. Coordinate line items in Schedule of Values with administrative forms and schedules, including the following:
    - a. Application for Payment forms with continuation sheets.
    - b. Updated Submittal schedule.
    - c. Items required to be indicated as separate activities in updated Contractor's construction schedule.
  - 2. Submit Schedule of Values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Application for Payment. Contractor's standard form or electronic media printout will be considered but must be approved by the School District.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
  - 1. Identification: Include the following Project identification on the schedule of values:
    - a. Project name and location.
    - b. Name of Architect.
    - c. Architect's project number.
    - d. Contractor's name and address.
    - e. Date of submittal.
  - 2. Arrange schedule of values consistent with format of AIA G703.
  - 3. Arrange 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 Rentals.
      - 4) General Conditions.
        - (a) Supervisor.
        - (b) Submittals.

- (c) Close-out.
  - (d) Field Engineering.
  - (e) Daily Clean-up.
  - (f) Final Clean-up.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
  5. Provide 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.
  6. 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.
  7. 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.
  8. 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. Submit preliminary (pencil) copy of proposed values to Architect or Architect's field representative and School District for review by 20th day of the month. Allow 48 hours for comments.
- B. Once preliminary (pencil) approved, submit electronic copy of notarized originals of each application on AIA G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet for AIA G702 or other similar form approved by the School District.
  1. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
  2. Submit updated construction or recovery schedule with each Application for Payment.
- C. Payment Period: Submit at intervals stipulated in the Agreement in accordance with Section 00 73 00 - Supplementary Conditions.
- D. Only materials stored on the project site shall be paid for unless the materials are stored in a bonded warehouse.
- E. Substantiating Data: When Architect requires substantiating information, submit data justifying dollar amounts in question. Items which may be requested by the Architect or School District to substantiate costs include, but are not limited to the following:
  1. Current Record Documents as specified in Section 01 77 00 - Closeout Procedures maintained.
  2. Labor time sheets, purchase orders, or similar documentation.
  3. Affidavits attesting to off-site stored products.

#### **PART 2 PRODUCTS**

**NOT USED**

#### **PART 3 EXECUTION**

**NOT USED**

**END OF SECTION 01 29 00**

**SECTION 01 29 73**

**SCHEDULE OF VALUES - SAMPLE**

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	<b>Div. 1 - General Reqs.</b> Site Work General Conditions Supervision Mobilization Bonds & Insurance Permits Contractor's Fee Close-Out Documents								
	<b>Div. 1 - Total</b>								
	<b>Div. 2 - Existing Conditions</b> Demolition (As applicable) Erosion Control <b>Div. 2 - Total</b>								
	<b>Div. 3 - Concrete</b> Drill Piers Caps & Beams Slab on Grade Cooling Tower Basin Misc Bldg Conc Floor Sealer Rebar Matl Rebar Labor Lt.Wt.Insul Fill - Materials Lt.Wt.Insul Fill - Labor Submittals/Close-Out Documents Supervision Clean-up								
	<b>Div. 3 - Total</b>								
	<b>Div 4 - Masonry</b> Brickwork - Labor Brickwork - Matls Concrete Masonry - Labor Concrete Masonry - Materials Str. Glazed Tile-Labor Str. Glazed Tile-Materials Submittals/Close-Out Documents Supervision Clean-up								
	<b>Div. 4 - Total</b>								
	<b>Div 5 - Metals</b> Structural Steel - Labor Structural Steel - Materials Alternating Stairs Misc. Steel - Materials Steel Joists - Materials Lt. Gauge Steel Framing-Labor Lt. Gauge Steel Framing-Matls Metal Decking - Labor Expansion Joint Covers Metal Decking - Matls Detailing Submittals/Close-Out Documents Supervision Clean-up								
	<b>Div. 5 - Total</b>								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	<b>Div. 6 - Wood &amp; Plastics</b> Rough Carpentry - Labor Rough Carpentry - Materials Millwork - Labor Millwork - Materials Submittals/Close-Out Documents								
	<b>Div. 6 - Total</b>								
	<b>Div. 7 - Thermal and Moisture Protection</b> Waterpfng / Dampprfng-Matls Waterpfng / Dampprfng-Labor Building Insulation - Labor Building Insulation - Materials Fireproofing - Labor Fireproofing - Materials Metal Roof - Labor Metal Roof - Materials Metal Roof Guarantee Built-up Roofing-Labor Built-up Roofing-Materials Built-up Roofing Guarantee Roof Accessories Building Sheet Metal - Labor Building Sheet Metal - Matls Bldg. Sheet Metal Guarantee Roof Curbs Roof Hatches Sealants Submittals/Close-Out Documents Supervision Clean-up								
	<b>Div. 7 - Total</b>								
	<b>Div. 8 - Doors and Frames</b> Finish Carpentry/Door - Labor Finish Hardware - Matls Thresholds & Seals - Matls+B66 Hollow Metal Doors & Frames - Matls Plastic Faced Doors-Matls Overhead Doors & Grilles-Labor Overhead Doors & Grilles - Matls Alum. Entrances & Store-fronts - Labor Alum. Entrances & Store-fronts - Matls Alum. Windows - Labor Alum Windows - Matls Glass & Glazing-Labor Glass & Glazing-Matls Submittals/Close-Out Documents Supervision Clean-up								
	<b>Div. 8 - Total</b>								

**SECTION 01 29 73**

**SCHEDULE OF VALUES - SAMPLE**

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	<b>Div. 9 - Finishes</b>								
	Lath & Plaster-Labor								
	Lath & Plaster-Matls								
	Gypsum Wallboard Systems - Labor								
	Gypsum Wallboard Systems - Matls								
	Ceramic Tile - Labor								
	Ceramic Tile - Matls								
	Quarry Tile - Labor								
	Quarry Tile - Matls								
	Terrazzo-Labor								
	Terrazzo-Matls								
	Acoustic Clg. - Labor								
	Acoustic Clg. - Matls								
	Acoustic Wall Panels								
	Resilient Flooring - Labor								
	Resilient Flooring - Matls								
	Carpet - Labor								
	Carpet - Matls								
	Athletic Flooring - Materials								
	Athletic Flooring - Labor								
	Floor Sealer								
	Painting - Labor								
	Painting - Mtls								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	<b>Div. 9 - Total</b>								
	<b>Div. 10 - Specialties</b>								
	Visual Display Boards & Tackboards - Materials								
	Visual Display Boards & Tackboards - Labor								
	Toilet Partitions - Labor								
	Toilet Partitions - Matls								
	Louvers								
	Aluminum Flag Pole								
	Graphics								
	Lockers								
	Cubicle Curtains & Track								
	Fire Extinguisher Cabinets								
	Demountable Partitions-Labor								
	Demountable Partitions-Matls								
	Shelving								
	Toilet Room Accessories-Matls								
	Toilet Room Accessories-Lbr								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	<b>Div. 10 - Total</b>								
	<b>Div. 11 - Equipment</b>								
	Stage Curtains								
	Misc. Appliances								
	Food Service Eqpt-Labor								

**SECTION 01 29 73**

**SCHEDULE OF VALUES - SAMPLE**

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Food Service Eqpt-Matls Submittals/Close-Out Documents Supervision Clean-up								
	<b>Div. 11 - Total</b>								
	<b>Div. 12 - Furnishings</b> Horizontal Blinds Projection Screens Casework - Labor Casework - Matls Science Casework - Labor Science Casework - Matls Submittals/Close-Out Documents Supervision Clean-up								
	<b>Div. 12 - Total</b>								
	<b>Div. 13 - Specialties</b> Stage Curtains and Draperies Music Instrument Storage Bleachers Press Box Pre-eng. Metal Bldg. Stadium Seating Submittals/Close-Out Documents Supervision Clean-up								
	<b>Div. 13 - Total</b>								
	<b>Div. 14 - Conveying Systems</b> Platform Lifts Elevators Submittals/Close-Out Documents Supervision Clean-up								
	<b>Div. 14 - Total</b>								
	<b>Div. 21, 22 - Plumbing</b> Shop Drawings As-Builts/Close-Out/ O&M Manuals Sanitary Underground - Labor Sanitary Underground - Matls Storm Underground - Labor Storm Underground - Matls Domestic Water - Labor Domestic Water - Matls Plumbing Insulation - Matls Plumbing Insulation - Labor Gas Piping - Matls Gas Piping - Labor Grease Trap Plumbing Fixtures - Matls Plumbing Fixtures - Labor Coordination Drawings								

**SECTION 01 29 73**

**SCHEDULE OF VALUES - SAMPLE**

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Submittals/Close-Out Documents Supervision Clean-up								
	<b>Div. 21, 22 Plumbing - Total</b>								
	<b>Div. 23 - Mechanical</b>								
	Shop Drawings								
	As-Builts/Close-Out/ O&M Manuals								
	Chillers - Mats								
	Chillers - Labor								
	Cooling Towers - Mats								
	Cooling Towers - Labor								
	Boilers - Mats								
	Boilers - Labor								
	AHU's - Mats								
	AHU's - Labor								
	Fans - Mats								
	Fans - Labor								
	Grilles - Mats								
	Grilles - Labor								
	Ductwork - Mats								
	Ductwork - Labor								
	Pumps - Mtls								
	Pumps - Labor								
	Water Treatment - Labor								
	Water Treatment - Mats								
	Isolation - Labor								
	Isolation - Mats								
	Pipe Flex - Mats								
	Pipe Flex - Labor								
	Connections								
	Sheet Metal - Mats								
	Sheet Metal - Labor								
	Duct Insulation - Mats								
	Duct Insulation - Labor								
	Pipe Insulation - Mats								
	Pipe Insulation - Labor								
	VAV Boxes - Materials								
	VAV Boxes - Labor								
	Refrigerant Monitor - Mats								
	Refrigerant Monitor - Labor								
	Unit Heaters - Materials								
	Unit Heaters - Labor								
	Startup								
	Controls - Mats								
	Control - Labor								
	Engineer / Submittals								
	Modules / End Devices								
	Low Voltage Wiring								
	Startup								
	Close-Out Documents								
	Fire Sprinkler								
	Engineer / Submittals								
	Piping - Materials								
	Piping - Labor								
	Equipment - Materials								

**SECTION 01 29 73**

**SCHEDULE OF VALUES - SAMPLE**

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Equipment - Labor Trimout - Materials Trimout - Labor Pipe, Valves, Fittings - Labor Pipe, Valves, Fittings - Mats Misc. - Mats Insulation - Mats Insulation - Labor Sanitary Above Slab-Labor Sanitary Above Slab-Mats Storm Above Slab - Labor Storm Above Slab - Mats Gas - Labor Gas - Mats Fixtures - Labor Fixtures - Mats Permits Coordination Drawings Submittals/Close-Out Documents Supervision Clean-up								
	<b>Div. 23 Mechanical - Total</b>								
	<b>Div. 26 - Electrical</b> Mobilization+B220 Shop Drawings As-Builts/Close-Out/ O&M Manuals Underground Conduit - Labor Conduit - Matl Wire - Labor Wire - Mats Feeder Wire - Labor Feeder Wire - Mats Switches/Recpt. Switchgear - Labor Switchgear - Mats Temporary - Materials Temporary - Labor Gas Generator - Materials Gas Generator - Labor Fixtures - Labor Fixtures - Mats Communications - Labor Communications - Mats Fire Alarm - Labor Fire Alarm - Mats Security - Labor Security - Mats Low Voltage Ltng Sys-Mats Low Voltage Ltng Sys-Labor Voice System - Materials Voice System - Labor Video System - Materials Video System - Labor Data System - Materials								



**SECTION 01 29 73**

**SCHEDULE OF VALUES - SAMPLE**

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Data System - Labor Master Clock - Materials Master Clock - Labor+B277 Coordination Drawings Submittals/Close-Out Documents Supervision Clean-up								
	<b>Div. 26 - Total</b>								
	<b>Divs. 31, 32 and 33 - Earthwork, Exterior Improvements and Utilities</b>								
	Site Clearing & Grubbing								
	Building Pad - Materials								
	Building Pad - Labor								
	Paving Subgrade								
	Signage / Striping								
	Bike Racks								
	Landscaping - Materials								
	Landscaping - Labor								
	Hydro Mulch - Materials								
	Hydro Mulch - Labor								
	Irrigation - Materials								
	Irrigation - Labor								
	Earthwork								
	Finish Grading								
	Stabilization - Materials								
	Stabilization - Labor								
	Site Drainage - Materials								
	Site Drainage - Labor								
	Chain Link Fence-Materials								
	Chain Link Fence-Labor								
	Paving - Labor								
	Paving - Materials								
	Sidewalks								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	<b>Div. 31, 32 and 33 - Total</b>								
	<b>General Conditions</b>								
	Mobilization								
	Temp. Facilities								
	Final Cleaning								
	Record Documents/Close-out/ O&M Manuals								
	Supervision								
	Permits								
	Bonds								
	Insurance								
	Allowances								
	Alternates (list)								
	Change Orders								
	A. PR#								
	B. PR#								
	C. PR#								

END OF SECTION

## **SECTION 01 29 73 - SCHEDULE OF VALUES**

### **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 necessary to prepare a Schedule of Values.

#### **1.3 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  - 1. Schedule of Values.

#### **1.4 DESCRIPTION**

- A. Work Included: Provide a detailed breakdown of the agreed Contract Sum showing values allocated to each of the various parts of the work, as specified herein and in other provisions of the Contract Documents.
- B. Coordinate requirements of this Section with the requirements of the General and Supplementary Conditions of the Contract concerning Schedule of Values.

#### **1.5 QUALITY ASSURANCE**

- A. Use required means to assure arithmetical accuracy of the sums described.
- B. When so required by the Owner, provide copies of the subcontracts or other data acceptable to the Owner, substantiating the sums described.

#### **1.6 SUBMITTALS**

- A. Prior to the first Application for Payment, submit a proposed schedule of values to the School District, as outlined below:
  - 1. Meet with the School District and determine additional data, if any, required to be submitted.
    - a. Secure the School District's approval of the schedule of values prior to submitting first Application for Payment.

#### **1.7 SCHEDULE OF VALUES**

- A. Schedule of Values shall be broken down into item costs for each specification section as a minimum. After review by School District, Schedule of Values shall be broken down into further items as required. (See following list and refer to the enclosed sample.). In addition, total each Specification Division separately.
- B. Schedule of Values - Items in addition to Specification Sections.
  - 1. Mobilization.
  - 2. Clean Up.
  - 3. Building Permit.
  - 4. Bonds, Insurance.
  - 5. Mechanical Accessories.
    - a. Demolition.
  - 6. Rough-In Labor - (Electrical).
  - 7. Rough-In Material - (Electrical).
  - 8. Finish Labor - (Electrical).
  - 9. Finish Material - (Electrical).
  - 10. Allowances (listed separately).
  - 11. Record drawings and close-out documents.
  - 12. Submittals listed separately per mechanical, electrical and plumbing.

13. Roof warranty as a line item.
14. Donated items individually itemized at \$0.00 (zero dollars).

**PART 2 PRODUCTS**

**NOT USED**

**PART 3 EXECUTION**

**3.1 SCHEDULE OF VALUES**

- A. Refer to following sample.

**END OF SECTION 01 29 73**

## **SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes: Administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. General coordination procedures.
  - 2. Coordination drawings.
  - 3. Pre-install meetings.
- B. Each trade shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific trade.
- C. The Contractor shall make a reasonable attempt to interpret the Contract Documents before asking the Architect for assistance in interpretation. Requests for Information (RFIs) will not be allowed from the Contractor. The Contractor shall arrange the necessary meeting in the field with appropriate Architect's field representative(s) to obtain clarification as needed on items that may need interpretation.

#### **1.3 SUBMITTALS**

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
  - 1. Name, address, 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.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and email 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, and by each temporary telephone. Keep list current at all times.

#### **1.4 COORDINATION PROCEDURES**

- A. Coordination: Coordinate construction operations to ensure efficient and orderly installation of each part of the Work. Coordinate operations included in different Sections which depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain 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, including the School District, outlining special procedures required for coordination. Include items as required notices, reports, and list of attendees at meetings.
- 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. 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.
  9. Coordinating inspections and other jurisdictional requirements.
  10. Coordinate OFCI equipment.
  11. Action items and issue logs.
- 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 the Specifications Sections for disposition of salvaged materials that are designated as School District's property.

## 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 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:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
  2. Plenum Space: Indicate subframing for support of ceiling 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, ductwork, piping, 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 (32 mm) 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.
    - e. Floor boxes.
  8. Fire Protection System: Show the following:
    - a. Locations of standpipes, mains piping, branch lines, pipe drops, sprinkler heads, and inspector test locations.
  9. IDF/MDF Rooms: Communications and low voltage (security, data, phone, etc.) audio
  10. 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.
  11. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00 - Submittal Procedures.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
  2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
  3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
    - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
    - b. Digital Data Software Program: Drawings are available in Revit.
    - c. Contractor shall execute a data licensing agreement in the form of AIA Document AIA C106.

## 1.6 PROJECT MEETINGS

- A. 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 School District and Architect of scheduled meeting dates and times.

2. Agenda: Architect to prepare the meeting agenda and distribute the agenda to all invited attendees.
  3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including School District and Architect, within three days of the meeting.
  4. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
  5. Issue logs: Documentation element of software project management and contains a list of ongoing and closed issues of the project.
- B. Kick-off & Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to School District and Architect.
1. Conduct the conference to review responsibilities and personnel assignments.
  2. Attendees: Authorized representatives of School District, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Discuss items of significance that affect progress.
  4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
  5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
- C. Preinstallation Conferences: Conduct a preinstallation trade conference at site before each construction activity that requires coordination with other construction trades.
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: Contractor to review progress of other construction activities and preparations for the particular activity under consideration.
  3. Contractor to record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  4. Reporting: Contractor to 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.
  6. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
- 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 Substantial Completion.
  2. Attendees: Authorized representatives of School District, 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.
  4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
  5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
- E. Progress Meetings: Conduct progress meetings at weekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.

2. Attendees: In addition to representatives of School District and Architect, each Contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
  4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
    - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
    - b. Six (6) week look-ahead schedules.
  5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
- F. Coordination Meetings: Conduct coordination meetings at weekly intervals. 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 School District 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 meetings 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.
    - 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.
  3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.
  4. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

**PART 2 PRODUCTS**

**NOT USED**

**PART 3 EXECUTION**

**NOT USED**

**END OF SECTION 01 31 00**



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## **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 schedule.
  - 2. Contractor's construction schedule.
  - 3. Construction schedule updating reports.
  - 4. Daily construction reports.
  - 5. Material location reports.
  - 6. Site condition reports.
  - 7. Special reports.

#### **1.3 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  - 1. Activity.
    - a. Critical Activity.
    - b. Predecessor Activity.
    - c. Successor Activity.
  - 2. Cost Loading.
  - 3. Critical Path.
  - 4. Critical Path Method (CPM).
  - 5. Float.
  - 6. Look-Ahead Schedule.
  - 7. Milestones.
  - 8. Recovery Schedule.
  - 9. Resource Loading.

#### **1.4 SUBMITTALS**

- A. Submittal Format: Submit required submittals in the following format:
  - 1. Working electronic copy of schedule file, where indicated.
  - 2. PDF electronic file.
- B. Startup Diagram: Of size necessary to display entire network for entire construction period; show logic relationship ties for all activities
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
  - 1. Submit a working electronic copy of schedule, labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
  - 1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
  - 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
  - 3. Total Float Report: List of all activities sorted in ascending order of total float.

4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Daily Construction Reports: Submit at monthly intervals.
- G. Material Location Reports: Submit at monthly intervals.
- H. Site Condition Reports: Submit at time of discovery of differing conditions.
- I. Special Reports: Submit at time of unusual event.

## **1.5 QUALITY ASSURANCE**

- A. Pre-Scheduling Conference: Conduct conference at site. 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 stages, area separations, interim milestones, and partial School District occupancy.
  4. Review delivery dates for School District furnished products.
  5. Review schedule for Work of School District's separate contracts, if any.
  6. Review submittal requirements and procedures.
  7. Review time required for review of submittals and re-submittals.
  8. Review requirements for tests and inspections by independent testing and inspecting agencies.
  9. Review time required for Project closeout and School District startup procedures.
  10. Review and finalize list of construction activities to be included in schedule.
  11. Review procedures for updating schedule.

## **1.6 COORDINATION**

- A. 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 entities involved.
  2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

## **PART 2 PRODUCTS**

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

- A. Time is of the essence to the School District. Commence Work immediately upon issuance of the Notice to Proceed. There is a critical need for the Work to be substantially complete within the time frame identified in the Agreement.
- B. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion and date of final completion.
  1. Contract completion date shall not be changed by submission of schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each separate area or story as a separate numbered activity for each main element of the Work. Comply with the following:
  1. Activity Duration: Define activities in terms of number of days anticipated.
  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 re-submittal times indicated in Section 01 33 00 - Submittal Procedures in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
  4. Startup and Testing Time: Include number of days anticipated for startup and testing.
  5. Substantial Completion: Indicate completion of all conditions as 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 a maximum of 30 days for completion of punch list items and final completion.
  7. Inspections required by Authorities Having Jurisdiction (AHJ).
- D. Constraints: Include constraints and Work restrictions indicated in the Contract Documents and show how the sequence of the Work is affected.
1. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Coordination with existing construction.
    - b. Limitations of continued occupancies.
    - c. Uninterruptible services.
    - d. Partial occupancy before Substantial Completion.
    - e. Use of premises restrictions.
    - f. Provisions for future construction.
    - g. Seasonal variations.
    - h. Environmental control.
    - i. Rain days are to be included in project schedule; refer to Section 01 10 00 - Summary for additional weather information.
  2. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
    - a. Submittals.
    - b. Mockups.
    - c. Fabrication.
    - d. Installation.
    - e. Tests and inspections.
    - f. Adjusting.
    - g. Curing.
- E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
- F. Six (6) week, lookahead schedule: Prepare schedule indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
  2. Unanswered Requests for Information.
  3. Rejected or unreturned submittals.
  4. Notations on returned submittals.
  5. Pending modifications affecting the Work and Contract Time.
  6. Inspections by Authorities Having Jurisdiction (AHJ).
  7. Trade pre-installation conference.
- 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.
- H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

- I. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time impact analysis to demonstrate the effect of the proposed change on the overall project schedule.
- J. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
  - 1. Identification of activities that have changed.
  - 2. Changes in early and late start dates.
  - 3. Changes in early and late finish dates.
  - 4. Changes in activity durations in workdays.
  - 5. Changes in the critical path.
  - 6. Changes in total float or slack time.
  - 7. Changes in the Contract Time.

## **2.2 REPORTS**

- A. Daily Construction Reports: Prepare a daily construction report recording information concerning events at the site and submit each month to Architect:
  - 1. List of subcontractors at Project site.
  - 2. List of separate contractors at Project site.
  - 3. Approximate count of personnel at Project site.
  - 4. Rental equipment at Project site.
  - 5. Material deliveries.
  - 6. High and low temperatures and general weather conditions, including presence of rain or snow.
  - 7. Accidents.
  - 8. Meetings and significant decisions.
  - 9. Unusual events (see special reports).
  - 10. Stoppages, delays, shortages, and losses.
  - 11. Meter readings and similar recordings.
  - 12. Emergency procedures.
  - 13. Orders and requests of Authorities Having Jurisdiction (AHJ).
  - 14. Change Orders received and implemented.
  - 15. Construction Change Directives received and implemented.
  - 16. Services connected and disconnected.
  - 17. Equipment or system tests and startups.
  - 18. Partial completions and occupancies.
  - 19. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
  - 1. Material stored prior to previous report and remaining in storage.
  - 2. Material stored prior to previous report and since removed from storage and installed.
  - 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report and contact Architect Field Representative. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents to Architect Field Representative.
- D. Special Reports: Submit special reports directly to School District Owner within 24 hours of an occurrence. Distribute copies of report to parties affected by the occurrence.
  - 1. Reporting Unusual Events: When an event of an unusual and significant nature occurs at site, whether or not related directly to the Work, prepare and submit a special report. List

chain of events, persons participating, and response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise School District and Architect 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 with a pencil copy of pay application.
  - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  - 3. As the Work progresses, indicate final completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect, School District, separate contractors, testing and inspecting agencies, and interested parties identified by Contractor with a need to know schedule responsibility.
  - 1. Post copies in Project meeting rooms and temporary field offices.
  - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

**END OF SECTION 01 32 00**

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## **SECTION 01 32 33 - PHOTOGRAPHIC 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 the following:
  - 1. Preconstruction photographs.
  - 2. Periodic construction photographs.
  - 3. Final completion construction photographs.

#### **1.3 SUBMITTALS**

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph or video recording. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within three days of taking photographs.
  - 1. Digital Camera: Minimum sensor resolution of 8 megapixels.
  - 2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
  - 3. Identification: Provide the following information with each image description in file metadata tag:
    - a. Name of Project.
    - b. Name and contact information for photographer.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Date photograph was taken.
    - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
    - g. Unique sequential identifier keyed to accompanying key plan.
- C. Construction Photographs: Submit two prints of each photographic view within seven days of taking photographs.
  - 1. Format: 8 inch by 10 inch (203 mm by 254 mm) smooth surface matte prints on single weight, commercial grade photographic paper; mounted on card stock to allow a 1 inch (25 mm) wide margin punched for standard three-ring binder.
  - 2. Identification: On back of each print, provide an applied label or rubber-stamped impression with the following information:
    - a. Name of Project.
    - b. Name and contact information for photographer.
    - 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 keyed to accompanying key plan.
- D. Construction Photographs: Each photographic view within seven days of taking photographs.
  - 1. Format: Electronic (PDF, Word, or Excel)
  - 2. Identification: Provide the following information:
    - a. Name of Project.
    - b. Name and contact information for photographer.
    - 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 keyed to accompanying key plan.

#### **1.4 QUALITY ASSURANCE**

- A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

#### **1.5 USAGE RIGHTS**

- A. Obtain and transfer copyright usage rights from photographer to School District for unlimited reproduction of photographic documentation.

### **PART 2 PRODUCTS**

#### **2.1 PHOTOGRAPHIC MEDIA**

- A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.

### **PART 3 EXECUTION**

#### **3.1 CONSTRUCTION PHOTOGRAPHS**

- A. 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.
  - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- 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 file name for each image.
  - 2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.
- C. Pre-Construction Photographs: Before commencement of the Work, take photographs of site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
  - 1. Flag construction limits before taking construction photographs.
  - 2. Take minimum of 20 photographs to show existing conditions adjacent to property before starting the Work.
  - 3. Take minimum of 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
  - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Periodic Construction Photographs: Take minimum of 20 photographs monthly, coinciding with cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- E. Architect Directed Construction Photographs: From time to time, Architect will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.
- F. Time Lapse Sequence Construction Photographs: Take minimum of 20 photographs as indicated, to show status of construction and progress since last photographs were taken.
  - 1. Frequency: Take photographs monthly, coinciding with the cutoff date associated with each Application for Payment.

2. Vantage Points: Following suggestions by Architect and Contractor, photographer to select vantage points. During each of the following construction phases, take not less than two of the required shots from same vantage point each time to create a time lapse sequence.
  - a. Commencement of the Work, through completion of subgrade construction.
  - b. Above grade structural framing.
  - c. Exterior building enclosure.
  - d. Interior Work, through date of Substantial Completion.
- G. Final Completion Construction Photographs: Take minimum of 20 color photographs after date of Substantial Completion for submission as project record documents. Architect will inform photographer of desired vantage points.
  1. Do not include date stamp.
- H. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
  1. Three days' notice will be given, where feasible.
  2. In emergency situations, take additional photographs within 24 hours of request.
  3. Circumstances that could require additional photographs include, but are not limited to, the following:
    - a. Special events planned at Project site.
    - b. Immediate follow up when on site events result in construction damage or losses.
    - c. Take photographs at fabrication locations away from site.
    - d. Substantial Completion of a major phase or component of the Work.
    - e. Extra record photographs at time of final acceptance.
    - f. School District's request for special publicity photographs.

**END OF SECTION 01 32 33**

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## **SECTION 01 33 00 - SUBMITTAL 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: Requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

#### **1.3 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  - 1. Submittals.
  - 2. File Transfer Protocol (FTP).
  - 3. Portable Document Format (PDF).

#### **1.4 SUBMITTALS**

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by date required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
  - 1. Coordinate submittal schedule with list of subcontracts, schedule of values, and the Contractor's construction schedule.
  - 2. Initial Submittal: Submit concurrently with 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. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

#### **1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS**

- A. The Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by the Architect for the Contractor's use in preparing submittals.
  - 1. Upon request, the Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
    - a. The Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
    - b. Digital Drawing Software Program: Contract Drawings are available in Revit.
    - c. Contractor shall execute a data licensing agreement in the form of AIA Document AIA C106, Digital Data Licensing Agreement.
    - d. The following digital data files will be furnished for each appropriate discipline:
      - 1) Floor plans.
      - 2) Reflected ceiling plans.
- 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 submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

4. Coordinate transmittal of 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. The 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. Time for review shall commence on the Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  1. Initial Review: Allow ten (10) days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process in same manner as initial submittal.
  3. Resubmittal Review: Allow ten (10) days for review of each resubmittal.
  4. Sequential Review: Where sequential review of submittals by Architect's consultants, School District, or other parties is indicated, allow 21 days for initial review of each submittal.
  5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to the Architect and to the Architect's consultants, allow ten (10) days for review of each submittal. Submittal will be returned to the Architect before being returned to the Contractor.
- D. Electronic Submittals: Identify and incorporate information in each electronic submittal file:
  1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
  2. Name file with submittal number or other unique identifier, including revision identifier:
    - a. File name shall use Project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., SLOHSM-06 10 00.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., SLOHSM-06 10 00.01.A).
  3. Provide means for insertion to permanently record the Contractor's review and approval markings and action taken by the Architect.
  4. Transmittal Form for Electronic Submittals: Use software generated form from electronic project management software acceptable to School District, containing the following information:
    - a. Project name.
    - b. Name and address of the Architect.
    - c. Name of the Construction Manager.
    - d. Name of the Contractor.
    - e. Name of firm or entity that prepared submittal.
    - f. Names of subcontractor, manufacturer, and supplier.
    - g. Category and type of submittal.
    - h. Submittal purpose and description.
    - i. Specification Section number and title.
    - j. Specification paragraph number or drawing designation and generic name for each of multiple items.
    - k. Drawing number and detail references, as appropriate.
    - l. Location(s) where product is to be installed, as appropriate.
    - m. Related physical samples submitted directly.
    - n. Indication of full or partial submittal.
    - o. Transmittal number, numbered consecutively.
    - p. Submittal and transmittal distribution record.

- q. Other necessary identification.
- r. Remarks.
- 5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
  - a. Project name.
  - b. Number and title of appropriate Specification Section.
  - c. Manufacturer name.
  - d. Product name.
- E. Options: Identify options requiring selection by the Architect.
- F. Deviations and Additional Information: On an attached separate sheet, prepared on the 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 marked with approval notation from Architect's action stamp.
- 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 that are marked with approval notation from Architect's action stamp.

## **PART 2 PRODUCTS**

### **2.1 SUBMITTAL PROCEDURES**

- A. Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
  - 1. Certificates and Certifications Submittals: Provide 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.
- 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 published 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 product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  - 4. For equipment, include the following in addition to the above, as applicable:

- a. Wiring diagrams 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 PDF electronic file.
- C. Shop Drawings: Prepare Project specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
  1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
  2. Sheet Size: Except for templates, patterns, and similar full size drawings, submit Shop Drawings on sheet size indicated in specification section.
  3. Submit Shop Drawings in PDF electronic file.
  4. BIM File Incorporation: Develop and incorporate Shop Drawing files into Building Information Model established for Project.
    - a. Prepare Shop Drawings in same digital data software program, version, and operating system as the original Drawings.
    - b. Refer to Section 01 31 00 - Project Management and Coordination for requirements for coordination drawings.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of 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. 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.
  3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
  4. 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 School District's property, are the property of the Contractor.
  5. Samples: Submit full size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections

- of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
- a. Key Items Review Time: Submit samples to the Architect at least 30 days prior to date Contractor needs reviewed submittals returned. The Contractor shall be prepared to submit color samples on any key items in Division 09 finishes within 30 days of the award of Contract. Once samples of all key items are received, the Architect will finalize color selections.
  - b. Number of Samples: Submit three sets of Samples. The Architect will retain two Sample sets; remainder will be returned.
    - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
    - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by the 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 PDF electronic file.
- F. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00 - Project Management and Coordination.
- G. Contractor's Construction Schedule: Comply with requirements specified in Section 01 32 00 - Construction Progress Documentation.
- H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 29 00 - Payment Procedures.
- I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 40 00 - Quality Requirements.
- J. Closeout Submittals required for Substantial Completion: Comply with requirements specified in Section 01 77 00 - Closeout Procedures.
- K. Maintenance Data: Comply with requirements specified in Section 01 78 23 - Operation and Maintenance Data.
- L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- N. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.



- P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- R. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- S. 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.
- T. 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.
- U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- W. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- X. 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 the 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 the Architect.
- B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to the Contractor to be designed or certified by a design professional.
  - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

- C. BIM File Incorporation: Incorporate delegated design drawing and data files into Building Information Model established for Project.
  - 1. Prepare delegated design drawings in the same digital data software program, version, and operating system as the original Drawings.

### **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. 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, checked, and approved for compliance with the Contract Documents.

#### **3.2 ARCHITECT'S ACTION**

- A. Submittals: The Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. The Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
  - 1. Reviewed: Indicates the Architect has reviewed the submittal and takes no exceptions as submitted.
  - 2. Furnish as Corrected: Submittal is approved, provided modifications noted are properly incorporated. Resubmission is not usually necessary.
  - 3. Revise and Resubmit: Modifications are required prior to approval. Work cannot proceed until the submittal is revised and resubmitted for further review.
  - 4. Rejected: Work covered by the submittal is not complete or does not conform the Contract Documents and cannot proceed. A new submittal needs to be made according to the notations and resubmitted for approval prior to fabrication or construction.
- B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from the Architect.
- C. Incomplete submittals are not permitted, will be considered non-responsive, and will be returned for resubmittal without review.
- D. Submittals not required by the Contract Documents will be returned by the Architect without action.

**END OF SECTION 01 33 00**

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## **SECTION 01 35 16 - ALTERATION PROJECT 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: Special procedures for alteration Work.

#### **1.3 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  1. Alteration Work.
  2. Consolidate.
  3. Design Reference Sample.
  4. Dismantle.
  5. Match.
  6. Refinish.
  7. Repair.
  8. Replace.
  9. Replicate.
  10. Reproduce.
  11. Retain.
  12. Strip.

#### **1.4 REFERENCE STANDARDS**

- A. 40 CFR 745 - Lead-Based Paint Poisoning Prevention in Certain Residential Structures; current edition.
- B. ANSI A10.6 - Safety & Health Program Requirements for Demolition Operations - American National Standard for Construction and Demolition Operations; 6th Edition, 2016.
- C. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. ICC (IEBC) - International Existing Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 51B - Standard for Fire Prevention During Welding, Cutting, and Other Hot Work; 2020.
- F. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).
- G. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

#### **1.5 COORDINATION**

- A. Alteration Work Subschedule: A construction schedule coordinating sequencing and scheduling of alteration Work for entire Project, including each activity to be performed, and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for alteration Work.
  1. Schedule construction operations in sequence required to obtain best Work results.
  2. Coordinate sequence of alteration Work activities to accommodate the following:
    - a. School District's continuing occupancy of portions of existing building.
    - b. School District's partial occupancy of completed Work.
    - c. Other known Work in progress.
    - d. Tests and inspections.
  3. Detail sequence of alteration Work, with start and end dates.

4. Utility Services: Indicate how long utility services will be interrupted. Coordinate shutoff, capping, and continuation of utility services.
  5. Use of elevator and stairs.
  6. Equipment Data: List gross loaded weight, axle-load distribution, and wheel base dimension data for mobile and heavy equipment proposed for use in existing structure. Do not use such equipment without certification from Contractor's professional engineer that the structure can support the imposed loadings without damage.
- B. Pedestrian and Vehicular Circulation: Coordinate alteration Work with circulation patterns within Project building(s) and site. Some Work is near circulation patterns and adjacent to restricted areas. Circulation patterns cannot be closed off entirely and in places can be only temporarily redirected around small areas of Work. Access to restricted areas may not be obstructed. Plan and execute the Work accordingly.

#### **1.6 PROJECT MEETINGS FOR ALTERATION WORK**

- A. Preliminary Conference for Alteration Work: Before commencing alteration Work, conduct conference at site.
- B. Coordination Meetings: Conduct coordination meetings specifically for alteration Work at regular intervals. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
  1. Review items of significance that affect progress of alteration Work.
    - a. Interface requirements of alteration work with other Project Work.
    - b. Status of submittals for alteration Work.
    - c. Access to alteration work locations.
    - d. Effectiveness of fire prevention plan.
    - e. Quality and work standards of alteration Work.
    - f. Change Orders for alteration Work.
  2. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

#### **1.7 MATERIALS OWNERSHIP**

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to School District that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain School District's property.
  1. Carefully dismantle and salvage each item or object in a manner to prevent damage and protect it from damage, then promptly deliver it to School District where directed.
- B. Alteration Work Subschedule: Submit alteration Work subschedule within seven days of date established for commencement of alteration Work.
- C. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements that are to remain, including finish surfaces, that might be misconstrued as damage caused by Contractor's alteration Work operations.
- D. Alteration Work Program: Submit 30 days before Work begins.
- E. Fire Prevention Plan: Submit 30 days before Work begins.

#### **1.8 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  1. Building Code: Comply with ICC (IBC) and ICC (IEBC) for alteration Work.
  2. Fire Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire control devices during each phase or process. Coordinate plan with School District's fire protection equipment and requirements. Include fire watch personnel's training, duties, and authority to enforce fire safety.
  3. Safety and Health Standard: Comply with ANSI A10.6.

4. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a Lead-Safe Certified Firm according to 40 CFR 745 , Subpart E, and use only workers that are trained in lead safe Work practices.
5. Accessibility Requirements: Comply with applicable requirements.
  - a. Texas Accessibility Standards (TAS) .
- B. Specialist Qualifications: An experienced firm having minimum 10 years documented experience that is regularly engaged in specialty Work similar in nature, materials, design, and extent to alteration Work specified.
  1. Field Supervisor Qualifications: Full time supervisors experienced in specialty Work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on site when specialty Work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond the control of the specialist firm.
    - a. Construct new mockups of required Work whenever a supervisor is replaced.
- C. Alteration Work Program: Prepare a written plan for alteration Work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole Project alteration Work program with specific requirements of programs required in other alteration Work Sections.
  1. Dust and Noise Control: Include locations of proposed temporary dust and noise control partitions and means of egress from occupied areas coordinated with continuing on site operations and other known Work in progress.
  2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.

#### **1.9 STORAGE AND HANDLING OF SALVAGED MATERIALS**

- A. Salvaged Materials:
  1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
  2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
  3. Store items in a secure area until delivery to School District.
  4. Transport items to School District's storage area designated by School District.
  5. Protect items from damage during transport and storage.
- B. Salvaged Materials for Reinstallation:
  1. Repair and clean items for reuse as indicated.
  2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
  3. Protect items from damage during transport and storage.
  4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.
- C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction Work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction Work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.
- D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.
  1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
  2. Secure stored materials to protect from theft.
  3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 degrees F (3 degrees C) or more above the dew point.

- E. Storage Space:
  - 1. Owner will arrange for limited on site location(s) for free storage of salvaged material. Storage space does include security and climate control for stored material.
  - 2. Arrange for off site locations for storage, protection, and insurance coverage of salvaged material that cannot be stored and protected on site.

#### **1.10 FIELD CONDITIONS**

- A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of [measured drawings] [preconstruction photographs] [and] [preconstruction videotapes].
  - 1. Comply with requirements specified in Section 01 32 00 - Construction Progress Documentation.
- B. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling Work.
- C. School District's Removals: Before beginning alteration Work, verify in correspondence with School District that the following items have been removed:
- D. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including temporary protection, by 12 inches (300 mm) or more.

#### **PART 2 PRODUCTS**

##### **NOT USED**

#### **PART 3 EXECUTION**

##### **3.1 PROTECTION**

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

3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.
- E. Existing Drains: Prior to the start of Work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin Work in an area until the drainage system is functioning properly.
  1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration Work.
  2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- F. Existing Roofing: Prior to the start of Work in an area, install roofing protection.

### **3.2 PROTECTION FROM FIRE**

- A. Follow fire prevention plan and the following:
  1. Comply with NFPA 241 requirements unless otherwise indicated.
  2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate Work.
    - a. If combustible material cannot be removed, provide fire blankets to cover materials.
- B. Heat Generating Equipment and Combustible Materials: Comply with procedures while performing Work with heat generating equipment or combustible materials, including welding, torch cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:
  1. Obtain School District's approval for operations involving use of open flame or welding or other high heat equipment. Use of open plume equipment is not permitted. Notify School District at least 72 hours before each occurrence, indicating location of such Work.
  2. As far as practicable, restrict heat generating equipment to shop areas or outside the building.
  3. Do not perform Work with heat generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
  4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
  5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
  6. Fire Watch: Before Working with heat generating equipment or combustible materials, station personnel to serve as a fire watch at each location where Work is performed. Firewatch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:
    - a. Train each fire watch in the proper operation of fire control equipment and alarms.
    - b. Prohibit firewatch personnel from other Work that would be a distraction from firewatch duties.
    - c. Cease Work with heat generating equipment whenever fire watch personnel are not present.
    - d. Have fire watch personnel perform final fire safety inspection each day beginning no sooner than 30 minutes after conclusion of Work in each area to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
    - e. Maintain fire watch personnel in each area site until 60 minutes after conclusion of daily Work.
- C. Fire Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each Work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.



- D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.
  - 1. Remove temporary guards at the end of Work shifts, whenever operations are paused, and when nearby Work is complete.

### **3.3 PROTECTION DURING APPLICATION OF CHEMICALS**

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

### **3.4 ALTERATION WORK**

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

**END OF SECTION 01 35 16**

## **SECTION 01 35 43.13 - ENVIRONMENTAL PROCEDURES FOR HAZARDOUS MATERIALS**

### **PART 1 GENERAL**

#### **1.1 NOTICE OF HAZARDOUS WASTE OR MATERIALS**

- A. The Contractor shall give notice in writing to the School District, the Construction Manager (CM), and the Architect promptly, before any of the following conditions are disturbed, and in no event later than 24 hours after first observance, of any:
  - 1. Material that the Contractor believes may be a material that is hazardous waste or hazardous material, as defined in Section 25117 of the Health and Safety Code, that is required to be removed to a Class I, Class II, or Class III disposal site in accordance with provisions of existing law, or
  - 2. Other material that may present a substantial danger to persons or property exposed thereto in connection with Work at the site.
- B. The Contractor's written notice shall indicate whether the hazardous waste or material was shown or indicated in the Contract Documents to be within the scope of Work, and whether the materials were brought to the site by the Contractor, Subcontractors, suppliers, or anyone else for whom the Contractor is responsible. As used in this Section, the term "hazardous materials" shall include, without limitation, asbestos, lead, polychlorinated biphenyl (PCB), petroleum and related hydrocarbons, and radioactive material.
- C. In response to the Contractor's written notice, the School District shall investigate the identified conditions.
- D. If the School District determines that conditions do not involve hazardous materials or that no change in terms of Contract is justified, the School District shall so notify Contractor in writing, stating reasons. If the School District and the Contractor cannot agree on whether conditions justify an adjustment in Contract Price or Contract Time, or on the extent of any adjustment, Contractor shall proceed with the Work as directed by the School District.
- E. If after receipt of notice from the School District, the Contractor does not agree to resume Work based on a reasonable belief it is unsafe, or does not agree to resume Work under special conditions, then School District may order such portion of Work that is in connection with such hazardous condition or such affected area to be deleted from the Work, or performed by others, or the School District may invoke its rights to terminate the Contract in whole or in part. The School District will determine entitlement to or the amount or extent of an adjustment, if any, in Contract Price or Contract Time as a result of deleting such portion of Work or performing the Work by others.
- F. If the Contractor stops Work in connection with any hazardous condition and in any area affected thereby, the Contractor shall immediately redeploy its workers, equipment, and materials, as necessary, to other portions of the Work to minimize delay and disruption.

#### **1.2 ADDITIONAL WARRANTIES AND REPRESENTATIONS**

- A. The Contractor represents and warrants that the Contractor, the Contractor's employees, and the Subcontractors and their employees, shall at all times have the required levels of familiarity with the site and the Work, training, and ability to comply fully with all applicable legal and contractual requirements for safe and expeditious performance of the Work, including whatever training is or may be required regarding the activities to be performed (including, but not limited to, all training required to address adequately the actual or potential dangers of Contract performance).
- B. The Contractor represents and warrants that the Contractor, the Contractor's employees, and the Subcontractors and their employees, shall at all times have and maintain in good standing any and all certifications and licenses required by applicable federal, state, and other governmental and quasi-governmental requirements applicable to the Work.
- C. The Contractor represents and warrants that he or she has studied carefully all requirements of the Specifications regarding procedures for demolition, hazardous waste abatement, or safety

practices specified in the Contract, and prior to submitting its bid has either (a) verified to its satisfaction that the specified procedures are adequate and sufficient to achieve the results intended by the Contract Documents, or (b) by way of approved "or equal" request or request for clarification and written Addenda, secured changes to the specified procedures sufficient to achieve the results intended by the Contract Documents. The Contractor accepts the risk that any specified procedure will result in a completed Project in full compliance with the Contract Documents.

### **1.3 MONITORING AND TESTING**

- A. The School District reserves the right, in its sole discretion, to conduct air monitoring, earth monitoring, Work monitoring, and any other tests (in addition to testing required under the agreement or applicable law), to monitor Contract requirements of safe and statutorily compliant work methods and (where applicable) safe re-entry level air standards under state and federal law upon completion of the job, and compliance of the Work with periodic and final inspection by public and quasi-public entities having jurisdiction.
- B. The Contractor acknowledges that the School District has the right to perform, or cause to be performed, various activities and tests including, but not limited to, pre-abatement, during abatement, and post-abatement air monitoring, that the School District shall have no obligation to perform said activities and tests, and that a portion of said activities and tests may take place prior to the completion of the Work by the Contractor. In the event the School District elects to perform these activities and tests, the Contractor shall afford the School District ample access to the site and all areas of the Work as may be necessary for the performance of these activities and tests. The Contractor will include the potential impact of these activities or tests by the School District in the Contract Price and the Scheduled Completion Date.
- C. Notwithstanding the School District's rights granted by this paragraph, Contractor may retain his or her own industrial hygiene consultant at the Contractor's own expense and may collect samples and may perform tests including, but not limited to, pre-abatement, during abatement, and post-abatement personal air monitoring: The School District reserves the right to request documentation of all such activities and tests performed by the Contractor relating to the Work and Contractor shall immediately provide that documentation upon request.

### **1.4 COMPLIANCE WITH LAWS**

- A. The Contractor shall perform safe, expeditious, and orderly work in accordance with the best practices and the highest standards in the hazardous waste abatement, removal, and disposal industry, the applicable law, and the Contract Documents including, but not limited to, all responsibilities relating to the preparation and return of waste shipment records, all requirements of the law, delivering of all requisite notices, and obtaining all necessary governmental and quasi-governmental approvals.
  - 1. The Contractor represents that they are familiar with, and shall comply with, all laws applicable to the Work or completed Work including, but not limited to, all federal, state, and local laws, statutes, standards, rules, regulations, and ordinances applicable to the Work relating to:
    - a. The protection of public health and welfare, and environment,
    - b. Storage, handling, or use of asbestos, PCB, lead, petroleum-based products or other hazardous materials,
    - c. The generation, processing, treatment, storage, transport, disposal, destruction, or other management of asbestos, PCB, lead, petroleum, or hazardous waste materials or other waste materials of any kind, and

### **1.5 DISPOSAL**

- A. The Contractor has the sole responsibility for determining current waste storage, handling, transportation, and disposal regulations for the job site and for each waste disposal facility. The Contractor must comply fully at its sole cost and expense with these regulations and any applicable law. The School District may, but is not obligated to, require submittals with this information for it to review consistent with the Contract Documents.

- B. The Contractor shall develop and implement a system acceptable to the School District to track hazardous waste from the site to disposal, including appropriate "Hazardous Waste Manifests" on the EPA form, so that School District may track the volume of waste it put in each landfill and receive from each landfill a certificate of receipt.
- C. The Contractor shall provide the School District with the name and address of each waste disposal facility prior to any disposal, and the School District shall have the express right to reject any proposed disposal facility. The Contractor shall not use any disposal facility to which School District has objected. The Contractor shall document actual disposal or destruction of waste at a designated facility by completing a disposal certificate or certificate of destruction forwarding the original to the School District.

#### **1.6 PERMITS**

- A. Before performing any of the Work, and at such other times as may be required by applicable law, the Contractor shall deliver all requisite notices and obtain the approval of all governmental and quasi-governmental authorities having jurisdiction over the Work. For example, before commencing any work in connection with the Work involving asbestos-containing materials, PCBs, or other hazardous materials subject to regulation, the Contractor agrees to provide the required notice of intent to renovate or demolish to the appropriate state or federal agency having jurisdiction, by certified mail, return receipt requested, or by some other method of transmittal for which a return receipt is obtained, and to send a copy of that notice to the School District. The Contractor shall not conduct any Work involving asbestos-containing materials or PCBs unless the Contractor has first confirmed that the appropriate agency having jurisdiction is in receipt of the required notification. All permits, licenses, and bonds that are required by governmental or quasi-governmental authorities, and all fees, deposits, tap fees, off-site easements, and asbestos and PCB disposal facilities expenses necessary for the prosecution of the Work, shall be procured and paid for by the Contractor. The Contractor shall give all notices and comply with all applicable laws bearing on the conduct of the Work as drawn and specified. If the Contractor observes or reasonably should have observed that Drawings and Specifications and other Contract Documents are at variance therewith, it shall be responsible for promptly notifying the School District in writing of such fact. If the Contractor performs any Work contrary to applicable laws, it shall bear all costs arising therefrom.
- B. The Contractor shall submit evidence satisfactory to the School District that he or she and any disposal facility:
  - 1. Has obtained all required permits, approvals, and the like in a timely manner both prior to commencement of the Work and thereafter as and when required by applicable law, and
  - 2. Is in compliance with all such permits, approvals, and the regulations.
- C. In the case of any permits or notices held in the School District's name or of necessity to be made in the School District's name, the School District shall cooperate with the Contractor in securing the permit or giving the notice, but the Contractor shall prepare for the School District review and execution upon approval, all necessary applications, notices, and other materials.

#### **1.7 INDEMNIFICATION**

- A. To the extent permitted by law, the indemnities and limitations of liability expressed throughout the Contract Documents apply with equal force and effect to any claims or liabilities imposed or existing by virtue of the removal, abatement, and disposal of hazardous waste. This includes, but is not limited to, liabilities connected to the selection and use of a waste disposal facility, a waste transporter, personal injury, property damage, loss of use of property, damage to the environment or natural resources, or "disposal" and "release" of materials associated with the Work (as defined in 42 U.S.C. § 9601 et seq.).

#### **1.8 TERMINATION**

- A. The School District shall have an absolute right to terminate for default immediately without notice and without an opportunity to cure should the Contractor knowingly or recklessly commit a material breach of the terms of the Contract Documents, or any applicable law, on any matter involving the exposure of persons or property to hazardous waste. If, however, the breach of

contract exposing persons or property to hazardous waste is due solely to an ordinary, unintentional, and non-reckless failure to exercise reasonable care, then the procedures for termination for cause shall apply without modification.

**PART 2 PRODUCTS**

**NOT USED**

**PART 3 EXECUTION**

**NOT USED**

**END OF SECTION 01 35 43.13**

## **SECTION 01 35 46 - INDOOR AIR QUALITY 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 indoor air quality management during construction operations.

#### **1.3 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  - 1. Sustainable Definitions: ASTM E2114 Standard Terminology for Sustainability Relative to the Performance of Buildings.
    - a. Adequate Ventilation.
    - b. Formaldehyde.
      - 1) Urea Formaldehyde.
      - 2) Phenolformaldehyde.
    - c. Hazardous Materials.
    - d. Indoor Air Quality (IAQ).
    - e. Interior Final Finishes.
    - f. MERV.
    - g. Packaged Dry Products.
    - h. Wet Products.

#### **1.4 REFERENCE STANDARDS**

- A. ANSI/SMACNA 008 - IAQ Guidelines for Occupied Buildings Under Construction; Current Edition.
- B. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017, with Addendum (2022).
- C. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. ASTM E2114 - Standard Terminology for Sustainability; 2023 Edition, April 1, 2023.

#### **1.5 PERFORMANCE REQUIREMENTS**

- A. Develop and utilize an indoor air quality (IAQ) management plan to limit indoor contamination during construction activities until Date of Substantial Completion. Coordinate with environmental quality management plan.
  - 1. Identify potential construction-related outdoor and indoor contaminants.
  - 2. Identify possible means of contaminant spread.
  - 3. Identify reasonable control options for containing contaminants.
- B. Indoor Environmental Quality: Comply with ASHRAE Std 62.1 to reduce indoor environmental quality issues resulting from contaminants during and after construction until Date of Substantial Completion.
  - 1. Identify methods for controlling air contaminants, such as odors and irritants generated during the Work based on ANSI/SMACNA 008 SMACNA IAQ Guidelines for Occupied Buildings under Construction.
  - 2. Avoid use of materials high in pollutants, such as volatile organic compounds (VOCs) or toxins. Refer to Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions for applicable limits.
  - 3. Avoid entrainment of pollutants into ventilation air path.
  - 4. Sufficiently ventilate enclosed areas.

5. Protect organic matter and materials against mold, insect infestation, or absorption of odors.
6. Sequence construction activities to prevent absorption of contaminants by building materials.
7. Limit use of building ventilation system during construction activities. For systems that are used during construction activities, utilize filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 at each return air grille complying with ASHRAE Std 52.2.
  - a. Cover diffusers, registers, grilles, and open ducts during construction to prevent dust and odors from entering ventilation system.
  - b. Replace filtration media prior to Date of Substantial Completion with media having Minimum Efficiency Reporting Value (MERV) of 13, unless noted otherwise. Refer to Division 23 and Mechanical Drawings.
- C. VOC Content Limitations Requirements: Utilize materials and products complying with VOC content limitations for low emitting materials as indicated in Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- D. Restricted Components for Paint and Coatings: EPA prohibited components in the formulation of paints and coatings.
- E. Mold, Mildew, and Moisture Stains: Materials that evidence growth of molds or mildew or moisture stains are not permitted, including both stored and installed materials. Immediately remove from site and dispose of properly.

## 1.6 SUBMITTALS

- A. IAQ Management Plan: Minimum 10 days before commencement of the Work, prepare and submit an IAQ Management Plan including, but not limited to, the following:
  1. Procedures for control of emissions during construction.
  2. Identify schedule for application of interior finishes.
  3. Procedures for moisture control during construction.
  4. Identify porous materials and absorptive materials.
  5. Identify schedule for inspection of stored and installed absorptive materials.
  6. Revise and resubmit Plan as required by School District. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations.
- B. Product Data: Submit product data for filtration media used during construction and during operation. Include Minimum Efficiency Reporting Value (MERV).
  1. Submit air pressure difference maps for each mode of operation of HVAC.

## 1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
  1. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE): Comply with requirements applicable to air quality control.
    - a. ASHRAE Std 55 Thermal Environmental Conditions for Human Occupancy.
    - b. ASHRAE Std 62.1 Ventilation for Acceptable Indoor Air Quality.
    - c. ASHRAE Std 129 Measuring Air Change Effectiveness.
    - d. ASHRAE Std 90.1 I-P: Energy Standard for Buildings Except Low Rise Residential.
  2. SMACNA IAQ Guidelines for Occupied Buildings under Construction.
- B. Pre-Construction Conference: Conduct conference to review methods and procedures related to environmental quality procedures and responsibilities. Review Construction Environmental Program with staff and subcontractors.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Air Infiltration Media: Minimum Efficiency Reporting Value (MERV) as determined by ASHRAE Std 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, unless noted otherwise. Refer to Division 23 specifications.
- B. Cleaning Materials: Low toxic and low emitting spot removers and cleaning agents for surfaces, equipment, and workers' personal use. Use HEPA filters equipped vacuum cleaners for the final cleaning.

## **PART 3 EXECUTION**

### **3.1 IMPLEMENTATION**

- A. Implement, monitor, and enforce IAQ Management Plan during demolition and construction activities until date of Final Completion.
1. Control dust particles, aerosols, and gaseous byproducts from demolition and construction activities, processing, and preparation of materials.
  2. Perform particulate control as Work proceeds and whenever particulate nuisance or hazard occurs
  3. Potential sources of emissions include the following:
    - a. Environmental Tobacco Smoke: Lighted cigarettes, cigars, pipes, vapes.
    - b. Combustion Contaminants: Furnaces, generators, gas or kerosene space heaters, tobacco products, outdoor air, vehicles.
    - c. Biological Contaminants: Wet or damp materials, cooling towers, humidifiers, cooling coils or drain pans, damp duct insulation or filters, condensation, re-entrained sanitary exhausts, bird droppings, cockroaches or rodents, dustmites on upholstered furniture or carpeting, body odors.
    - d. Volatile Organic Compounds (VOC): Paints, stains, varnishes, solvents, pesticides, adhesives, wood preservatives, waxes, polishes, cleansers, lubricants, sealants, dyes, air fresheners, fuels, plastics, copy machines, printers, tobacco products, perfumes, dry cleaned clothing.
    - e. Formaldehyde: Particle board, plywood, cabinetry, insulation, furniture, fabrics.
    - f. Soil Gases (Radon, Sewer Gas, VOC, Methane): Soil and rock (radon), sewer drain leak, dry drain traps, leaking underground storage tanks, land fill.
    - g. Pesticides: Termiticides, insecticides, rodenticides, fungicides, disinfectants, herbicides.
    - h. Particles and Fibers: Printing, paper handling, smoking and other combustion, outdoor sources, deterioration of materials, construction/renovation, vacuuming, insulation.
- B. Housekeeping and Pest Management Procedures: During demolition and construction, maintain project and building products and systems to prevent contamination of building spaces.
1. Designate area for food storage and consumption. Immediately dispose of food or food residues after meals or breaks in appropriate waste or recycling containers.
  2. Minimize entry of dirt into enclosed building with installed finishes with walk-off grilles or mats at entrances. Clean entry grilles or mats daily.
  3. Sweep using dust reducing wax based sweeping compounds.
  4. Keep materials clean and stored neatly on dunnage or pallets required by manufacturer.
  5. Inspect and clean coils, fans, and air-handler chambers including return air chambers prior to start up, final testing, commissioning, and air testing.

### **3.2 EMISSIONS CONTROL**

- A. During construction operations, follow the recommendations in SMACNA IAQ Guidelines for Occupied Buildings under Construction.
- B. 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.
- C. Source Control: Control odors from construction activities, processing, and preparation of materials from potentially noxious materials. Identify and employ control measures complying with SMACNA guidelines.
1. Smoking and tobacco materials are not permitted in building.
  2. Vaping is not permitted in building.
  3. Use of gasoline or fuel fired equipment is not permitted inside enclosed building.
  4. Keep wet processes within enclosed building to a minimum.
  5. Protect chase and wallboard materials from water. Remove and replace damaged materials.
  6. Use low-emission materials and chemicals.
  7. Perform cleaning involving chemicals outside building to the greatest extent possible.
  8. Remove waste daily to the appropriate recycle container.
  9. Treat mold growth according to the procedures recommended by the EPA.
  10. Clean inside of walls at base track to remove excess materials and dirt with vacuum prior to enclosing wall.
  11. HEPA vacuum concrete floors before installation of floor covering materials.
  12. Do not enclose, hide, or paint over mold or chemical contamination.
- D. 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 degrees F minimum to 90 degrees 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 Minimum Efficiency Reporting Value (MERV) of 8 as determined by ASHRAE Std 52.2 during construction. Coordinate with Work of mechanical specifications.
- E. Hydrocarbons and Carbon Monoxide Emissions from Equipment: Control emissions to comply with federal, state, and local allowable limits. For potentially noxious materials, identified and employ control measures complying with SMACNA guidelines.
- F. Monitoring Indoor Air Quality: Monitor air areas affected by construction activities.
- G. HVAC System: To extent possible, isolate or shut down return side of HVAC system during construction activities.
1. HVAC System Protection: When ventilation system is operational, provide temporary, replaceable filters and seal return air openings.
    - a. Comply with recommendations of SMACNA IAQ "Guideline for Occupied Buildings Under Construction."
    - b. Keep air handling equipment, ducts, and accessories clean during transportation, storage and assembly.
    - c. Wrap lined, spiraled, and assembled ducts and protect from dirt and water during transportation and storage.
    - d. Keep insulation and lined ducts dry. Remove and replace insulation that becomes wet.
    - e. Keep fiberglass duct board in air handlers and bases dry and clean. Coat exposed fiberglass subject to erosion with sealer to prevent entry of raw fiberglass into air stream.
    - f. Do not permit water to stand on mechanical equipment.
    - g. Cover and seal open ends of installed duct and equipment to prevent the entry of dirt.

- h. Wrap zone boxes and seal from dirt and water before installation. Seal openings in installed zone boxes until permanently connected to ductwork.
- i. Cover dampers and attenuators into open chases and ducts to reduce dirt entry.
- j. Do not start air handlers without MERV 8 filtration at each return grille. Upon system activation, install sheet media on return openings and filters in zone box plenum openings.
  - 1) Monitor and change media filters as necessary to prevent the entry of dirt into the system.
  - 2) Remove temporary media after building flush out and before occupancy.
- k. Do not permit use of return air system during gypsum board installation, sanding or painting operations.
- l. Keep building under a positive pressure to the extent possible.
- m. Keep chase dampers closed until the system is activated.
- n. Complete the initial mechanical checklists at system startup.
- o. Replace final filters with new MERV 13 filters before flush out or occupancy.
- 2. Inspect ductwork for refuse, contaminants, moisture, and foreign contamination prior to commissioning by Owner. Notify Owner of satisfactory inspection prior to beginning of commissioning.
- 3. HVAC System Cleaning: Clean coils, media filters, and fans before performing testing and balancing procedures and before conducting air quality tests or flush out.
- H. Pathway Interruption: Isolate areas of Work necessary to prevent contamination of clean or occupied spaces. Provide pressure differentials or physical barriers to protect clean or occupied spaces.
  - 1. Humidity Conditions: During rain or high humidity conditions, cool air supply from coils to 55 degrees F or stop air handler stopped to prevent moist air entry into building. Do not permit exhaust fans to draw moist air into building.
  - 2. Cover return air dampers and openings with filter media during construction operations.
- I. Scheduling: Schedule construction operations involving wet and odorous materials and products prior to packaged dry products or odor absorbent materials and products to reduce absorption of VOCs by porous materials.
  - 1. To the extent possible, group contaminating operations.
  - 2. Replace materials and products directly exposed to moisture through precipitation, plumbing leaks, or condensation from the HVAC system that are susceptible to microbial contamination.

### 3.3 MOISTURE CONTROL

- A. Housekeeping:
  - 1. Keep materials dry. Protect stored on site and installed absorptive materials from moisture damage.
  - 2. Verify installed materials and products are dry prior to sealing and weatherproofing the building envelope.
  - 3. Install interior absorptive materials after building envelope is sealed and weatherproofed.
- B. Inspections: Document and report results of inspections; state whether inspections indicate satisfactory conditions.
  - 1. Examine materials for dampness as they arrive. When acceptable to Architect and School District, dry damp materials completely prior to installation; otherwise, reject materials that arrive damp.
  - 2. Examine materials for mold upon arrival; and reject materials contaminated with mold.
  - 3. Inspect stored and installed absorptive materials regularly for dampness and mold growth. Inspect periodically and after each rain event.
    - a. When stored on site or installed absorptive materials become wet, notify Architect and inspect for damage. If acceptable to Architect and School District, dry completely prior to closing in assemblies; otherwise, remove and replace with new materials.

4. Site Drainage: Verify final grades of site Work and landscaping drain surface water and ground water away from the building.
  5. Weatherproofing: Inspect moisture control materials during installation. Include the following:
    - a. Air Barrier: Verify air barrier is installed without punctures and/or other damage. Verify air barrier is completely sealed.
    - 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: Coordinate inspections with requirements in Division 07.
  6. Plumbing: Verify pressure test of pipes and drains is performed prior to closing in and insulating lines.
  7. HVAC: Inspect HVAC system in accordance with mechanical specifications to verify:
    - 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 to endure absorptive materials, including but not limited to porous insulations, paper faced gypsum board, ceiling tile, and finish flooring, are not installed until building is enclosed and materials can be protected from rain and construction related water.
  2. Schedule installation of moisture control materials, including but not limited to air barriers, flashing, exterior sealants and roofing, to reduce exposure of the elements.
- D. Testing for Moisture Content: Test moisture content of porous materials and absorptive materials to ensure materials are dry before sealing 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. Moisture test in accordance with one or more of the following; unless otherwise indicated, acceptable upper limits for concrete are less than 4 percent top inch; less than 85 percent headspace RH; less than 3 lbs/1000 sq. ft./day:
    - a. ASTM D4263 Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
    - b. ASTM F1869 Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
    - c. ASTM F2170 Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes.
  2. Wood: Moisture test in accordance with ASTM D4444 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 and less than 15 percent at surface.
  3. Gypsum Board, Plaster, Insulation, and Absorptive materials: Moisture test with a Pinless Moisture Meter to assess patterns of moisture, if any.
- E. Testing for Moisture Penetration:
1. Windows: Test in accordance with ASTM E1105 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; unless otherwise indicated, acceptable upper limits are no leakage for 15 minutes.
  2. Horizontal Waterproofing (other than roofing): Test in accordance with ASTM D5957 Standard Guide for Flood Testing Horizontal Waterproofing Installations; acceptable upper

- limits are no leakage for 15 minutes.
3. Masonry: Test in accordance with ASTM C1601 Standard Test Method for Field Determination of Water Penetration of Masonry Wall Surfaces; acceptable upper limits are no leakage for 15 minutes.
  4. Exterior Walls:
    - a. Air Tightness of the Enclosure Test: ASTM E779 Standard Test Method for Determining Air Leakage Rate by Fan Pressurization or ASTM E1827 Standard Test Methods for Determining Air tightness of Buildings Using an Orifice Blower Door. Refer to cladding specification sections for acceptable upper limits of leakage.
    - b. Water Leakage: Review in accordance with ASTM E2128 Standard Guide for Evaluating Water Leakage of Building Walls.
- F. Testing for Support of Microbial Growth: Test and report in accordance with ASTM D6329 Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers. Indicate susceptibility of product or material to colonization and amplification of microorganisms. Identify microorganisms and conditions of testing.
1. Normal Conditions: Perform testing at 35 degrees C and 50 percent relative humidity.
  2. Extreme Conditions: Perform worst case scenarios screening tests by providing an atmosphere where environmental conditions may be favorable for microbial growth.
  3. Perform testing for the following:
    - a. Fireproofing material on appropriate substrate.
    - b. Ceiling tile.
    - c. Wallcovering.

### 3.4 SPECIFICATION REQUIREMENTS

- A. Refer to individual specification sections for details.
1. Division 06 Wood, Plastics, and Composites:
    - a. Utilize fiberboard that is urea formaldehyde free and does not exceed ANSI A208.1 emission standard of 0.20 ppm of formaldehyde.
    - b. Structural Fiberboard (OSB, MDF, and Particleboard): Utilize structural fiberboard that maximizes post-consumer waste material.
    - c. Plastic Laminate: Install plastic laminate with water based, urea formaldehyde free, low VOC (volatile organic compound) adhesive.
    - d. Millwork and Casework Adhesives: Provide water based, urea formaldehyde free, low VOC adhesives.
    - e. Transparent Wood Finish Systems: Utilize waterborne acrylic sealers and finish coats.
    - f. Chromated Copper Arsenate (CCA): Use of CCA as a wood treating material is not permitted; use of ammonium copper quat (ACQ) is acceptable.
    - g. Cast Resin (Solid Surface) Countertops: Provide water based, zero or low VOC silicone sealant.
  2. Division 07 Thermal and Moisture Protection:
    - a. Building Insulation:
      - 1) Insulation materials manufactured using chlorofluorocarbons (CFCs) are prohibited.
      - 2) Extruded Polystyrene Insulation (XPS) manufactured with chlorofluorocarbon (CFC) blowing agent is prohibited.
      - 3) Utilize XPS with recycled content and manufactured with EPA approved blowing agents.
      - 4) Fiberglass Batt Insulation, Fiberglass Board Insulation, and Mineral Wool Insulation: Utilize batt and board insulation with recycled material.
      - 5) Mineral Wool Fire Safing Insulation: Utilize fire safing insulation having recycled material.
    - b. Sealants:

- 1) Sealants: Use of sealants containing mercury, butyl rubber, neoprene, SBR (styrene butadiene rubber), or nitrile is prohibited.
  - 2) Silicone Sealants: Use silicone sealants having zero or low VOC content.
  - 3) Polyurethane Sealants: Use of polyurethane sealants containing mercury are prohibited. Use polyurethane sealants having low VOC content.
  - 4) Compressible Foam Joint Filler: Use of polyester polyurethane foam impregnated with neoprene rubber or acrylic ester styrene copolymer manufactured with CFC blowing agents is prohibited.
  - 5) Sealants formulated with aromatic solvents (organic solvent with a benzene ring in its molecular structure), fibrous talc, or asbestos, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium, or associated components are prohibited.
3. Division 08 Openings:
- a. Glass and Glazing:
    - 1) Sealants and Glazing Compounds: Utilize low VOC content.
    - 2) Sealants and glazing compounds formulated with aromatic solvents (organic solvent with a benzene ring in its molecular structure), fibrous talc, or asbestos, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium, or their components are prohibited.
4. Division 09 Finishes:
- a. Gypsum Drywall:
    - 1) Gypsum Board and Accessories: Utilize gypsum board containing recycled or synthetic gypsum and facing paper manufactured from recycled newsprint including post-consumer waste.
    - 2) Sound Attenuation Blanket:
      - (a) Glass Fiber Blanket: Use sound blanket with recycled material content.
      - (b) Cotton Blankets: Use sound blankets with recycle natural cotton fiber content.
      - (c) Mineral Fiber Blankets: Utilize sound blanket with recovered material.
    - 3) Joint Compound: Utilize dustless joint compound having low VOC content.
    - 4) Multilayer Gypsum Board Applications: Screw attached gypsum board; laminated with adhesives is prohibited.
    - 5) Thoroughly clean and remove silica/gypsum dust upon completion of gypsum drywall installation, including, but not limited to, components in plenum spaces, including tops of pipes and sills, and insides and outsides of ducts.
    - 6) Joint Tape: Utilize paper joint tape; fiberglass tape is prohibited.
    - 7) Steel Studs, Runners, and Channels for Framing: Utilize components with recycled steel content.
  - b. Acoustic Panel Ceilings:
    - 1) Utilize ceiling panels having recycled material and finished with water based low VOC paint.
    - 2) Suspension Systems: Provide steel components having recycled material.
  - c. Resilient Flooring:
    - 1) Adhesives: Utilize adhesives having low VOC content.
  - d. Carpet:
    - 1) Carpet: Provide carpet products from manufacturer offering a reclamation program or operating recycling program which extracts component materials for reuse and/or reclaims inherent energy, and does not contribute significantly to land fill.
    - 2) Adhesive: Utilize low VOC manufacturer recommended carpet adhesive and install in accordance with manufacturer recommended frame or perimeter adhesive pattern method.
    - 3) Seam Sealer: Utilize carpet manufacturer recommended low VOC seam sealer or recommend heat welded seaming.

- e. Field Paint and Polychromatic Finish Coating: Refer to Section 09 90 00 - Painting and Coating.
  - 1) Use of water based paints formulated with aromatic hydrocarbons (organic solvent with a benzene ring in its molecular structure), formaldehyde, halogenated solvents, mercury or mercury compounds, or tinted with pigments of lead, cadmium, chromium VI and their oxides is prohibited.
  - 2) Provide water based paints having zero or low VOC content and flash point of 61 degrees C or greater.
  - 3) Where necessary to use solvent based paints, provide paints formulated for compliant VOC emissions; formulated without formaldehyde, halogenated solvents, mercury or mercury compounds, or tinted with pigments of lead, cadmium, chromium VI and their oxides; and not formulated with more than 10% aromatic hydrocarbons by weight.
  - 4) Provide paints and coatings having zero or low VOC content and not formulated with aromatic hydrocarbons (organic solvent with a benzene ring in its molecular structure) formaldehyde, halogenated solvents, mercury or mercury compounds, or tinted with pigments of lead, cadmium, chromium VI and their oxides.
    - (a) High performance water based acrylic coatings.
    - (b) Pigmented acrylic sealers.
    - (c) Catalyzed epoxy coatings.
    - (d) High performance silicone grafted epoxy coatings.
- 5. Division 22 Plumbing:
- 6. Division 23 Mechanical:
  - a. Basic Mechanical Materials and Methods: Use zero or low VOC sealants.
  - b. Mechanical Insulation: Utilize mechanical sound insulation materials within duct having impervious, nonporous coating that prevents dust from accumulating in insulating materials.
  - c. Metal Ductwork: Utilize zero or low VOC sealants.

**END OF SECTION 01 35 46**

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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. 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 assurance and 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 other quality assurance and quality control procedures that facilitate compliance with Contract Document requirements.
  - 3. Requirements for Contractor to provide quality assurance and quality control services required by Architect, School District, or authorities having jurisdiction are not limited by provisions.
  - 4. Specific test and inspection requirements are not specified in this Section.

#### **1.3 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  - 1. Experienced.
  - 2. Installer/Applicator/Erector.
  - 3. Mockups.
    - a. Laboratory Mockups.
    - b. Integrated Exterior Mockups.
    - c. Room Mockups.
  - 4. Quality Assurance Services.
  - 5. Quality Control Services.
  - 6. Testing:
    - a. Field Quality Control Testing.
    - b. Preconstruction Testing.
    - c. Product Testing.
    - d. Source Quality Control Testing.
  - 7. Testing Agency.
- B. 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).

#### **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 SUBMITTALS**

- A. Shop Drawings: Submit 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.
- B. 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 wind resisting component listed in the wind force resisting system quality assurance plan prepared by Architect.
- C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
  - 1. Specification Section number and title.
  - 2. Entity responsible for performing tests and inspections.
  - 3. Description of test and inspection.
  - 4. Identification of applicable standards.
  - 5. Identification of test and inspection methods.
  - 6. Number of tests and inspections required.
  - 7. Time schedule or time span for tests and inspections.
  - 8. Requirements for obtaining samples.
  - 9. Unique characteristics of each quality control service.

### **1.6 REPORTS AND DOCUMENTS**

- A. Test and Inspection Reports: Prepare and submit certified written reports specified. 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. Record of temperature and weather 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.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
  - 1. Name, address, 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 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.
- C. Factory Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, 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.
- D. Permits, Licenses, and Certificates: For School District'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.
- E. Trade Preinstallation Conferences: Meeting minutes to be Contractor provided.

#### **1.7 QUALITY ASSURANCE**

- A. Qualifications establish the minimum qualification levels required; refer to individual Specification Sections for additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated and sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated and with record of successful in service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling Work similar in material, design, and extent to that indicated for this Project, whose Work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of Texas, experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated.
- F. Specialists: Certain Specification Sections 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. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, documented according to ASTM E329; 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.
  2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products.
- I. Factory Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of

manufacturer's products.

- 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 representative of proposed products and construction.
    - b. Submit specimens 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. Build site assembled test assemblies and mockups using installers who will perform 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, mockups, and laboratory mockups; do not reuse products on Project.
  2. Testing Agency Responsibilities: Submit certified written report of each test, inspection, and similar quality assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
  2. Notify Architect a minimum of 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.
  4. Demonstrate the proposed range of aesthetic effects and workmanship.
  5. Obtain Architect's approval of mockups before starting Work, fabrication, or construction. 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. Integrated Exterior Mockups: Mockup of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies shall be constructed. Mockup, if not specifically shown on the drawings, shall be minimum 8 ft by 8 ft. Mockup shall include all major façade elements and at least one window minimum 2 ft by 2 ft in size. Prior to constructing mockup verify requirements with architect. Pre-installation conferences for trades involved in Integrated Exterior Mockup shall be held after mock up is completed.
- M. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.
- N. Trade Preinstallation Conferences: Meeting minutes to be Contractor provided.

## 1.8 QUALITY CONTROL

- A. School District Responsibilities: Where quality control services are indicated as School District's responsibility, School District shall engage a qualified testing agency to perform the services.
1. School District shall furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.

2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to School District 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 the quality control services. Contractor shall not employ same entity engaged by School District, unless agreed to in writing by School District.
  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.
- 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 31 00 - Project Management and Coordination.
- 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 replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the 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 the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform any duties of Contractor.
- 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.
  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 -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. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
1. Distribution: Distribute schedule to School District, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

### **1.9 SPECIAL TESTS AND INSPECTIONS**

- A. Special Tests and Inspections: School District shall engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of School District:
- B. Special Tests and Inspections: Conducted by a qualified testing agency or special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections.
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 and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  3. Submitting a certified written report of each test, inspection, and similar quality control service to Architect with copy to Contractor and to authorities having jurisdiction.
  4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
  5. Interpreting tests and inspections and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
  6. Retesting and reinspecting corrected Work.

## **PART 2 PRODUCTS**

### **NOT USED**

## **PART 3 EXECUTION**

### **3.1 TEST AND INSPECTION LOG**

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

### **3.2 REPAIR AND PROTECTION**

- A. 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 cutting and patching in Section 01 73 29 - Cutting and Patching.

- 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 01 40 00**

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## **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 DESCRIPTION OF WORK REQUIREMENTS**

- A. General: This Section specifies procedural and administrative requirements for compliance with governing regulations and codes and standards imposed upon the Work. These requirements include the obtaining of permits, licenses, inspections, releases, and similar statements, as well as payments associated with regulations, codes, and standards.
- B. Governing Regulations: Refer to General and Supplementary Conditions for requirements related to compliance with governing regulations.

#### **1.3 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  - 1. Approved.
  - 2. Directed.
  - 3. Furnish.
  - 4. Indicated.
  - 5. Install.
  - 6. Provide.
  - 7. Regulations.
  - 8. Testing Agencies.

#### **1.4 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. Individual Specification Sections indicate which codes and standards the Contractor must keep available at the project site for reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Conflicting Requirements: Where compliance with two or more standards is specified, and where these standards establish different or conflicting requirements for minimum quantities or quality levels, the most stringent requirement will be enforced, unless the Contract Documents specifically indicate a less stringent requirement. Refer requirements that are different, but apparently equal, and uncertainties as to which quality level is more stringent to the Architect for a decision before proceeding.
- D. Minimum Quantities or Quality Levels: In every instance the quantity or quality level shown or specified is intended to be the minimum for the Work to be provided or performed. Unless otherwise indicated, the actual Work may either comply exactly, within specified tolerances, with the minimum quantity or quality specified, or may exceed that minimum within reasonable limits. In complying with these requirements, the indicated numeric values are either minimum or maximum values, as noted, or as appropriate for context of the requirements. Refer instances of uncertainty to the Architect for decision before proceeding.

#### **1.5 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 trade association, standards-producing organization, authorities having jurisdiction or other entity applicable to the context of the text provision.



- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the Agency.
- C. 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.

**1.6 SUBMITTALS**

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

**PART 2 PRODUCTS**

**NOT USED**

**PART 3 EXECUTION**

**NOT USED**

**END OF SECTION 01 42 00**

## **SECTION 01 42 16 - DEFINITIONS**

### **PART 1 GENERAL**

#### **1.1 CONTRACTING DEFINITIONS**

- A. General: Basic Contract definitions included through Section 00 70 00 - Conditions of the Contract include:
  - 1. Change Order.
  - 2. Construction Change Directive.
  - 3. Contract Documents.
  - 4. Contract.
  - 5. Drawings.
  - 6. Instruments of Service.
  - 7. Initial Decision Maker.
  - 8. Project.
  - 9. Specifications.
  - 10. Subcontractor.
  - 11. Substantial Completion.
- B. Miscellaneous Other Definitions
  - 1. Addenda, Addendum.
  - 2. Alternate Proposal(s).
  - 3. Approved, Approved Equivalent, Approved Equal, or Equal.
  - 4. Base Proposal.
  - 5. Contract Time.
  - 6. Date of Agreement.
  - 7. Date of Commencement of the Work.
  - 8. Date of Final Completion.
  - 9. Notice to Proceed.
  - 10. Provide.
  - 11. Punch List.
  - 12. Unit Prices.

#### **1.2 DEFINITIONS**

A.

Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

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.

Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.

Predecessor Activity: An activity that precedes another activity in the network.

Successor Activity: An activity that follows another activity in the network.

Adequate Ventilation: Ventilation, including air circulation and air changes, required for curing materials, dissipate humidity, and prevent accumulation of dust fumes, vapors, or gases.

Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.

AESS: Refer to Architecturally-Exposed Structural Steel.

Alteration Work: Remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.

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 School District 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.

Alternates described are part of the Work when enumerated in the Agreement.

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.

Anchorage Connector: A component or subsystem that functions as an interface between the anchorage and a fall protection, work positioning, rope access, or rescue system for the purpose of coupling the system to the anchorage.

Architecturally-Exposed Structural Steel (AESS): Structural steel complying with designated AESS category as defined in AISC 303.

B.

Basis of Design (BOD) (Document): A document that records the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements and to satisfy applicable regulatory requirements, standards and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

Basis of Design (BoD) (Product): A product around which the project has been designed. If a product other than the Basis of Design is provided, it must be coordinated with Architect.

Basis of Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "Basis of Design Product", 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 additional manufacturers named in the specification.

C.

Casework: Products including, but not limited to framework, doors, drawers, hardware, and finishes which constitute cabinets and cases.

Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation and cabinets less than 30 inches (762 mm) above finished floor.

Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than 42 inches (1.066 m) above finished floor, tops of cases less than 72 inches (1.82 m) above finished floor and all members visible in open cases or behind glass doors.

Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than 72 inches (1.828 m) above finished floor and bottoms of cabinets more than 30 inches (0.762 m) but less than 42 inches (1.066 m) above finished floor.

Cast Stone: Refined architectural concrete building unit manufactured to simulate natural cut stone, used in unit masonry applications.

Dry Cast Concrete Products: Manufactured from zero slump concrete:

Vibrant Dry Tamp (VDT) casting method - Vibratory ramming of earth moist, zero slump concrete against a rigid mold until densely compacted.

Wet Cast Concrete Products: Manufactured from measurable slump concrete:

Wet casting method - Manufactured from measurable slump concrete and vibrated into a mold until densely consolidated.

Certified Wood: Wood based materials and products certified in accordance with Forest Stewardship Council's (FSC) Principles and Criteria for wood building components.

Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited

certification body to comply with FSC STD-01-001. Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body. A chain-of- custody certification is not required by distributors of a product that is individually labeled with the Forest Stewardship Council logo and manufacturer's chain of custody number. Chain of Custody certification requirements are determined by Forest Stewardship Council Chain of Custody Standard 40-004 v2-1.

Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

Commissioning (Cx): A systematic process confirming that building systems have been installed, properly started, and consistently operated in strict accordance with the Project Documents, that all systems are complete and functioning in accordance with the Contract Documents at Substantial Completion, and the Contractor has provided the Owner adequate system documentation and training.

Commissioning Authority (CxA): Party having a contractual agreement with the Owner to provide third party commissioning services as defined herein under Commissioning Authority's Role and Responsibilities. Commissioning Authority may represent the Owner and is authorized to act on behalf of the Owner. The Commissioning Authority does not have authority to alter design or installation procedures without the written approval of the Owner or the design team.

1. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce 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.
2. Composite Materials: Materials made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce materials with characteristics different from the individual components.

Composite Wood (also referred to as "Engineered Wood"): Examples of Composite Wood are: particleboard; flake-board; plywood; fiberboard; MDF; agrifiber products; millwork substrates; flooring substrates; equipment backboards; door cores.

Consolidate: To strengthen loose or deteriorated materials in place.

Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

Contract Documents: The General Conditions, Drawings, Specifications, Addenda, and other documents developed by the A/E Team and approved by the Owner that constitute the contractual obligations of the project scope.

Control Point and Sensor Calibration Verification: Process of verifying the point integrity and/or sensor calibration from the physical point of monitoring (sensor, contact, actuator, etc.) to the digital point location at the Operator's interface within the respective control system (Building Automation, Lighting Controls, Power Status and Monitoring, etc.).

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.

Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

Critical Path Method (CPM): A method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

Cutting: Removal of existing construction necessary to permit installation or performance of other Work.

D.

Deconstruct: To remove by disassembling or detaching an item from a surface, using methods and equipment to successfully prevent damage to the item and surfaces, and dispose of items unless indicated as salvaged or for reinstallation.

Deferred Testing: Functional Performance or Integrated System Tests performed after Substantial Completion due to partial occupancy, partial equipment acceptance, seasonal requirements, design, or other site conditions that prohibit the test from being performed prior to Substantial Completion.

Deficiency: Condition of a component, piece of equipment, or system that is not in compliance with the Project Documents.

Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

Design Reference Sample: A sample that represents the Architect's prebid selection of Work to be matched; it may be existing Work or Work specially produced for the Project.

Directed: A command or instruction by Architect. Other terms including "requested," "authorized", "selected", "required", and "permitted" have the same meaning as "directed."

Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

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.

E.

Engineered Wood: Refer to Composite Wood.

Equipment: A product with operational parts, regardless of whether motorized or manually operated, and in particular, a product that requires service connections such as wiring or piping.

Existing to Remain: Leave existing items that are not scheduled for salvage or reuse, as is; do not remove.

Experienced: When used with an entity or individual, experienced means having successfully completed a minimum of five years documented experience with projects similar in nature, size, and extent; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

F.

Fall Arrest System: A system designed to stop you in the process of a fall, typically including an anchor point or series of anchor points, a safety lanyard or self-retracting lifeline, and a harness.

Fall Protection System: System can be either a fall arrest or a fall restraint system.

Fall Restraint System: A system designed to keep you from getting close enough to the fall hazard to fall, typically including an anchor point or series of anchor points, a safety lanyard or self-retracting lifeline, and a harness.

Fiber-Reinforced Polymer (FRP): Material that consists of polymer resin-based matrix with fibers of either glass, carbon or aramid, and hybrid combinations of these fiber types.

Field Quality Control Testing: Tests and inspections performed onsite for work scheduled to be performed and upon completed Work.

Float: The measure of leeway in starting and completing an activity.

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.

Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.

Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

Formaldehyde: Naturally occurring VOC, found in small amounts in animals and plants; carcinogenic and irritant to humans when present in high concentrations. (Levels above 0.1 ppm).

Urea Formaldehyde: Combination of urea and formaldehyde, used in glue, and readily decomposes at room temperature.

Phenolformaldehyde: Type of formaldehyde that off gasses only at high temperature; used for exterior products and suitable for interior applications.

Functional Performance Test (FPT): Test of dynamic function and operation of equipment and systems executed by the Contractor and witnessed by the CxA. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, life safety conditions, power failure, etc. Systems are operated through all specified sequences of operation. Components are verified to be responding in accordance with requirements in the Project Documents.

Functional Performance Testing Procedures: Commissioning protocols, detailed test procedures and instructions in tabular and script-type format that fully describe system configuration and steps required to determine if the system is performing and functioning properly.

Furnish: Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G.

General Emissions Evaluation: To comply with low-emitting material criteria, building products must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.2–2017mg/, using the applicable exposure scenario. Manufacturers' claims of compliance with the above requirements must also state the range of total VOCs after 14 days (336 hours), measured as specified in the CDPH Standard Method v1.2: 0.5 mg/m<sup>3</sup> or less; between 0.5 and 5.0 mg/m<sup>3</sup>; or 5.0 mg/m<sup>3</sup> or more.

H.

Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.

Hazardous Materials: Material regulated as hazardous material in accordance with 49 CFR 173, requiring 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. Hazardous material includes hazardous chemicals.

Hazardous materials include but are not limited to pesticides, biocides, and carcinogens listed by the Environmental Protection Agency (EPA) and International Agency for Research on Cancer (IARC) and recognized authorities.

I.

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."

Indoor Air Quality (IAQ): Composition and characteristics of air in an enclosed space affecting occupants of space. The indoor air quality refers to relative quality of air in a building with respect to contaminants and hazards and is determined by levels of indoor air pollution and characteristics of air, including those that impact thermal comfort such as air temperature, relative humidity, and air speed.

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

Integrated Systems Test (IST): Test of dynamic function and operation of multiple systems. Integrated Systems Tests are tested under various modes, such as fire alarm and emergency situations, life safety conditions, power failure, etc. Systems are integrally operated through all specified sequences of operation. Systems and interconnections are verified to be responding in accordance with the requirements in the Project Documents.

Integrated Systems Testing Procedures: Commissioning protocols and detailed test procedures and instructions in tabular and script-type format that fully describe system

configurations and steps required to determine if the interacting systems are performing and functioning properly.

Interior Final Finishes: Materials and products exposed at interior, occupied spaces including flooring, wallcovering, finish carpentry, and ceilings.

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.

Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform particular construction operations, including installation, erection, application, and similar operations.

Interior (of Building): Within the weatherproof membrane.

J.

N/A

K.

N/A

L.

Lifeline: A component of a fall protection system consisting of a flexible line designed to hang vertically, a vertical lifeline, or connecting to anchorages or anchorage connectors at both ends to span horizontally, a horizontal lifeline.

Look-Ahead Schedule: Prepare schedule indicating activities scheduled to occur or commence prior to submittal of next schedule update.

M.

Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.

Materials: Products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, or installed to form units of work.

MERV: Minimum Efficiency Reporting Value: Arrestance rating of filter at three MERV Rating Explanation particle sizes of 0.3 microns to 10 microns at a determined face velocity.

Milestones: measurable and observable and serve as progress markers (flags) but, by definition, are independent of time (have zero durations) therefore no work or consumption of resources is associated with them.

Millwork: Ready-made wood products manufactured at a wood-planing mill or woodworking plant: moldings, doors, door frames, window sashes, stair work, cabinets, etc. excluding flooring, ceilings, and sidings.

Mockups: Full-size physical assemblies that are constructed on-site. 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.

Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.

Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.

Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.

N.

Non-Hazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

Non-Toxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

O.

Operational Testing: Activities and testing occurring after initial energizing and/or start-up of equipment that determine whether equipment is operating within the manufacturer's recommendations and the design requirements. These activities are intended to ensure that equipment and systems meet all warranty requirements and are ready for Functional Performance Testing. Common examples are Testing, Adjusting and Balancing of HVAC systems and initial load testing of electrical equipment.

Owner's Project Requirements (OPR): A written document that details the functional requirements of a project and the expectations of how the facility will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria and supporting information.

P.

Packaged Dry Products: Materials and products installed in dry form and delivered in manufacturer's packaging; including carpets, resilient flooring, ceiling tiles, and insulation.

Patching: Fitting and repair Work required to restore surfaces to original conditions after installation of other Work.

Pencil Copy: A preliminary review copy of the application for payment for review by Architect and Owner prior to submission of final copy.

Permeable Surface: Surfaces which allow storm water to pass through and infiltrate the soil below.

1. Plastic Composites, or Wood-Plastic Composites: Composite materials made primarily from wood- or cellulose-based materials and plastics.

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.

Project Documents: Consists of the Contract Documents, Approved Submittals, Requests for Information (RFI), Vendor documentation, Operations and Maintenance (O&M) information and other documentation that determines the requirements for acceptable installation and operation of the specific equipment and systems on the project.

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.

Product: Item obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material", "equipment", "system", "assembly", and terms of similar intent.

Comparable Product: Product that is demonstrated and approved through submittal process 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.

Named Product: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature current as of date of the Contract Documents.

New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.

Specified Product: Same as Named Product.

Provide: Furnish and install, complete and ready for the intended use.

Q.

Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate



that proposed construction will comply with requirements.

Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

R.

Recovery Schedule: Submittal of a revised critical path method (CPM) schedule and a written plan.

Recyclable: Ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

Recycled Content: Defined in accordance with the International Organization of Standards document ISO 14021, Environmental labels and declarations, Self-declared environmental claims (Type II environmental labeling).

Postconsumer material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.

Preconsumer material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials, such as rework, regrind, or scrap, generated in a process and capable of being reclaimed within the same process that generated it.

Recycling: Process of sorting, cleansing, treating, and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.

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.

Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

Remove: Detach items from existing construction and dispose off-site unless indicated as salvaged or reinstallation.

Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.

Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.

Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.

Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.

Request for interpretation (RFI): A request seeking one of the following:

An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.

A resolution to an issue which has arisen due to field conditions and affects design intent.

Resource Loading: The allocation of manpower and equipment necessary for completion of an activity as scheduled.

Retain: To keep existing items that are not to be removed or dismantled.

Return: To give back reusable items or unused products to vendors for credit.

Reuse: To reuse a construction waste material in some manner on the project site.

S.

Salvage: Recovery of demolition or construction waste for subsequent sale or reuse.

Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

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.

Scheduling Specialist (SS): An internal or third party entity contracted to the Owner providing scheduling advice (if applicable).

Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

Source Separation: Separating waste materials from the time they become waste.

Start-Up: The activities where equipment is initially energized, tested and operated. Start-up is completed prior to Operational Testing and Functional Performance Testing and is an integral item documented in the System Verification Checklist (SVC).

Strip: To remove existing finish down to base material unless otherwise indicated.

Submittals: Written and graphic information and physical samples that require Architect's responsive action or are for information and do not require the architect's action.

Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.

Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control such as unavailability or regulatory changes.

Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project

Subsystem: A portion of a system with characteristics similar to a system.

System: An organized collection of parts, equipment, or subsystems united by regular interaction.

System Verification Checklist (SVC): List of static inspections and material or component tests that verify proper installation of equipment (e.g., belt tension, oil levels, labels affixed, gages in place, sensors calibrated, etc.), start-up activities and documentation, as well as operational testing results. The checklists are meant to document all activities for an individual piece of equipment from procurement on the project through operational testing are performed in accordance with the requirements in the project documents.

T.

Testing:

Field Quality Control Testing: Tests and inspections performed on site for installation of the Work and for completed Work.

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.

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.

Source Quality Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

Testing Agency: An independent entity engaged to perform specific inspections, tests, or both, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

Testing Laboratory: Refer to Testing Agency.

Toxic: Poisonous to humans either immediately or after a long period of exposure.

Training Plan: A detailed plan prepared by the Contractor and reviewed by the Owner and Commissioning Authority that outlines the training activities, instructors, time durations, and system requirements in accordance with the Contract Documents and Commissioning Plan.

Trending: Data collection of monitored points using the Building Automation System, Lighting Controls System, Power Status and Monitoring System or independent data acquisition instrumentation.

U.

Unit Price: Price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

V.

Volatile Organic Compound (VOC): A carbon compound that vaporizes at normal room temperatures.

W.

Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

Wet Products: Materials and products installed in wet form, including paints, sealants, adhesives, and special coatings.

1. Wood-Plastic Composites: Refer to Plastic Composites.

X.

N/A

Y.

N/A

Z.

N/A

**PART 2 PRODUCTS**

**NOT USED**

**PART 3 EXECUTION**

**NOT USED**

**END OF SECTION 01 42 16**

## **SECTION 01 45 23 - TESTING AND INSPECTING SERVICES**

### **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: Requirements and qualifications including but not limited to:
  - 1. Professional testing and laboratory services.
  - 2. Accessories necessary for the completion of testing and laboratory services.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality assurance and 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 the Contractor's other quality assurance and quality control procedures that facilitate compliance with Contract Document requirements.
  - 3. Requirements for the Contractor to provide quality assurance and quality control services required by the Architect, the School District, or the Authorities Having Jurisdiction (AHJ) are not limited by provisions.
  - 4. Specific test and inspection requirements are not specified in this Section.
- C. A qualified independent testing laboratory and/or geotechnical engineering service selected and paid by the School District.
  - 1. The School District shall pay for the initial laboratory services of materials that comply with the requirements of the Contract Documents. The Contractor shall pay for testing and retesting of materials that do not comply with the requirements of the Contract Documents.
- D. Inspecting agency shall perform inspections and tests in accordance with the rules and regulations of the building code, local authorities, Specifications of ASTM, and the Contract Documents.
- E. Materials and workmanship found not in compliance with required standards or performance obligations shall be removed and replaced. Replacement and subsequent testing shall be at the Contractor's expense.
- F. Where terms "Inspector" and "Laboratory" are used, it is meant and in reference to an officially designated and accredited inspector of the testing laboratory or geotechnical service engaged by the School District.
- G. Laboratory inspections shall not relieve the Contractor or the Fabricator of his responsibility to furnish materials and workmanship in accordance with the Contract Documents.
- H. The Contractor or the Fabricator shall cooperate with the testing laboratory in matters pertaining to the Work.
- I. The Contractor shall address deficiency and failed reports.

#### **1.3 REFERENCE STANDARDS**

- A. 29 CFR 1910.7 - Definition and Requirements for a Nationally Recognized Testing Laboratory; current edition.
- B. AASHTO T 89 - Standard Method of Test for Determining the Liquid Limit of Soils; 2013.
- C. AASHTO T 99 - Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop; 2021.

- D. ACI 214R - Guide to Evaluation of Strength Test Results of Concrete; 2011.
- E. ACI 301 - Specifications for Concrete Construction (ACI 301-20); 2020 Edition, September 2020.
- F. ACI 311.4R - Guide for Concrete Inspection; 2005.
- G. ACI 318 - Building Code Requirements for Structural Concrete (ACI 318-19) Commentary on Building Code Requirements for Structural Concrete (ACI 318R-19); 2019 Edition, June 2019.
- H. ACI 613 - ACI Standard Recommended Practice for Selecting Proportions for Concrete; 1954.
- I. ACI SP-2 - ACI Manual of Concrete Inspection; 2007.
- J. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2024.
- K. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2023.
- L. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2024.
- M. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2023.
- N. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2023a.
- O. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
- P. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2017.
- Q. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2023.
- R. ASTM C192/C192M - Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory; 2019.
- S. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method; 2017a.
- T. ASTM C567 - Standard Test Method for Determining Density of Structural Lightweight Concrete; 2019.
- U. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2023.
- V. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry; 2020.
- W. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2023b.
- X. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)); 2012 (Reapproved 2021).
- Y. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2017, with Editorial Revision (2018).
- Z. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2019.
- AA. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.
- BB. ASTM E534 - Standard Test Methods for Chemical Analysis of Sodium Chloride; 2018 Edition, February 1, 2018
- CC. ASTM E605/E605M - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members; 2019 (Reapproved 2023).
- DD. ASTM E736/E736M - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members; 2019 (Reapproved 2023).

- EE. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
- FF. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

#### 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
  - 1. An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, documented according to ASTM E329 and ASTM E534; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
    - a. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
    - b. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
    - c. Testing agencies shall be insured against errors and omissions by a professional liability insurance policy having a minimum limit of liability of \$500,000.00.
- B. Inspection and testing services the of testing agency shall be under the direction of a Registered Engineer licensed in the State of Texas, charged with engineering managerial responsibility, and having a minimum of five (5) years engineering experience in inspection and testing of construction materials.
- C. Concrete Inspectors: Inspecting personnel monitoring concrete Work shall be ACI certified inspectors.
- D. Structural Steel: Primary inspectors performing structural steel inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with the provisions of AWS QCI, Standard and Guide for Qualification and Certification of Welding Inspectors.
  - 1. Inspector may be supported by assistant inspectors who perform specific inspection functions under the direct supervision of the Primary Inspector. Assistant inspectors shall be currently certified AWS Certified Associate Welding Inspectors (CAWI). Work of assistant inspectors shall be monitored daily by the inspector.
- E. Testing Equipment: Equipment shall be calibrated at intervals not exceeding 12 months by devices of accuracy traceable to the National Bureau of Standards.
- F. Referenced Standards: Latest adopted edition of standards referenced apply to the Work. In the event of conflict between the Contract Documents and referenced standards, the Contract Documents shall govern. In case of conflict between Contract Documents and the Building Code, the more stringent shall govern.

#### 1.5 QUALITY CONTROL

- A. School District Responsibilities: Where quality control services are indicated as the School District's responsibility, the School District will engage a qualified testing agency to perform the services.
  - 1. The School District will furnish the Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
  - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to the Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to the School District are the Contractor's responsibility. Perform additional quality control activities required to verify that the Work complies with requirements, whether specified or not.
  - 1. Refer to the individual specification sections for specific requirements.
  - 2. 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.
3. Where services are indicated as the Contractor's responsibility, engage a qualified testing agency to perform the quality control services. The Contractor shall not employ same entity engaged by the School District, unless agreed to in writing by the School District.
  4. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
  5. Where quality control services are indicated as the Contractor's responsibility, submit a certified written report, in duplicate, of each quality control service.
  6. Testing and inspecting requested by Contractor and not required by the Contract Documents are the Contractor's responsibility.
  7. Submit additional copies of each written report directly to the Authorities Having Jurisdiction (AHJ), when they so direct.
  8. Associated Responsibilities and 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:
    - a. Provide access to the Work.
    - b. Deliver of samples to testing laboratory, without cost to the School District, in adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
    - c. Advise laboratory and the Architect sufficiently in advance of construction operations to allow laboratory to complete required inspections or tests and to assign personnel for field inspection and testing as specified.
    - d. Provide facilities for storage and curing of concrete test samples on site for the first 24 hours and for subsequent field curing required by ASTM C31/C31M.
    - e. Incidental labor, facilities, and equipment necessary to assist laboratory personnel in obtaining and handling samples at the site.
    - f. Preliminary design mix proposed for use for material mixes that require control by testing agency.
    - g. Provide concrete mix designs in accordance with ACI 301 Section 3.9 made by an independent testing laboratory or qualified concrete supplier. Where mix designs by an independent testing laboratory are required, select and pay for laboratory.
    - h. Obtain required inspections or approvals of the building official. Inspection requests and notifications required by building code are responsibility of the Contractor.
    - i. Provide current welder certificates for each welder employed.
    - j. Provide fabrication and erection inspection and testing of welds in accordance with AWS D1.1/D1.1M, Chapter 6.
      - 1) Use prequalification of welding procedures in executing the Work.
    - k. Security and protection for samples and for testing and inspecting equipment at Project site.
  9. Retesting/Reinspecting: Regardless of payment responsibility of the original tests or inspections, provide quality control services, including retesting and reinspecting, for construction that replaced Work failing to comply with the Contract Documents or Code requirements.
- C. Testing Agency Responsibilities: Cooperate with the Architect and the Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify the Architect and the 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 the Contractor.

5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of the Contractor.
- 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. Schedule times for tests, inspections, obtaining samples, and similar activities.

#### **1.6 AUTHORITY AND DUTIES OF LABORATORY PERSONNEL**

- A. A representative of the testing laboratory, who has reviewed and is familiar with the project and specifications, shall participate in preconstruction conferences. Representative shall coordinate material testing and inspection requirements with the Contractor and its subcontractors consistent with the planned construction schedule. The laboratory representative shall attend conferences required or requested to address quality control issues.
- B. Laboratory personnel shall inspect and test materials, assemblies, specimens, and Work performed, including design mixes, methods and techniques and report the progress to the Architect.
- C. If material or Work fails to meet requirements of Contract Documents, laboratory inspector shall notify the Contractor, the Architect, the Engineers, supplier or subcontractor providing or preparing the materials or Work being tested of such failure.
- D. Laboratory personnel shall not perform the Work of the Contractor or act as foremen or superintendents. Work will be inspected as it progresses, but failure to detect defective Work or materials shall not prevent later rejection when a defect is discovered.
- E. Laboratory personnel are not authorized to revoke, alter, relax, enlarge, or release the requirements of the Contract Documents or approve or accept portions of Work, except where approval is specifically specified in the Specifications.
- F. Comply with building code requirements for Special Inspections.

#### **1.7 SUBMITTALS**

- A. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality control services required by the Contract Documents. Coordinate and submit concurrently with the Contractor's construction schedule. Update as the Work progresses.
- B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
  1. Specification Section number and title.
  2. Entity responsible for performing tests and inspections.
  3. Description of test and inspection.
  4. Identification of applicable standards.
  5. Identification of test and inspection methods.
  6. Number of tests and inspections required.
  7. Time schedule or time span for tests and inspections.
  8. Requirements for obtaining samples.
  9. Unique characteristics of each quality control service.
- C. Test and Inspection Reports: Prepare and submit certified written reports specified. 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. Record of temperature and weather 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.
- D. Submit copies of reports of each inspection and test to:
1. The School District, the Architect, and each Engineer or outside consultant regarding their particular phase of the project: One copy each.
  2. The Contractor: Two copies each.
- E. In addition to furnishing a written report, notify the Contractor verbally of uncorrected conditions or failures to comply with requirements of the Contract Documents, and immediately fax and email corresponding report to the Architect and the Engineer.
- F. At completion of each trade or branch of Work requiring inspecting and testing, submit a final certificate attesting to satisfactory completion of Work and full compliance with requirements of Contract Documents.
- G. Submit copies of test results sealed by a Registered Engineer to the Authorities Having Jurisdiction (AHJ), as required.

### **1.8 TESTING LABORATORY GUIDELINES AND PROCEDURES**

- A. Technicians scheduled to perform specific testing services must be qualified to review and perform other services that overlap, i.e. earthwork, foundation inspections, rebar inspection, and concrete when scheduled concurrently at the site.
- B. Technician time for services performed will be reimbursed at a regular time rate. Compensation at the overtime rate will be considered for hours over eight hours spent at the site on a single day, field testing services performed on a Saturday or Sunday, and field services performed on a recognized holiday.
- C. There shall be a three hour minimum for each scheduled testing service. Vehicle charges will be included on a \$25.00 per trip basis.
- D. Cylinder pick up will be controlled by the technician performing test on a scheduled pick up day. If there are no testing services scheduled, the cylinder pick up fee is \$40.00 on week days and \$50.00 on weekends and holidays with no technician or vehicle charge.
- E. The Contractor shall bear the responsibility of scheduling the testing services. The Contractor and testing laboratory shall assume full responsibility to coordinate the testing services. Cancellations or failed test shall be reimbursable to the School District by the responsible party for the cancellations or failure of a test or service.

## **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 the Architect.
  4. Identification of testing agency or special inspector conducting test or inspection
  5. Deficiency log.
- B. Maintain log at site. Post changes and revisions as they occur. Provide access to test and inspection log for the Architect's reference during normal working hours.

### **3.2 TESTING AND INSPECTION SERVICES**

- A. Testing services shall include, but not be limited to those specified below or which are necessary or required during course of construction to ascertain specification compliance and which may be deemed necessary by the Architect, the Engineer, or the School District to ensure the quality of the Work.
- B. The School District reserves the right to add to or delete any or all inspection and testing specified, excluding testing required by the applicable building codes.
- C. If conflicts arise between Drawings and Specifications, notify Architect immediately. The most stringent requirements shall dictate procedure.

### **3.3 TESTING OF EARTHWORK**

- A. Testing Services (As specified or required):
  - 1. Perform sieve analysis to develop grain size distribution curves for materials to be used for subgrade, fill under slab on grade, and backfills.
  - 2. Establish the moisture density relation of soils to be used as fill using the method best suited to the type of fill material.
  - 3. Determine moisture content of all fill materials before placement and advise Contractor when it is or is not suitable to achieve required compaction.
  - 4. Determine Liquid Limit in accordance with ASTM D4318 or AASHTO T 89, Plastic Limit in accordance with ASTM D4318, and Plasticity Index in accordance with ASTM D4318 of all fill material.
  - 5. Perform one in place density test for each 4,000 square feet (445 square yards) of existing subgrade material.
  - 6. Perform Moisture-Density curve in accordance with ASTM D698 or AASHTO T 99 for one type of fill material. If the original choice of material does not meet the specifications, the Contractor shall pay for additional testing.
  - 7. Perform in place density tests of each lift of compacted fill at locations adequate to evaluate the degree of compaction of all fill areas. Conduct one test for each 4,000 square feet (445 square yards) of each lift of compacted fill.
  - 8. Perform testing at a frequency of one in-place density and moisture test for each 75 linear feet or less of utility trench, with a minimum of three tests per lift.
- B. Reports: Submit reports with the following information:
  - 1. Type and condition of soil at footing bottoms.
  - 2. Level of water table in the excavated areas.
  - 3. Grain size distribution of fill materials (average of three tests).
  - 4. Moisture density test results.
  - 5. In place density test results with moisture content and relative density of each layer of compacted fill. Include with in place density test results, a plan showing location of each test.
  - 6. Notify the Architect by telephone within one hour of the discovery of the following conditions and follow up telephone notification with written report.
    - a. Materials used, or degree of soil compaction not meeting specified requirements.
    - b. Frost and freeze protection requirements for excavation bottoms not being complied with.
    - c. Water in excavations which is not being removed prior to Work being performed in excavation.

### **3.4 INSPECTION OF PIPED SITE UTILITIES**

- A. Laboratory representative shall observe and report on the following:
  - 1. Proper alignment and grade of trenches.
  - 2. Pipe bedding and supports.
  - 3. Pipe, joints, jointing material, and thrust blocks prior to installation of pipe.
  - 4. Installation of pipe and joints.

5. Testing of piped utilities performed by the Contractor.

### **3.5 PAVING**

- A. Testing Services: Perform field tests for moisture density properties:
  1. Provide field testing of the subgrade as specified.
  2. Paving Subbase: Provide one field test for every 7,500 square feet of area of crushed limestone or caliche subbase.
  3. Lime Treated Subgrade: Provide one field test for every 7,500 square feet of area of lime treated subgrade for content of lime and subgrade compaction.
  4. Cement Soil Stabilization: Provide one field test for every 7,500 square feet of area of cement stabilized subgrade for content of cement and subgrade compaction.

### **3.6 PIER DRILLING OPERATION**

- A. A representative of a qualified geotechnical laboratory shall provide services specified.
- B. Laboratory representative shall make continuous inspections to determine that proper bearing stratum is obtained and utilized for bearing and that shafts are properly clean and dry before placing concrete.
- C. Laboratory shall furnish complete pier log showing the diameter, top and bottom elevations of each pier, casing required or not required, actual penetration into bearing stratum, elevation of top of bearing stratum, volume of concrete used, and deviations from specified tolerances.
- D. Laboratory representative shall make continuous inspections of drilled pier construction to check the following:
  1. Verify soundness of bearing stratum and desired penetration.
  2. Verify pier dimensions and reinforcing used.
  3. Monitor condition of hole and removal of water and loose material from bottom.
  4. Monitor placement of concrete and use of tremie or pumps.
  5. Monitor the extraction of casing, if used.
- E. Request probe holes when deemed necessary to confirm safe bearing capacity.

### **3.7 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES**

- A. Inspect concrete reinforcing steel prior to placing concrete for compliance with Contract Documents and approved shop drawings. Noncompliance with Contract Documents and approved shop drawings shall be immediately brought to the attention of the Contractor for correction and, if left uncorrected, reported to the Architect.
- B. Laboratory representative shall observe and report on the following:
  1. Number and size of bars.
  2. Bending and lengths of bars.
  3. Splicing.
  4. Clearance to forms, including chair heights.
  5. Clearance to sides and bottom of trench if soil formed.
  6. Clearance between bars or spacing.
  7. Rust, form oil, and other contamination.
  8. Grade of steel.
  9. Securing, tying, and chairing of bars.
  10. Excessive congestion of reinforcing steel.
  11. Installation of anchor bolts and placement of concrete around such bolts.
  12. Fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
  13. Visually inspect studs and deformed bar anchors on embedded assemblies for compliance with Contract Documents. Check number, spacing and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360 degree fillet has not been obtained for a particular stud or bar, such stud or bar shall be struck with a hammer and bent 15 degrees off perpendicular and then bent back into position. Anchors failing this

test shall be replaced.

- C. Provide a qualified, experienced inspector to inspect reinforcing steel. Inspector shall have a minimum of three years' experience inspecting reinforcing steel in projects of similar size.

### **3.8 CONCRETE INSPECTION AND TESTING**

- A. Receive and evaluate proposed concrete mix designs submitted by the Contractor. If mix designs comply with Drawings and Specifications, the laboratory shall submit a letter to the Architect certifying compliance. Mix designs not complying with Drawings and Specifications shall be returned by the laboratory as being unacceptable. Check the proposed mixes for proportions, water cement ratio and slump in accordance with ACI 613 and ACI 318.
- B. Comply with ACI 311.4R Guide For Concrete Inspection and ACI SP-2 Manual of Concrete Inspection.
- C. Sample and test concrete placed at the site in accordance with ASTM C172/C172M. Each sample shall be obtained from a different batch of concrete on a random basis.
- D. Test Concrete:
  - 1. Mold and cure five specimens from each sample.
    - a. For each 50 cubic yards or fraction thereof of structural building concrete.
    - b. For each 100 cubic yards or fraction thereof of nonstructural concrete and site Work paving and sidewalks.
    - c. Laboratory cure two cylinders in accordance with ASTM C192/C192M.
    - d. Field cure remaining cylinders in accordance with ASTM C31/C31M.
  - 2. Two specimens shall be tested at seven days for information, two shall be tested at 28 days for acceptance.
- E. Deviations from the requirements of ASTM Specifications shall be recorded in the test report. Test concrete specimens in accordance with ASTM C39/C39M.
- F. Specimens for pumped concrete shall be taken at the discharge end of pumping equipment.
- G. Supervise curing and protection provided for test specimens in field, and transportation from the field to laboratory. Test cylinders shall be stored in the field 24 hours and then carefully transported to laboratory and cured in accordance with ASTM C31/C31M.
- H. Make one strength test (four cylinders) of each mix design of concrete placed in any one day.
- I. Make one slump test for each set of cylinders following procedural requirements of ASTM C143/C143M and ASTM C172/C172M. Make additional slump tests whenever consistency of concrete appears to vary. Slump tests corresponding to samples from which strength tests are made shall be reported with strength test results. Other slump tests need not be reported.
- J. Determine total air content of air entrained normal weight concrete sample for each strength test in accordance with ASTM C231.
- K. Determine air content and unit weight of lightweight concrete sample for each strength test in accordance with ASTM C173/C173M and ASTM C567.
- L. Determine temperature of concrete sample for each strength test.
- M. Inspect each batch of concrete, monitor addition of mixing water to assure uniform consistency from truck to truck. Check mixing form mixers before mix begins to set and within time limits set forth in ASTM C94/C94M.
  - 1. Monitor addition of water and high range water reducer to concrete at job site and length of time concrete is allowed to remain in truck during placement.
- N. Testing agency shall furnish and maintain a competent inspector at the mixing plant at the start of each day's mixing. Inspector shall examine concrete materials for compliance with Specifications and approved mix design, weighing and measuring devices, proportioning and mixing of materials, water and cement content of each batch, general operation of the plant, and transportation of concrete to jobsite. Inspector shall verify that amount of free surface moisture contained in fine and course aggregate has been properly accounted for in the

- concrete mixing to achieve required consistency and water cement ratio.
- O. Testing laboratory shall monitor addition of water to concrete at the jobsite and the length of time concrete is allowed to remain in the truck before placement. Inspector shall compare mixture with criteria on the approved mix design and report any significant deviation to the Architect, the Contractor, and the concrete supplier. Do not permit addition of water which will exceed maximum water/cement ratio for the mix as given on the approved mix design.
  - P. Observe placing of concrete, except nonstructural slabs on grade and site Work. Observe and report on placing method, consolidation, cold joints, length of drop, and displacement of reinforcement. Report deficiencies to the Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when all procedures have been deemed satisfactory by the laboratory.
  - Q. Test reports shall include but no be limited to the following information: date of concrete placement, concrete mix identification number or proportion of ingredients, truck ticket number, time test was made, time of batching, location of each placement, slump, unit weight, water content (microwave test) and air content of concrete sampled and date and results of strength test.
  - R. Report promptly to the Architect all details of reasons for rejection of any and all quantities of concrete. Give all information concerning locations of the concrete pours, quantities, date of pours, and other pertinent facts concerning concrete represented by the specimens.
  - S. Testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or placed), amount of water added and time at which cement and aggregate were dispensed into the truck, and time at which concrete was discharged from the truck.
  - T. Evaluation and Acceptance:
    - 1. If measured slump, or air content of air entrained concrete, falls outside specified limits, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, concrete shall be considered to have failed to meet the requirements of the specifications, and shall not be used in the structure.
    - 2. Strength level of concrete will be considered satisfactory if the averages of sets of three consecutive strength tests results are equal to, or exceed, specified strength and no individual test result (average of two cylinders) is below specified strength by more than 500 psi.
    - 3. Completed concrete Work will be accepted when requirements of ACI 301 Chapter 18 Specifications for Structural Concrete for Buildings have been met.
  - U. Concrete Test Reports: Reports shall be made and distributed immediately after respective tests or inspections are made.
    - 1. Where reports indicate deviations from Contract Documents, they shall also include a determination of the probable cause of deviation and where applicable, a recommendation for corrective action.
  - V. Furnish a statistical analysis for each class of concrete placed on the project in accordance with ACI 214R and ACI 318. Information shall be updated and distributed once a month as directed by the Architect. Information shall include, but not be limited to, the following:
    - 1. Strength tests at 7 days of one cylinder.
    - 2. Strength tests at 28 days of two cylinder averages.
    - 3. 28 day moving average strength tests of last three test groups.
    - 4. Standard deviation and coefficient of variation based on 28 day strength tests.
    - 5. Average strength and number of 28 days tests for most recent month.
  - W. Test Footings (Shafts) (Piers) (Caissons): Same diameter and type specified for footings, placed in same manner. Accepted test footings may be used in the Work.
  - X. Noncompliant Test Reports: Immediately send an electronic copy of test reports indicating noncompliance to each party on the test report distribution list.

- Y. Inspect application of curing compound and monitor curing conditions to assure compliance with specification requirements. Report curing deficiencies to Contractor immediately and submit a written report to Architect.

### **3.9 TESTING OF NON-SHRINK GROUT**

- A. Make one strength test for all plates grouted and for all grout used in joints between members.
- B. Each test shall consist of four cubes, two tested at 7 days and two at 28 days, made and tested in accordance with ASTM C109/C109M, with the exception that grout shall be restrained from expansion by a top plate.

### **3.10 STRUCTURAL STEEL**

- A. Inspect structural steel during and after erection for compliance with Contract Documents and shop drawings. Review and report on fabricator's quality control procedures and capabilities.
- B. Field Inspection:
  - 1. Proper erection of pieces.
  - 2. Proper touch up painting of shop primed structural steel exposed to view or in crawl space.
  - 3. Proper installation of bolts.
  - 4. Plumbness of structure and proper bracing.
  - 5. Proper field painting.
  - 6. Initial inspection of welding process and periodically thereafter as necessary.
  - 7. Visual examination of completed welds.
  - 8. Ultrasonic testing of penetration field welds.
  - 9. Installation of field welded shear studs.
  - 10. Inspect shop fabricated members, upon arrival at the site, for defects incurred during transit and handling.
  - 11. Measure and record camber of beams upon arrival and before erection for compliance with specified camber. Measure lying flat with web horizontal. Return members outside specified camber tolerance to shop for correction.
- C. Qualifications of Welders: Fabricator and erector shall provide the testing laboratory with names of welders employed on Work, along with certification that each welder has passed qualification tests within the past 12 months, using procedures covered in AWS D1.1/D1.1M Structural Welding Code - Steel. Verify welder qualifications.
- D. Inspection of field welding shall include:
  - 1. Visually inspect fillet welds for size, soundness, and proper return around ends. Inspect seams, folds, and delaminations.
  - 2. Visually inspect welds for proper repair of painting.
  - 3. Ultrasonically test penetration welds in accordance with ASTM E164.
  - 4. Inspect surfaces to be welded. Note surface preparations, fit up, and cleanliness of surface. Verify electrodes for size, type, and condition.
  - 5. Welding inspector shall be present during alignment and fit up of members being welded, and shall verify for correct surface preparation of root openings, sound weld metal, and proper penetration in the root pass. Where weld has not penetrated completely, inspector shall order the joint to be chipped down to sound metal, or gouged out, and rewelded. Thoroughly inspect root passes for cracks. Gouge out cracks and rewelded to 2 inches beyond each end of crack.
  - 6. Inspector shall verify that welds have been marked with welder's symbol and shall mark welds requiring repairs and reinspection. Inspector shall maintain a written record of welds. Work completed and inspected shall receive an identification mark by the inspector. Identify unacceptable material and Work identified by word reject or repair marked directly on the material.
  - 7. Testing agency shall advise the School District and the Architect of any shop and/or field conditions which may require further tests and examination by means other than those

- specified. Additional tests and examinations shall be performed as authorized by the School District and the Architect.
8. The School District reserves the right to use ultrasonic or radiographic inspection to verify adequacy of welds. Testing procedures and acceptance criteria shall be as specified in AWS D1.1/D1.1M.
  9. Weld quality to comply with the American Institute of Steel Construction (AISC) Manual of Steel Construction.
  10. Determine percentage of weld tested by the number of welds that fail the initial testing.
  11. Reweld and retest welds that fail until the welds pass. Test two additional welds for every weld failure.
- E. Inspect bolted construction in accordance with AISC Specification for Structural Steel Buildings:
1. Visually inspect bolts ensuring that plies have been brought into snug contact.
  2. Inspect high strength bolt in accordance with Section 9 of the Specifications for Structural Joints Using ASTM F3125/F3125M Bolts.
- F. Inspect stud welding in accordance with Section 7.8, of AWS D1.1/D1.1M Structural Welding Code:
1. Weld at least two shear studs at the start of each production period to determine correct generator, control unit, and stud welder setting. The studs shall be capable of being bent 45 degrees from vertical without weld failure.
  2. When the temperature is below 32 degrees F (0 degrees C), test one stud in each 100 after cooling. Do not weld studs at temperatures below 0 degrees F or when surface is wet with rain or snow. If stud fails in the weld, two new studs shall pass the test before resumption of welding.
  3. Visually inspect studs for compliance with the requirements of the Contract Documents. Verify number, spacing, and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360 degree fillet has not been obtained for a particular stud, that stud shall be struck with a hammer and bent 15 degrees off perpendicular in the direction away from the missing weld. Studs failing test shall be replaced.

### **3.11 REINFORCING STEEL MECHANICAL SPLICES**

- A. Inspection and Observation Services:
1. Visually inspect and report on completed condition of each mechanical splice of reinforcing steel.
  2. Visually inspect each mechanical splice to ensure compliance with the ICC-ES Reports and the manufacturer's published criteria for acceptable completed splices.
  3. Place special emphasis on the inspection of the end preparation of each bar to be spliced required by the ICC-ES Report.
- B. Reports: Submit reports to the Architect:
1. Submit copies of manufacturer's published criteria for acceptable completed splices prior to observing mechanical splices.
  2. Reports on each mechanical splice shall indicate location of the splice, size of bars spliced, and acceptability or rejection of splice. Indicate reasons for rejection on each report.

### **3.12 OPEN WEB JOISTS AND JOIST GIRDERS**

- A. Inspect joists at jobsite for compliance with specified fabrication requirements. Verify welded connections between web and chord, splices, and straightness of members.
- B. Inspect installation of joists at jobsite. Check connections to supporting members, chord extensions, number of rows of bridging, and bridging connections for compliance with Contract Documents and referenced standards.
- C. Verify welder qualification certificates for both shop and field welding operators.

### **3.13 METAL FLOOR DECK**

- A. Field inspection shall consist of:

1. Verifying types, gauges and finishes for compliance with Contract Documents and shop drawings.
2. Examine composite floor deck exposed to crawl space for damage to galvanizing due to welding or construction activities. Repair galvanized composite floor deck in accordance with the specifications.
3. Examine the erection of metal deck, fastenings, reinforcing of holes, deck reinforcing, miscellaneous deck supports, hanger tabs, shear studs, deck closures, painting or other coating.
4. Certification of welders.
5. Inspect and test field welded shear studs used to fasten metal floor decking to supporting steel as specified for structural steel.

### **3.14 METAL ROOF DECK**

- A. Field inspection shall consist of:
1. Verify types, gauges and finishes for compliance with Contract Documents and shop drawings.
  2. Examine the erection of the metal deck, including fastenings at supports and side laps, reinforcing of holes, and miscellaneous deck supports.
  3. Certification of welders.
  4. Visual inspection of at least 25 percent of welds.

### **3.15 SPRAYED FIREPROOFING**

- A. Verify applied thickness, density, and bond strength of sprayed fireproofing meets fire rating requirements of approved design.
- B. Verify installation complies with fire rating requirements of approved design.
- C. Inspect and test for thickness:
1. Test 25 percent of structural frame columns and beams in each building level.
  2. Test 10 percent of beams other than structural frame in each building level.
  3. Test one slab per 5,000 square feet of building area.
- D. Inspect and test in accordance procedures of ASTM E605/E605M and ASTM E736/E736M.

### **3.16 EXPANSION BOLT INSTALLATION**

- A. Inspect drilling of each hole and installation of each expansion bolt for compliance with Contract Documents and shop drawings.
- B. Verify installation torque for each expansion bolt for compliance with manufacturer's installation instructions.

### **3.17 LIGHTWEIGHT INSULATING CONCRETE FILL**

- A. Inspection and Observation Services (As required):
- B. Testing Services (As required):

### **3.18 TESTING OF ROOFING**

### **3.19 MASONRY**

- A. Inspection and Observation Services:
1. Inspection of placement of reinforcement including condition, grade, size, location, spacing, and lap splices.
  2. Review mortar design mixes.
  3. Inspection of laying, mortaring, and grouting of concrete masonry units and elements.
    - a. Preconstruction: Perform the following tests in accordance with ASTM C140/C140M.
    - b. Preconstruction: Perform the following tests in accordance with ASTM C780 on each type of mortar mix used on the Project.
    - c. Construction: Perform 28 day compressive strength test in accordance with ASTM C780 on each type of mortar mix used on the Project at the rate of one test per 2,000 square feet of masonry.



- d. Preconstruction: Perform the following tests in accordance with ASTM C1019 on each type of grout mix used on the Project.
  - 1) Construction: Perform 28 day compressive strength test in accordance with ASTM C1019 on each type of grout mix used on the Project at the rate of one (1) test per 2,000 square feet of masonry.
  - 2) Prism Test: Perform preconstruction 28 day compressive strength test on concrete masonry walls in accordance with ASTM C1314, Method B.

**3.20 REPAIR AND PROTECTION**

- A. 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 cutting and patching in Section 01 73 29 - Cutting and Patching.
- B. Protect construction exposed by or for quality control service activities.
- C. Repair and protection are the Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

**END OF SECTION 01 45 23**

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

### **PART 1 GENERAL**

#### **1.1 RELATED SECTIONS**

- 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: Requirements for temporary utilities, support facilities, and security and protection facilities, including but not limited to:
  1. Water service and distribution.
  2. Sanitary facilities, including toilets, wash facilities, and drinking water facilities.
  3. Heating and cooling facilities.
  4. Ventilation.
  5. Electric power service.
  6. Lighting.
  7. Waste disposal facilities.
  8. Storage and fabrication sheds.
  9. Lifts and hoists.
  10. Construction aids and miscellaneous services and facilities.
  11. Environmental protection.
  12. Pest control.
  13. Site enclosure fence.
  14. Security enclosure and lockup.
  15. Barricades, warning signs, and lights.
  16. Temporary partitions.
  17. Fire protection.
  18. Temporary project signage.
  19. Accessories necessary for a complete installation.

#### **1.3 USE CHARGES**

- A. Installation and removal of, and use charges for, temporary facilities 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, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service: Pay sewer service use charges for water used and sewer usage by all entities for construction operations.
- C. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

#### **1.4 SUBMITTALS**

- A. Site Plan: Show temporary facilities, utility connections, staging areas, and construction personnel parking areas.
- B. 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 tile 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.

- C. 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. HVAC system isolation schematic drawing.
  - 2. Waste handling procedures.
  - 3. Other dust control measures.

## 1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Accessible Temporary Egress: Comply with applicable provisions in ADA Standards, ICC A117.1-2009, and 2012 Texas Accessibility Standards (2012 TAS).
- B. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70-2017.
- C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

## 1.6 PROJECT CONDITIONS

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

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for intended use.
- B. Chain Link Fencing: Minimum 2 inch (50 mm), 0.148 inch (3.8 mm) thick, galvanized steel, chain link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8 inch (60 mm) OD line posts and 2-7/8 inch (73 mm) OD corner and pull posts.
- C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10 mils (0.25 mm) minimum thickness, with flame spread rating of 15 or less per ASTM E84.
- D. Dust Control Adhesive Surface Walk off Mats: Provide mats minimum 36 inches by 60 inches (914 mm by 1624 mm).
- E. Insulation: Unfaced mineral fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame spread and smoke developed indexes of 25 and 50, respectively.
- F. Lumber and Plywood: Comply with requirements in Section 06 10 00 - Rough Carpentry.
- G. Gypsum Board: Minimum 1/2 inch (12.7 mm) thick by 48 inches (1219 mm) wide by maximum available lengths; Type X or Type C panels with tapered edges. Comply with Section 09 21 16 - Gypsum Board Assemblies.
- H. Paint: Comply with requirements in Section 09 90 00 - Painting and Coating.
- I. Tarpaulins: Fire resistive labeled with flame-spread rating of 15 or less.
- J. Water: Potable.

### 2.2 TEMPORARY FACILITIES

- A. Contractor's Field Offices:
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations. Store combustible materials apart from building.

## **2.3 EQUIPMENT**

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. Drinking Water: Containerized, tap dispenser, bottled water drinking water units, including paper cup supply. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 degrees F to 55 degrees F (7.2 degrees C to 12.7 degrees C).
- C. Electrical Outlets: Properly configured, NEMA polarized outlets to prevent insertion of 110V to 120V plugs into higher voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- D. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125V AC, 20 A rating, and lighting circuits may be non-metallic sheathed cable.
- E. 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.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Locate facilities where they will serve project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
  - 1. Locate facilities to limit site disturbance as specified in Section 01 10 00 - Summary.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

### **3.2 TEMPORARY UTILITY INSTALLATION**

- A. Install temporary service. Arrange with utility company, School District, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
  - 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. 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. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.
- 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 that will not have a harmful effect on completed installations or elements being installed.
- F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
  - 1. Prior to commencing Work, isolate the HVAC system in area where Work is to be performed according to coordination drawings.

- a. Disconnect supply and return ductwork in Work area from HVAC systems servicing occupied areas.
  - b. Maintain negative air pressure within Work area using HEPA equipped air filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
  2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust producing equipment. Isolate limited Work within occupied areas using portable dust containment devices.
  3. Perform daily construction cleanup and final cleanup using approved, HEPA filter equipped vacuum equipment.
- G. 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.
- H. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations. Install electric power service underground unless otherwise indicated.
1. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.
    - a. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length voltage ratio.
    - b. Provide warning signs at power outlets other than 110 to 120V.
    - c. Provide metal conduit, tubing, or metallic cable for wiring exposed to possible damage. Provide rigid steel conduits for wiring exposed on grades, floors, decks, or traffic areas.
    - d. Provide metal conduit enclosures or boxes for wiring devices.
    - e. Provide 4 gang outlets, spaced so 100 foot (30 m) extension cord can reach each area for power hand tools and task lighting. Provide a separate 125V AC, 20A circuit for each outlet.
  - I. 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.

### **3.3 SUPPORT FACILITIES INSTALLATION**

- A. Temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines shall be of non-combustible construction according to ASTM E136. Comply with NFPA 241.
1. 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 School District.
- B. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.

2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 31 20 00 - Earth Moving.
  3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
  4. Delay installation of final course of permanent pavement until immediately before Substantial Completion.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Provide temporary parking areas for construction personnel.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
- F. 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.
- G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- H. Temporary Elevators: Use of temporary elevators is not permitted.
- I. Temporary Use of Permanent Elevators: Use of new elevators for construction traffic will be permitted, provided elevators are protected and finishes restored to new condition at time of Substantial Completion.
- J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

### 3.4 TEMPORARY PROJECT SIGNAGE

- A. Provide signs as indicated. Unauthorized signs are not permitted.
- B. Project Identification Signs: Provide Project identification signs as specified and indicated on Drawings.
1. Furnish and install a project sign which includes the following. Contractor shall be responsible for the cost of printing the image, mounting the sign on an aluminum substrate, and installing the sign at the site.
    - a. Size: 6'-0" by 8'-0".
    - b. Location: Coordinate with Architect.
    - c. Graphics: Image shall be provided to the graphics printing company by the Architect after Award of Contract.
    - d. Provide the following information on the sign:
      - 1) Name of the Project.
      - 2) School District.
      - 3) Owner's Designated Representative.
      - 4) Contractor.
      - 5) Architect.
      - 6) Each Project Consultant.
- C. Additional Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project. Other signs permitted at the site:
1. Warning Signs.

2. Directional Signs for construction personnel and visitors.
  3. Identification Signs at Field Offices.
  4. Emergency Medical Services Sign.
  5. Signs required by Authorities Having Jurisdiction (AHJ).
  6. Storm Water Pollution Prevention Plan sign (SWPPP).
- D. Contractor shall allow no other signs to be displayed at the project site, unless authorized by the School District.

### **3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION**

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities to the satisfaction of Owner and Architect.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
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: Engage pest control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- G. Site Enclosure Fence: Before construction operations begin, provide site enclosure fence to prevent people and 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.
- H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each Work day.
- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- J. Temporary Egress: 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 incomplete, insulate temporary enclosures.
- L. Temporary Partitions: Provide floor to ceiling dustproof partitions to limit dust and dirt migration and to separate occupied areas occupied from fumes and noise.
  1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire retardant treated plywood on construction operations side.
  2. Construct dustproof partitions with two layers of 6 mil (0.14 mm) polyethylene sheet on each side. Cover floor with two layers of 6 mil (0.14 mm) polyethylene sheet, extending sheets 18 inches (460 mm) up the sidewalls. Overlap and tape full length of joints. Cover floor with fire retardant treated plywood. Do not apply tape to finish floor surfaces.
    - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1219 mm) between doors. Maintain water dampened foot mats in vestibule.
  3. Where fire resistance rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
  4. Insulate partitions to control noise transmission to occupied areas.
  5. Seal joints and perimeter. Equip partitions with gasketed, dustproof doors and security locks where openings are required.
  6. Protect air handling equipment.
  7. Provide walk off mats at each entrance through temporary partition.
- M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
  1. Prohibit smoking in construction areas.
  2. Supervise welding operations, combustion type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
  3. Develop and supervise an overall fire prevention and protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
  4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

### **3.6 MOISTURE AND MOLD CONTROL**

- A. 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 Condition 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 and moisture control.
    - a. Hygroscopic materials that may support mold growth, including wood and gypsum based products, which become wet during the course of construction and remain wet for 48 hours are considered defective and are to be removed and replaced.
    - 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.

### **3.7 OPERATION, TERMINATION, AND REMOVAL**

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

**END OF SECTION 01 50 00**

## **SECTION 01 55 00 - VEHICULAR ACCESS AND PARKING**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Access roads.
  - 2. Parking.
  - 3. Existing pavements and parking areas.
  - 4. Construction parking controls.
  - 5. Flag persons.
  - 6. Flares and lights.
  - 7. Haul routes.
  - 8. Traffic signs and signals.
  - 9. Maintenance.
  - 10. Removal, repair.
  - 11. Mud from site vehicles.
- B. Related Sections:
  - 1. Section 01 10 00 - Summary: For access to site, work sequence, and occupancy.
  - 2. Section 01 50 00 - Temporary Facilities and Controls: Post Mounted and Wall Mounted Traffic Control and Informational Signs.
  - 3. Section 31 22 13 - Rough Grading: Specifications for earthwork and paving bases.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. Temporary Construction: Contractor's option.
- B. Materials for Permanent Construction: As specified in product specification sections, including earthwork, paving base, and topping.

#### **2.2 SIGNS, SIGNALS, AND DEVICES**

- A. Stock, Post-Mounted and Wall-Mounted Traffic Control and Informational Signs:
  - 1. Manufacturers:
- B. Traffic Cones and Drums, Flares and Lights: As approved by the Authorities Having Jurisdiction (AHJ).
- C. Flag Person Equipment: As required by the local Authorities Having Jurisdiction (AHJ).

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Clear areas, provide surface and storm drainage of road, parking, area premises, and adjacent areas.

#### **3.2 ACCESS ROADS**

- A. Use of designated, existing, on-site streets and driveways for construction traffic is permitted.
- B. Tracked vehicles not allowed on paved areas.
- C. Construct temporary, all-weather access roads as needed from public thoroughfares to serve construction area, of a width and load bearing capacity to provide unimpeded traffic for construction purposes.
  - 1. Extend and relocate as work progress requires, provide detours as necessary for unimpeded traffic flow.
  - 2. Location as indicated.
- D. Provide unimpeded access for emergency vehicles. Maintain 20 foot (6 m) width driveways with turning space between and around combustible materials.

- E. Provide and maintain access to fire hydrants free of obstructions.

**3.3 PARKING**

- A. Use of existing parking facilities by construction personnel is not permitted.
- B. Use of designated areas of existing parking facilities by construction personnel is permitted.
- C. Arrange for temporary parking areas to accommodate use of construction personnel.
  - 1. Locate as indicated by the Authorities Having Jurisdiction (AHJ).
- D. When site space is not adequate, arrange for additional off-site parking.

**3.4 CONSTRUCTION PARKING CONTROL**

- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and the School District's operations.
- B. Monitor parking of construction personnel's vehicles. Maintain vehicular access to and through parking areas.
- C. Prevent parking on or adjacent to access roads or in non-designated areas.

**3.5 FLAG PERSONS**

- A. Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

**3.6 FLARES AND LIGHTS**

- A. Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

**3.7 HAUL ROUTES**

- A. Consult with the Authorities Having Jurisdiction (AHJ), establish public thoroughfares to be used for haul routes and site access.
- B. Confine construction traffic to designated haul routes.
- C. Provide traffic control at critical areas of haul routes to regulate traffic, to minimize interference with public traffic.

**3.8 TRAFFIC SIGNS AND SIGNALS**

- A. At approaches to site and on site, install at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.
- B. Relocate as work progresses, to maintain effective traffic control.

**3.9 MAINTENANCE**

- A. Maintain traffic and parking areas in a sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
- B. Maintain existing paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

**3.10 REMOVAL, REPAIR**

- A. Repair existing and new permanent facilities damaged by use, to original condition.
- B. Remove equipment and devices when no longer required.
- C. Repair damage caused by installation.
- D. Remove post settings to a depth of 2 feet (600 mm).

**3.11 MUD FROM SITE VEHICLES**

- A. Provide means of removing mud from vehicle wheels before entering streets.

**END OF SECTION 01 55 00**

## **SECTION 01 56 00 - TEMPORARY BARRIERS AND ENCLOSURES**

### **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 SECTION INCLUDES**

- A. Temporary jobsite protection including the following:
  1. Temporary floor and wall protection.
  2. Door jamb protection.
  3. Small project floor and wall protection.
  4. Seaming tape for floor protection.
  5. Recyclable, portable jobsite trash containers.

#### **1.3 RELATED SECTIONS**

- A. Section 03 30 00 "Cast-In-Place Concrete".
- B. Division 08 Openings.

#### **1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00 - Submittal Procedures.
- 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. Installation methods.

#### **1.5 QUALITY ASSURANCE**

- A. Manufacturer: Minimum Five (5) years' experience manufacturing similar products.

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

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Handle materials to avoid damage.

### **PART 2 PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
  1. Ram Board.
  2. Surface Shields.
  3. Trimaco, Inc.

#### **2.2 TEMPORARY FLOOR AND WALL PROTECTION**

- A. Temporary protection board shall comply with the following requirements, as necessary for the use.
  1. Fold lines allowing corner, horizontal and vertical wall protection.
    - a. Wall guard fold lines at 4 inches (101 mm), 8 inches (203 mm) and 12 inches (305 mm) from edge of board.
  2. Allow protected substrates and finishes to cure while being protected.
  3. Protection against water, paint, mud, and more.
- B. Basis of Design:

1. Products as manufactured by Ram Board.
  - a. Heavy Duty Temporary and Reusable Floor and Wall Protection: Ram Board Model #RB 38-100.
  - b. Pre-Taped Board: Ram Board Plus Model #RB PLUS 38-100.
  - c. Reusable Protection for Small Projects: Ram Board Home Edition Model #RBHE 36-50.
  - d. Painter's Board: Ram Board Painter's Board Model #20RB 35-50.

### **2.3 DOOR JAMB PROTECTION**

- A. Door Jamb Protection: Heavy-duty flexible re-usable door jamb protection.
  1. Materials: Recycled and recyclable materials.
  2. Door Jamb Sizes: Fits 4 inches – 9 inches (102 mm – 229 mm).
  3. Basis of Design: Model # RBJP 60 or RBJP 36 Ram Jamb.

### **2.4 SEAMING AND EDGE TAPES FOR FLOOR PROTECTION**

- A. Seaming Tape: Used to cover Ram Board seams.
  1. Backing: Unique kraft backing tears easily and creates an extremely durable, smooth finish.
  2. Basis of Design: Ram Board Model #RT 3-164.
- B. Vapor-Cure Tape: Used to cover Ram Board seams which prevents tape lines.
  1. Performance: Allows vapors and moisture to escape from concrete, glue down floors, stained floors, epoxy floors, refinished floors, vinyl composition tile, and most other floor types.
  2. Basis of Design: Ram Board Model #RB VCT 3-108
- C. Edge Tape: Used to secure Ram Board Temporary Floor Protection edges to flooring or wall surfaces.
  1. Performance: Easy Release, low tack tape for up to 14 days. Grips tightly to Ram Board while easy release on flooring surfaces up to 14 days.
  2. Basis of Design: Ram Board Model #RB ET 2.5-180.

### **2.5 PORTABLE JOBSITE TRASH CONTAINERS**

- A. Portable Jobsite Trash Containers: Portable, reusable jobsite trash container.
  1. Fits Trash Bags: 42 gal – 50 gal (159 to 189 L).
  2. Quick self-locking assembly, no tape required.
  3. Basis of Design: Ram Board Trash Box Model # RBTB 16-36.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates for compliance with requirements for installation. Proceed with installation or protection products only after unsatisfactory conditions have been corrected.
- B. Do not begin protection installation until substrates have been properly prepared.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### **3.2 INSTALLATION**

- A. Install protection products in accordance with manufacture's written instructions and approved submittals.

### **3.3 PROTECTION**

- A. Protection installed products may be left in place until completion of project or adjacent work.

**END OF SECTION 01 56 00**

## **SECTION 01 57 13 - TEMPORARY EROSION AND SEDIMENT CONTROL**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.
- D. Performance bond.
- E. Compensation of School District for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

#### **1.2 RELATED SECTIONS**

- A. Section 32 11 23 - Aggregate Base Courses: Temporary and permanent roadways.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus; 2021.
- B. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 2021.
- C. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2015 (Reapproved 2023).
- D. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a.
- E. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile; 2021.
- F. ASTM D4873/D4873M - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2017 (Reapproved 2021).
- G. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.
- H. FHWA FLP-94-005 - Best Management Practices for Erosion and Sediment Control; 1995.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Comply with requirements of EPA (NPDES) for erosion and sedimentation control, as specified by the NPDES, for Phases I and II, and in compliance with requirements of Construction General Permit (CGP), whether the project is required by law to comply or not.
- B. Best Management Practices Standard: FHWA FLP-94-005.
- C. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.
- D. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
  - 1. Obtain and pay for permits and provide security required by authority having jurisdiction.
- E. Provide to School District a Performance Bond covering erosion and sedimentation preventive measures only, in an amount equal to 100 percent of the cost of erosion and sedimentation control work.
- F. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.

- G. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
  - 1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
  - 2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.
- H. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
  - 1. Control movement of sediment and soil from temporary stockpiles of soil.
  - 2. Prevent development of ruts due to equipment and vehicular traffic.
  - 3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to School District.
- I. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
  - 1. Prevent windblown soil from leaving the project site.
  - 2. Prevent tracking of mud onto public roads outside site.
  - 3. Prevent mud and sediment from flowing onto sidewalks and pavements.
  - 4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to School District.
- J. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
  - 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to School District; remove deposited sediments; comply with requirements of authorities having jurisdiction.
  - 2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.
- K. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
  - 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to School District; remove deposited sediments; comply with requirements of authorities having jurisdiction.
- L. Open Water: Prevent standing water that could become stagnant.
- M. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

## 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Erosion and Sedimentation Control Plan:
  - 1. Submit within 2 weeks after Notice to Proceed.
  - 2. Include:
    - a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
    - b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
    - c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
    - d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
    - e. Other information required by law.

- f. Format required by law is acceptable, provided any additional information specified is also included.
- 3. Obtain the approval of the Plan by authorities having jurisdiction.
- 4. Obtain the approval of the Plan by School District.
- C. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.
- D. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.
- B. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
  - 1. Average Opening Size: 30 U.S. Std. Sieve (0.600 mm), maximum, when tested in accordance with ASTM D4751.
  - 2. Permittivity:  $0.05 \text{ sec}^{-1}$ , minimum, when tested in accordance with ASTM D4491/D4491M.
  - 3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
  - 4. Tensile Strength: 100 pounds-force (450 N), minimum, in cross-machine direction; 124 pounds-force (550 N), minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.
  - 5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
  - 6. Tear Strength: 55 pounds-force (245 N), minimum, when tested in accordance with ASTM D4533/D4533M.
  - 7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
- C. Silt Fence Posts: One of the following, minimum 5 feet (1500 mm) long:
  - 1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot (1.98 kg per linear m).
  - 2. Softwood, 4 by 4 inches (100 by 100 mm) in cross section.
  - 3. Hardwood, 2 by 2 inches (50 by 50 mm) in cross section.
- D. Gravel: See Section 32 11 23 for aggregate.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

### **3.2 PREPARATION**

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

### **3.3 SCOPE OF PREVENTIVE MEASURES**

- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
- B. Construction Entrances: Traffic-bearing aggregate surface.
  - 1. Width: As required; 20 feet (7 m), minimum.
  - 2. Length: 50 feet (16 m), minimum.
  - 3. Provide at each construction entrance from public right-of-way.



4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.
- C. Linear Sediment Barriers: Made of silt fences.
  1. Provide linear sediment barriers:
    - a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
    - b. Along the top of the slope or top bank of drainage channels and swales that traverse disturbed areas.
    - c. Along the toe of cut slopes and fill slopes.
    - d. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space at maximum of 200 feet apart (at maximum of 60 m apart).
    - e. Across the entrances to culverts that receive runoff from disturbed areas.
  2. Space sediment barriers with the following maximum slope length upslope from barrier:
    - a. Slope of Less Than 2 Percent: 100 feet (30 m)..
    - b. Slope Between 2 and 5 Percent: 75 feet (23 m).
    - c. Slope Between 5 and 10 Percent: 50 feet (15 m).
    - d. Slope Between 10 and 20 Percent: 25 feet (7.5 m).
    - e. Slope Over 20 Percent: 15 feet (4.5 m).
- D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
  1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
  2. Straw bale row blocking entire inlet face area; anchor into pavement.
- E. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.
- F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.
- G. Soil Stockpiles: Protect using one of the following measures:
  1. Cover with polyethylene film, secured by placing soil on outer edges.
  2. Cover with mulch at least 4 inches (100 mm) thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches (150 mm) of straw or hay.
- H. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.
- I. Temporary Seeding: Use where temporary vegetated cover is required.

### 3.4 INSTALLATION

- A. Traffic-Bearing Aggregate Surface:
  1. Excavate minimum of 6 inches (150 mm).
  2. Place geotextile fabric full width and length, with minimum 12 inch (300 mm) overlap at joints.
  3. Place and compact at least 6 inches (150 mm) of 1 1/2 to 3 1/2 inch (40 to 90 mm) diameter stone.
- B. Silt Fences:
  1. Store and handle fabric in accordance with ASTM D4873/D4873M.
  2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch (405 mm) high barriers with minimum 36 inch (905 mm) long posts spaced at 6 feet (1830 mm) maximum, with fabric embedded at least 4 inches (100 mm) in ground.
  3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch (710 mm) high barriers, minimum 48 inch (1220 mm) long posts spaced at 6 feet (1830 mm) maximum, with fabric embedded at least 6 inches (150 mm) in ground.

4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet (6 m), use nominal 32 inch (810 mm) high barriers with woven wire reinforcement and steel posts spaced at 4 feet (1220 mm) maximum, with fabric embedded at least 6 inches (150 mm) in ground.
  5. Install with top of fabric at nominal height and embedment as specified.
  6. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches (460 mm), with extra post.
  7. Fasten fabric to wood posts using one of the following:
    - a. Four nails per post with 3/4 inch (19 mm) diameter flat or button head, 1 inch (25 mm) long, and 14 gauge, 0.083 inch (2.11 mm) shank diameter.
    - b. Five staples per post with at least 17 gauge, 0.0453 inch (1.150 mm) wire, 3/4 inch (19 mm) crown width and 1/2 inch (12 mm) long legs.
  8. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.
  9. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches (300 mm) high with post spacing not more than 4 feet (1220 mm).
- C. Temporary Seeding:
1. When hydraulic seeder is used, seedbed preparation is not required.
  2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
  3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft (0.5 kg per 100 sq m).
  4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft (6 to 8 kg per 100 sq m).
  5. Incorporate fertilizer into soil before seeding.
  6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch (12 to 25 mm) deep.
  7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
  8. Repeat irrigation as required until grass is established.

### **3.5 MAINTENANCE**

- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches (13 mm) or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.
- C. Silt Fences:
  1. Promptly replace fabric that deteriorates unless need for fence has passed.
  2. Remove silt deposits that exceed one-third of the height of the fence.
  3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- D. Clean out temporary sediment control structures weekly and relocate soil on site.
- E. Place sediment in appropriate locations on site; do not remove from site.

### **3.6 CLEAN UP**

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

**END OF SECTION 01 57 13**

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## **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: Administrative and procedural requirements for selection of products, including but not limited to:
  - 1. Product delivery, storage, and handling.
  - 2. Product warranties.
  - 3. Comparable products.

#### **1.3 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  - 1. Basis of Design Product Specification.
  - 2. Product.
    - a. Comparable Product.
    - b. Named Products.
    - c. New Products.

#### **1.4 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 specified requirements.
  - 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 shall 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, select product 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.
- B. Delivery and Handling:
  - 1. Schedule delivery to minimize long term storage at site and to prevent overcrowding of construction spaces.

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

## **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 School District.
  2. Warranty: Written warranty required by the Contract Documents to provide specific rights for School District.
- B. Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
  2. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 77 00 - Closeout Procedures.

## **PART 2 PRODUCTS**

### **2.1 PRODUCT SELECTION PROCEDURES**

- A. Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and items needed for complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. School District 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 shall make selection.
  5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

- B. Product Selection Procedures:
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: 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.
  4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  5. Basis of Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and characteristics based on the product named. Comply with requirements for consideration of an unnamed product by one of the named manufacturers.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with specified requirements, comply with requirements of Section 01 25 13 - Product Substitution Procedures for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "selected by Architect" or similar phrase, select a product that complies with requirements. Architect shall select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect shall 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 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 01 60 00**

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## **SECTION 01 61 16 - VOLATILE ORGANIC COMPOUND (VOC) CONTENT 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. Requirements for Indoor-Emissions-Restricted products.
  - 2. Requirements for VOC-Content-Restricted products.
  - 3. Requirement for installer certification that they did not use any non-compliant products.
- B. Related Requirements:
  - 1. Section 01 33 00 - Submittal Procedures: Submittal procedures.
  - 2. Section 07 92 00 - Joint Sealants: Emissions-compliant sealants.

#### **1.3 INCLUDED PRODUCTS**

- A. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
  - 1. Interior paints and coatings applied on site.
  - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
  - 3. Flooring.
  - 4. Composite wood.
  - 5. Products making up wall and ceiling assemblies.
  - 6. Thermal and acoustical insulation.
- B. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
  - 1. Interior paints and coatings applied on site.
  - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
  - 3. Wet-applied roofing and waterproofing.
- C. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:
  - 1. Stone.
  - 2. Concrete.
  - 3. Clay brick.
  - 4. Metals that are plated, anodized, or powder-coated.
  - 5. Glass.
  - 6. Ceramics.
  - 7. Solid wood flooring that is unfinished and untreated.

#### **1.4 REFERENCE STANDARDS**

#### **1.5 SUBMITTALS**

- A. Refer to Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.
- C. Installer Certifications Regarding Prohibited Content: Require each installer of any type of product (not just the products for which VOC restrictions are specified) to certify that either 1) no adhesives, joint sealants, paints, coatings, or composite wood or agrifiber products have been used in the installation of installer's products, or 2) that such products used comply with these requirements.



## 1.6 QUALITY ASSURANCE

- A. Indoor Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
  - 1. Wet-Applied Products: State amount applied in mass per surface area.
  - 2. Paints and Coatings: Test tinted products, not just tinting bases.
  - 3. Evidence of Compliance: Acceptable types of evidence are the following;
    - a. Current UL (GGG) certification.
    - b. Current SCS (CPD) Floorscore certification.
    - c. Current SCS (CPD) Indoor Advantage Gold certification.
    - d. Current listing in CHPS (HPPD) as a low-emitting product.
    - e. Current CRI (GLP) certification.
    - f. Test report showing compliance and stating exposure scenario used.
  - 4. Product data submittal showing VOC content is NOT acceptable evidence.
  - 5. Manufacturer's certification without test report by independent agency is NOT acceptable evidence.
- B. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Report of laboratory testing performed in accordance with requirements.
    - b. Published product data showing compliance with requirements.
    - c. Certification by manufacturer that product complies with requirements.
- C. Composite Wood Emissions Standard: CARB (ATCM) for ultra-low emitting formaldehyde (ULEF) resins.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Current SCS "No Added Formaldehyde (NAF)" certification; [www.scs-certified.com](http://www.scs-certified.com).
    - b. Report of laboratory testing performed in accordance with requirements.
    - c. Published product data showing compliance with requirements.
    - d. Certification by manufacturer that product complies with requirements.
- D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.
- B. Indoor-Emissions-Restricted Products: Comply with Indoor Emissions Standard and Test Method, except for:
  - 1. Composite Wood, Wood Fiber, and Wood Chip Products: Comply with Composite Wood Emissions Standard or contain no added formaldehyde resins.
- C. VOC-Content-Restricted Products: VOC content not greater than required by the following:
  - 1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
  - 2. Aerosol Adhesives: GreenSeal GS-36.
  - 3. Joint Sealants: SCAQMD 1168 Rule.
  - 4. Paints and Coatings: Each color; most stringent of the following:
    - a. SCAQMD 1113 Rule.
  - 5. Wet-Applied Roofing and Waterproofing: Comply with requirements for paints and coatings.

**PART 3 EXECUTION**

**3.1 FIELD QUALITY CONTROL**

- A. School District reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to School District.
- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

**END OF SECTION 01 61 16**

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## **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. Section Includes: Administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
  1. Construction layout.
  2. Field engineering and surveying.
  3. Installation of the Work.
  4. Coordination of School District-installed products.
  5. Progress cleaning.
  6. Starting and adjusting.
  7. Protection of installed construction.

#### **1.3 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  1. Cutting.
  2. Patching.

#### **1.4 SUBMITTALS**

- A. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.
- B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- 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 legally qualified to practice in the State of Texas, 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. 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 warranted. Before beginning site Work, investigate and verify existence and location of underground utilities, mechanical and electrical systems, and 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; underground electrical services, and other utilities.
  2. Furnish location data for Work related to the Work that must be performed by public utilities serving the site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions 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 after correcting unsatisfactory conditions. Proceeding with the Work indicates acceptance of surfaces and conditions.

### **3.2 PREPARATION**

- A. Existing Utility Information: Furnish information to School District 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 (AHJ).
- 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 information to Architect according to requirements in Section 01 31 00 - Project Management and Coordination.

### **3.3 CONSTRUCTION LAYOUT**

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, promptly notify Architect.
- B. Engage a land surveyor or professional engineer 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 necessary to locate each element of Project.
  2. Establish limits on use of 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 (AHJ).
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical Work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control Work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

### **3.4 FIELD ENGINEERING**

- A. Identification: School District 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 site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other Work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor or professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, 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 (AHJ) as the official "property survey."

### **3.5 INSTALLATION**

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical Work plumb and make horizontal Work level.

2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
  4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
  - C. Install products at the time and under conditions ensuring 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 produce 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. Materials containing asbestos and BCPs are prohibited.

### **3.6 SCHOOL DISTRICT-INSTALLED PRODUCTS**

- A. Site Access: Provide access to site for School District's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with Work performed by School District's construction personnel.
  1. Construction Schedule: Inform School District of Contractor's preferred construction schedule for School District's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify School District if changes to schedule are required due to differences in actual construction progress.
  2. Preinstallation Conferences: Include School District's construction personnel at pre-installation conferences covering portions of the Work that are to receive School District's Work. Attend pre-installation conferences conducted by School District's construction personnel if portions of the Work depend on School District's construction.

### **3.7 PROGRESS CLEANING**

- A. Clean site and Work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
  1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.

2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 degrees F (27 degrees C).
  3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Use containers intended for holding waste materials of type to be stored.
  4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain 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 in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 50 00 - Temporary Facilities and Controls.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to 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. Coordinate startup and adjusting of equipment and operating components with mechanical, plumbing, and electrical.
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with 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. Refer to Section 01 56 00 - Temporary Barriers and Enclosures.



- B. Comply with manufacturer's written instructions for temperature and relative humidity.

**END OF SECTION 01 73 00**

## **SECTION 01 73 29 - CUTTING AND PATCHING**

### **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: Procedural requirements for cutting and patching.

#### **1.3 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  - 1. Cutting.
  - 2. Patching.

#### **1.4 SUBMITTALS**

- A. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
  - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
  - 2. Changes to In Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
  - 3. Products: List products used for patching and firms or entities that will perform patching Work.
  - 4. Dates: Indicate when cutting and patching will be performed.
  - 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
    - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

#### **1.5 QUALITY ASSURANCE**

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
- B. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
- C. Operational Elements: Do not cut and patch operating elements and related components that results in reducing the capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
  - 1. Primary operational systems and equipment.
  - 2. Fire separation assemblies.
  - 3. Air or smoke barriers.
  - 4. Fire suppression systems.
  - 5. Mechanical systems piping and ducts.
  - 6. Control systems.
  - 7. Communication systems.
  - 8. Fire detection and alarm systems.
  - 9. Conveying systems.
  - 10. Electrical wiring systems.
  - 11. Operating systems of special construction.

- D. Miscellaneous Elements: Do not cut and patch the following elements or related components that change the load bearing capacity, resulting in a reduction of capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
  - 1. Water, moisture, or vapor barriers.
  - 2. Membranes and flashings.
  - 3. Exterior curtain wall construction.
  - 4. Equipment supports.
  - 5. Piping, ductwork, vessels, and equipment.
  - 6. Noise and vibration control elements and systems.
  - 7. Sprayed fire resistive material.
- E. Visual Requirements: Do not cut and patch construction resulting in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
  - 1. If possible, retain original Installer or fabricator to cut and patch exposed Work. If possible, engage original Installer or fabricator. If original installer is not available, engage recognized, experienced, and specialized firm for the Work.
    - a. Processed concrete finishes.
    - b. Ornamental metal.
    - c. Matched veneer woodwork.
    - d. Preformed metal panels.
    - e. Roofing.
    - f. Firestopping.
    - g. Window system.
    - h. Fluid applied flooring.
    - i. Wall covering.
    - j. HVAC enclosures, cabinets, or covers.
- F. Cutting and Patching Conference: Before proceeding, meet at site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

## **1.6 WARRANTY**

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. Comply with specified requirements.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
  - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
  - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Services: Where removal, relocation, or abandonment is necessary, bypass existing services before cutting to avoid interruption of services to occupied areas.

### 3.3 CUTTING AND PATCHING

- A. Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at earliest feasible time, and complete without delay.
  - 1. Cut existing construction to provide for installation of components or performance of construction, and subsequently patch as necessary to restore surfaces to an original condition.
  - 2. Cut in place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Temporary Support: Provide temporary support of Work to be cut.
- C. Protection: Protect in place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 10 00 - Summary.
- E. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. Use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. Finished Surfaces: Cut or drill from exposed or finished side into concealed surfaces.
  - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  - 4. Excavating and Backfilling: Comply with requirements in applicable earthwork specifications by cutting and patching operations.
  - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  - 6. Proceed with patching after construction operations requiring cutting are complete.
- F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
  - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
  - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction to eliminate evidence of patching and refinishing.

- a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
- b. Restore damaged pipe covering to its original condition.
3. Floors and Walls: Where walls or partitions are removed, extend one finished area into another, patch and repair surfaces in new space. Provide even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.
4. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
5. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
6. Exterior Building Enclosure: Patch components and restore enclosure to a weathertight condition.

**END OF SECTION 01 73 29**

## **SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

### **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 the following:
  - 1. Salvaging non-hazardous waste.
  - 2. Disposing of non-hazardous waste.

#### **1.3 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  - 1. Construction Waste.
  - 2. Demolition Waste.
  - 3. Disposal.
  - 4. Recycle.
  - 5. Salvage.
  - 6. Salvage and Reuse.

#### **1.4 SUBMITTALS**

- A. Waste Management Plan: Submit plan within 10 days of date established for commencement of the work.
- B. Waste Reduction Progress Reports:
  - 1. Concurrent with each Application for Payment, submit report.
  - 2. Include the following information:
    - a. Material category.
    - b. Generation point of waste.
    - c. Total quantity of waste in tons (tonnes).
    - d. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
    - e. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
    - f. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- C. 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: Firm having minimum 10 years documented experience in specializing in waste management coordination.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Waste Management Conference:
  - 1. Conduct conference at site. Review methods and procedures related to waste management including, but not limited to, the following:
    - a. Review and discuss waste management plan including responsibilities of waste management coordinator.
    - b. Review requirements for documenting quantities of each type of waste and its disposition.
    - c. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.

- d. Review procedures for periodic waste collection and transportation to disposal facilities.
- e. Review waste management requirements for each trade.

### **1.6 PERFORMANCE REQUIREMENTS**

- A. Conform to applicable regulations regarding Solid Waste Control.
- B. Practice efficient waste management in the use of materials in the course of the Work.
- C. Facilitate recycling and salvage of materials.
- D. Use all reasonable means to divert demolition and construction waste, from landfills and incinerators.

### **1.7 WASTE MANAGEMENT PLAN**

- A. Develop a waste management plan and requirements.
  - 1. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis.
- B. Waste Identification: Indicate anticipated types and quantities of demolition site clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan:
  - 1. List each type of waste and whether it will be salvaged or recycled. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
    - a. 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.
    - b. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
    - c. 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:
  - 1. 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.
  - 2. Include the following:
    - a. Total quantity of waste.
    - b. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
    - c. Total cost of disposal (with no waste management).
    - d. Revenue from salvaged materials.
    - e. Savings in hauling and tipping fees by donating materials.
    - f. Savings in hauling and tipping fees that are avoided.
    - g. Handling and transportation costs. Include cost of collection containers for each type of waste.
    - h. Net additional cost or net savings from waste management plan.

## **PART 2 PRODUCTS**

**NOT USED**

## **PART 3 EXECUTION**

### **3.1 PLAN IMPLEMENTATION**

- A. 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.
- C. Training:
  1. Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work:
    - a. Distribute waste management plan to everyone concerned within three (3) days of submittal return.
    - b. 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:
  1. Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities:
    - a. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
    - b. Comply with Section 01 50 00 - Temporary Facilities and Controls for the control of dust and dirt, environmental protection, and noise control.
- E. Waste Management in Historic Zones or Areas: Hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by 12 inches (300 mm) or more.

### **3.2 SALVAGING DEMOLITION WASTE**

- A. Salvaged Items for Reuse in the work:
  1. Salvage items for reuse and handle:
    - a. Clean salvaged items.
    - b. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
    - c. Store items in a secure area until installation.
    - d. Protect items from damage during transport and storage.
    - e. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Sale and Donation: Not permitted on Project site.
- C. Salvaged Items for School District's Use:
  1. Salvage items for School District's use and handle as follows:
    - a. Clean salvaged items.
    - b. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
    - c. Store items in a secure area until delivery to School District.
    - d. Transport items to Owner's storage area designated by School District.
    - e. Protect items from damage during transport and storage.
- D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors, unless otherwise designated by School District.
- E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- F. Plumbing Fixtures: Separate by type and size.
- G. Lighting Fixtures: Separate lamps by type and protect from breakage.
- H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.



### **3.3 DISPOSAL OF WASTE**

- A. 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. Disposal: Remove waste materials and dispose of at designated spoil areas on School District's property.

**END OF SECTION 01 74 19**

## **SECTION 01 77 00 - CLOSEOUT 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 PRE-CLOSEOUT MEETING**

- A. Pre-Closeout Meeting: Schedule and convene Pre-Closeout Meeting with Owner and Architect in accordance with Section 01 31 00 - Project Management and Coordination.

#### **1.3 SUBSTANTIAL COMPLETION**

- A. Items listed in Supplementary Conditions, Article 9, Section 9.8 "Substantial Completion" and the following items shall be completed before Substantial Completion will be granted:
  - 1. Contractor's Completion List (Punch List): Submit a thorough list of items to be completed or corrected, along with a written request for Substantial Completion and for review of the Work or portion of the Work. The Architect's Project Representative, at their discretion, may attend and assist in the preparation of the Contractor's Punch List.
  - 2. Architect's Supplemental Punch List: The Architect, along with the School District at the School District's discretion, will inspect the Work utilizing the Contractor's prepared Punch List, noting completed items and incomplete items, and will prepare a supplemental list of items that have been omitted or incomplete items that were not previously noted.
  - 3. Operations and Maintenance Manuals: Submit as described in "Operations and Maintenance Manuals" article below.
  - 4. Final Cleaning: Provide final cleaning and adequate protection of installed construction as described in "Final Cleaning" and "Protecting Installed Construction" articles below.
  - 5. Starting of Systems: Start up equipment and systems as described in "Starting of Systems" article below.
  - 6. Testing and Balancing: Testing and balancing of systems must be performed and completed by School District's forces, and the report submitted and accepted by Architect and School District, as described in the Contract Documents. Make adjustments to equipment as required to achieve acceptance.
  - 7. Demonstrations: If required by individual specification sections or by School District, provide demonstrations and instructions for use of equipment as described in "Demonstration and Instructions" article below.
- B. Date of Substantial Completion: Complete or correct items identified on Punch List and confirm that all items have been corrected prior to Architects re-inspection. Architect, along with the School District, will re-inspect the corrected work to establish the Date of Substantial Completion. Incomplete items remaining will be appended to the Certificate of Substantial Completion (AIA G704). The Date of Substantial Completion represents day one (1) of the closeout period, and represents the date of commencement of the Contractors correctional period and all warranty periods as described and required by the Contract Documents, except as amended in the Certificate of Substantial Completion and elsewhere in the Contract Documents.
- C. Certificate of Substantial Completion: When the Work or designated portion thereof is substantially complete, Architect shall prepare the Certificate of Substantial Completion to be executed by the School District and Contractor. Items on the appended Punch List shall be completed or corrected within the time limits established in the Certificate.

#### **1.4 PUNCH LIST**

- A. A comprehensive list prepared by the Contractor prior to Substantial Completion, and attached thereto, to establish all items to be corrected, or limited items of work to be completed, if any. This list is intended to represent a limited number of items needing attention.

- B. Punch lists shall be furnished to the Architect in Microsoft Excel and PDF formats. The punch list shall be in matrix form and shall include the following information for each punch list item:
  - 1. Room number or other suitable location identifier
  - 2. Description of the work
  - 3. Sub-contractor/trade sign-off that the work has been verified to be 100% complete and in accordance with the Contract Documents
  - 4. Sub-contractor/trade sign-off date
  - 5. Contractor sign-off that the work has been verified to be 100% complete and in accordance with the Contract Documents
  - 6. Contractor/trade sign-off date
  - 7. Architect consultant sign-off
  - 8. Architect consultant sign-off date
  - 9. If requested by School District, provide two additional similar columns for their signoff.
  - 10. In the case of excessive repetition of the same item at various locations, the punch list may contain "general notes/items" that shall be applied to the entire project; and it shall be the responsibility of the Contractor to thoroughly examine the entire project and make corrective measures at all applicable locations.
- C. Should the Architect determine that the Contractor's punch list lacks sufficient detail or requires extensive supplementation, the punch list will be returned to the Contractor for reinspection and revision. The date of Substantial Completion will be delayed until the punch list submitted is a reasonable representation of the work to be done.
- D. A significantly large number of items to be completed or corrected will preclude Architect from issuing a Certificate of Substantial Completion. School District and Architect will be the sole judge of what constitutes a significantly large number of items. It is anticipated that the detailed list of items of work to be completed or corrected at the Date of Substantial Completion will be no longer than five (5) typed pages.
- E. Contractor's superintendent shall participate in the preparation of Contractor's punch list that is submitted to Architect and School District for supplementation. Upon receipt, Architect and Consultants shall perform a spot review to determine the adequacy and completeness of Contractor's punch list.
- F. Upon receipt of an acceptable Contractor's punch list, the Contractor's Superintendent shall accompany Architect, their Consultants and School District (at their discretion) during their observation and the preparation of their supplements to the Contractor's punch list.
  - 1. Superintendent shall record or otherwise take note of all supplementary items.
  - 2. Architect shall endeavor to furnish to Contractor typed, hand-written, or recorded supplements to the punch list in a prompt manner; however, any delay in Contractor's receiving said supplements from Architect will not be cause for a claim for additional cost or extension of time as Contractor's Superintendent shall have been in attendance during the observations of Architect and their Consultants and will have been expected to take their own notes.

#### **1.5 OPERATIONS AND MAINTENANCE MANUAL**

- A. As a requirement for Substantial Completion, the final Operation and Maintenance Manual shall be submitted to, and reviewed and accepted by the Architect prior to issuance of the Certificate.
- B. Prepare 3-ring D-slant binder cover and spline with printed title "OPERATIONS AND MAINTENANCE MANUAL", title of project, and subject matter of binder when multiple binders are required.
- C. Submit one (1) copy of preliminary Operations and Maintenance Manuals to respective consultants (Civil, MEP, Structural, etc.) for review of conformance with contract requirements prior to submitting final to Architect. Allow time for proper review.
- D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

- E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- F. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
  - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.
  - 2. Part 2: Operation and Maintenance, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
    - a. Significant design criteria.
    - b. List of equipment.
    - c. Parts list for each component.
    - d. Equipment start-up instructions
    - e. Operating instructions.
    - f. Maintenance instructions for equipment and systems.
    - g. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
  - 3. Part 3: Project documents and certificates, including the following:
    - a. Product data.
    - b. Air and water balance reports.
    - c. Photocopies of warranties, certificates and bonds. Submit originals with Closeout Documents as specified below.
- G. Submit one (1) final original and two (2) copies to Architect.
- H. Contractor shall provide a DVD, in PDF Format, the following documents after approval by the Architect, Consultants, and School District: Closeout manual, Material Safety Data Sheet (MSDS) binder, Operations and Maintenance (O&M) Manuals, specifications, and approved submittals. Documents shall be hyper-linked to the Table of Contents.

## 1.6 PROJECT CLOSEOUT

- A. Final Payment will not be authorized by Architect until Architect finds the Work acceptable under the Contract Documents, subject to the completion and acceptance of the following requirements and other applicable contract requirements:
  - 1. Close-out Documents: Provide bound closeout documents as described in "Closeout Documents" article below. Refer to Supplementary Conditions, Article 9, Section 9.10 "Final Completion and Final Payment" for additional information.
  - 2. Record Documents: Submit as described in "Project Record Documents" article below.
  - 3. Extra Materials: Provide extra stock, materials, and products as described in "extra Stock, Materials, and Maintenance Products" article below when required by individual specification sections.
  - 4. Locks: Make final changeover of permanent locks and transmit keys to the School District. Advise the School District's personnel of changeover in security provisions.
  - 5. Temporary Facilities: Discontinue and remove temporary facilities from the site, along with mockups, construction aids, and similar elements.
  - 6. Warranties, Certificates and Bonds: Execute and assemble transferable warranty documents, certificates, and bonds from subcontractors, suppliers, and manufacturers as described in "Warranties, Certificates, and Bonds" article below.
  - 7. Final Examination and Acceptance by Architect: As described in "Final Examination" article below.

## 1.7 CLOSEOUT DOCUMENTS

- A. Coordinate the following items with the requirements of Section 00 73 00 - Supplementary Conditions.

- B. Prepare 3-ring D-slant binder cover and spline with printed title "CLOSEOUT DOCUMENTS", title of project, and subject matter of binder when multiple binders are required. Submit one (1) original and two (2) copies.
- C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. The close-out documents shall be neatly organized and easily useable as determined by the Architect and School District. Separate Close-out Documents binders from Operations and Maintenance Manuals. Documents identified as "affidavit" shall be notarized.
- E. Contents: Prepare Table of Contents for each volume, with each item description identified, typed on white paper, in five (5) parts as follows:
  - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers. All Contractor's vendors/suppliers and subcontractors that provided materials or performed any work related to this project must be listed on this form. Submit Final List of Subcontractors on Section 00 40 12.
  - 2. Part 2: Closeout Documents and Affidavits, include the following:
    - a. AIA G706 - Contractor's Affidavit of Payment of Debts and Claims;
    - b. AIA G706A - Contractor's Affidavit of Release of Liens;
    - c. AIA G707 - Consent of Surety to Final Payment;
  - 3. Part 3: Project documents and certificates, including the following:
    - a. Copy of Certificate of Substantial Completion (AIA G704);
    - b. Copy of All Permits;
    - c. Copy of Final Utility Bill or letter of transfer;
    - d. Copy of Certificate of Occupancy;
  - 4. Part 4: Warranties, Release of Liens, compile sequentially based on specification sections:
    - a. General Contractor's Warranty: Submit on company letterhead as described below. This Warranty shall state all sections of Work performed by Contractor's own forces, and warranty period for each section of Work;
    - b. Subcontractor's Release of Lien: Include contractor's, subcontractor's and direct material and equipment supplier's separate final releases. Submit on attached 01 77 01 - Closeout Form A - Subcontractor's Affidavit of Release of Lien.
    - c. Hazardous Material Certificate: Affidavits from Contractor, Subcontractors, and General Contractor's vendors or suppliers stating that no hazardous materials/products have been used or installed in this project. Submit on attached 01 77 02 - Closeout Form B - Subcontractor Hazardous Material Certificate.
    - d. Subcontractor's Warranty: Provide notarized Warranty stating all sections of Work performed by subcontractor and warranty period. Submit on attached 01 77 03 - Closeout Form C - Subcontractor Warranty.
    - e. Special / Extended Warranties; List and provide, notarized warranties requested by School District, or required by or incorporated in the Contract Documents.
    - f. Spreadsheet depicting all items and materials that carry a warranty longer than one (1) year. Include information consisting of material/ supplier/ installer/ specification section/ length of warranty and contact information.
  - 5. Part 5: Receipts:
    - a. Extra Stock: Provide original receipts for delivery of "Extra Stock" items as described below. Receipts must be signed by an authorized Owner's representative;
    - b. Keys: Provide original receipts for delivery of "Keys". Receipts must be signed by an authorized School District's representative.
    - c. Sign in sheets: provide signatures of attendees from all demonstrations.
- F. In addition to the three (3) required close-out binders listed above, provide Architect with one (1) separate binder for their records containing the following:

1. Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers;
  2. All MSDS sheets for the project;
  3. All warranties from Contractor, subcontractors, direct suppliers, and manufacturers.
- G. Failure to complete and close-out project after substantial completion may result in liquidated damages being assessed to Contractor. Refer to Conditions of the Contract for additional requirements and liquidated damages.

#### **1.8 FINAL CLEANING**

- A. Execute final cleaning prior to final project inspection and acceptance.
- B. Clean interior and exterior glass, and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces, mop hard floor surfaces.
- C. Remove smudges, marks, stains, fingerprints, soil, dirt, spots, dust, lint, and other foreign materials from finished and exposed surfaces
- D. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.
- E. Remove waste and surplus materials, rubbish, and temporary construction facilities from site.

#### **1.9 PROTECTING INSTALLED CONSTRUCTION**

- A. Protect installed Work and provide special protection as specified in Section 01 56 00 - Temporary Barriers and Enclosures and where specified in individual specification sections until Work is accepted by Architect and School District.
- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

#### **1.10 STARTING OF SYSTEMS**

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect and School District 48 hours prior to start-up of each item.
- C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of Contractor's personnel, and installer in accordance with manufacturers' instructions.
- G. When specified in individual specification sections or required by manufacturer, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. When specified in individual specification sections or required by School District or Architect, submit a written report in accordance with Section 01 33 00 - Submittal Procedures, that equipment or system has been properly installed and is functioning correctly.

### **1.11 DEMONSTRATION AND INSTRUCTIONS**

- A. Demonstrate operation and maintenance of products to School District's personnel a minimum of 48 hours prior to date of Final Completion in accordance with School District's requirements.
- B. Demonstrate Project equipment instructed by qualified manufacturer's representative who is knowledgeable about the Project and equipment.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six (6) months.
- D. Utilize maintenance manuals as basis for instruction. Review contents of manual with School District's personnel to explain all aspects of operation and maintenance.
- E. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment.
- F. Prepare and insert additional data in maintenance manuals when need for additional data becomes apparent during instruction.
- G. Review and verify proper start-up and operation of equipment prior to scheduling demonstrations with School District.
- H. All demonstrations are to be documented by video and submitted to School District in DVD format along with the close out documents. Contractor is responsible for all video and compilation onto DVD with linked menus.

### **1.12 PROJECT RECORD DOCUMENTS**

- A. Project Record Documents, as described in Section 01 78 39, shall be submitted at Project Closeout. Final Payment will not be authorized by the Architect until final review and acceptance by Architect is achieved in accordance with the School District's requirements.
- B. At Contractor's request, and with associated fee, Architect may provide electronic versions of the construction drawing and specification files for Contractor's use, subject to the terms and conditions of Architect's standard electronic document transfer agreement.
- C. Submit reproducible to respective consultants (Civil, Structural, MEP, etc.) for review. Consultant will mark-up corrections and return to Contractor for final revisions. Make final revisions prior to submitting to Architect.
  - 1. Format: One (1) set of film positive reproducibles and two (2) sets blueines of approved reproducibles.
  - 2. Provide School District with one (1) set of Record Drawings on a non-rewritable CD in AutoCAD® latest release.
  - 3. Provide School District with one (1) set of Record Drawings on a on a non-rewritable CD in PDF format.

### **1.13 EXTRA STOCK, MATERIALS, AND MAINTENANCE PRODUCTS**

- A. Furnish extra stock, maintenance, and extra products in quantities specified in individual specification sections.
- B. Deliver to Project site or to School District's Maintenance Department as directed by School District; obtain signed receipt from Owner's Designated Representative prior to final application for payment. Delivery of materials to, or obtaining receipt from anyone other than Owner's Designated Representative may constitute breach of this requirement and may require delivery of additional materials at no cost to School District if original materials are misplaced.
- C. Include signed receipts for delivery of extra stock and materials, including keys, with Closeout Documents.

### **1.14 WARRANTIES, CERTIFICATES, AND BONDS**

- A. Definitions:
  - 1. Standard Product Warranties: preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to

School District.

2. Special Warranties: Written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide coverage of specific defects, or both.
- B. In accordance with the general warranty obligations under General Conditions, Article 3, Section 3.5 "Warranty" as amended by the Supplementary Conditions, Contractor's warranty shall be for a period of one (1) year following the date of Substantial Completion, hereinafter called the one-year warranty period. Contractor's one-year general warranty shall include all labor, material and delivery costs required to correct defective material and installation. This warranty shall not limit School District's rights with respect to latent defects, gross mistakes, or fraud.
- C. Contractor's one-year warranty shall run concurrently with the one (1) year period for correction of Work required under General Conditions, Article 12, Section 12.2 "Correction of Work".
- D. No service charges or call out charges are allowed to investigate warranty claims.
- E. In addition to Contractor's one-year warranty, Special Warranties as described in individual specifications sections, shall extend the warranty period for the period specified without limitation in respect to other obligations which Contractor has under the Contract Documents.
- F. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of the warranty on the Work that incorporates the products, nor does it relieve the suppliers, manufacturers, and subcontractors required to countersign special warranties with Contractor.
- G. Warranty Requirements:
1. When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
  2. When Work covered by a warranty has failed and been corrected by replacement or reconstruction, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
  3. Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. Contractor is responsible for the cost of replacing defective Work regardless of whether School District has benefited from use of the Work through a portion of its anticipated useful service life.
  4. Written warranties made to School District are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which School District can enforce such other duties, obligations, rights, or remedies.
  5. School District reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or designated portion of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- H. Compile copies of each required warranty properly executed by Contractor and the subcontractor, supplier, or manufacturer. Verify documents are in proper form, contain full information, and are notarized. Co-execute warranties, certificates and bonds when required and include signed warrantees with Closeout Documents submitted to Architect.

#### **1.15 FINAL COMPLETION AND FINAL PAYMENT**

- A. Final Notice and Examination:
1. When all items on the Punch List have been corrected, final cleaning has been completed, and installed work has been protected, submit written notice to Architect that the Work is ready for final examination.
  2. Upon receipt of written notice that the Work is ready for final inspection and acceptance, Architect will make final examination.



- B. Final Change Order: When the Project Closeout items described above are successfully completed and the Work is found acceptable to Architect and School District, a Final Change Order will be executed. This Change Order will include any Allowance adjustments as required by the Contract Documents.
- C. Final Application for Payment: When all of the above items are successfully complete, submit to the Architect a final Application for Payment and request for release of retainage.
- D. Release of Retainage: Release of retainage will not be authorized by Architect until Contractor completes all requirements for close-out to the satisfaction of School District and Architect as described herein.

**1.16 FINAL EXAMINATION**

- A. Immediately prior to expiration of the one (1) year period for correction of the Work, the Contractor shall make an inspection of the work in the company of the Architect and School District. Architect and the School District shall be given not less than ten (10) days notice prior to the anticipated date of final examination.
- B. Where any portion of the work has proven to be defective and requires replacement, repair or adjustment, Contractor shall immediately provide materials and labor necessary to remedy such defective work and shall execute such work without delay until completed to the satisfaction of Architect and School District, even if the date of completion of the corrective work may extend beyond the expiration date of the correction period.
- C. Contractor shall not be responsible for correction of work which has been damaged because of neglect or abuse by School District nor the replacement of parts necessitated by normal wear in use.

**PART 2 PRODUCTS**

**NOT USED**

**PART 3 EXECUTION**

**NOT USED**

**END OF SECTION 01 77 00**

# DRAFT AIA® Document G704™ – 2000

## Certificate of Substantial Completion

**PROJECT:**  
(Name and address)

**PROJECT NUMBER:** /  
**CONTRACT FOR:**  
**CONTRACT DATE:**

**TO OWNER:**  
(Name and address)

**TO CONTRACTOR:**  
(Name and address)

**OWNER:**   
**ARCHITECT:**   
**CONTRACTOR:**   
**FIELD:**   
**OTHER:**

### PROJECT OR PORTION OF THE PROJECT DESIGNATED FOR PARTIAL OCCUPANCY OR USE SHALL INCLUDE:

The Work performed under this Contract has been reviewed and found, to the Architect's best knowledge, information and belief, to be substantially complete. Substantial Completion is the stage in the progress of the Work when the Work or designated portion is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use. The date of Substantial Completion of the Project or portion designated above is the date of issuance established by this Certificate, which is also the date of commencement of applicable warranties required by the Contract Documents, except as stated below:

#### Warranty

#### Date of Commencement

\_\_\_\_\_  
ARCHITECT

\_\_\_\_\_  
BY

\_\_\_\_\_  
DATE OF ISSUANCE

A list of items to be completed or corrected is attached hereto. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. Unless otherwise agreed to in writing, the date of commencement of warranties for items on the attached list will be the date of issuance of the final Certificate of Payment or the date of final payment.

**Cost estimate of Work that is incomplete or defective:** \$0.00

The Contractor will complete or correct the Work on the list of items attached hereto within Zero (0) days from the above date of Substantial Completion.

\_\_\_\_\_  
CONTRACTOR

\_\_\_\_\_  
BY

\_\_\_\_\_  
DATE

The Owner accepts the Work or designated portion as substantially complete and will assume full possession at \_\_\_\_\_ (time) on \_\_\_\_\_ (date).

\_\_\_\_\_  
OWNER

\_\_\_\_\_  
BY

\_\_\_\_\_  
DATE

The responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance shall be as follows:

(Note: Owner's and Contractor's legal and insurance counsel should determine and review insurance requirements and coverage.)

# DRAFT AIA® Document G706™ - 1994

## Contractor's Affidavit of Payment of Debts and Claims

PROJECT: *(Name and address)*

ARCHITECT'S PROJECT NUMBER:

TO OWNER: *(Name and address)*

CONTRACT FOR:  
CONTRACT DATED:

OWNER:   
ARCHITECT:   
CONTRACTOR:   
SURETY:   
OTHER:

STATE OF:    |

COUNTY OF:  |

The undersigned hereby certifies that, except as listed below, payment has been made in full and all obligations have otherwise been satisfied for all materials and equipment furnished, for all work, labor, and services performed, and for all known indebtedness and claims against the Contractor for damages arising in any manner in connection with the performance of the Contract referenced above for which the Owner or Owner's property might in any way be held responsible or encumbered.

### EXCEPTIONS:

#### SUPPORTING DOCUMENTS ATTACHED HERETO:

1. Consent of Surety to Final Payment. Whenever Surety is involved, Consent of Surety is required. AIA Document G707, Consent of Surety, may be used for this purpose

Indicate Attachment         Yes     No

*The following supporting documents should be attached hereto if required by the Owner:*

1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.
2. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers, to the extent required by the Owner, accompanied by a list thereof.
3. Contractor's Affidavit of Release of Liens (AIA Document G706A).

CONTRACTOR: *(Name and address)*

BY: \_\_\_\_\_

*(Signature of authorized representative)*

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

Subscribed and sworn to before me on this date:

Notary Public:  
My Commission Expires:

# DRAFT AIA® Document G706A™ – 1994

## Contractor's Affidavit of Release of Liens

<b>PROJECT:</b> <i>(Name and address)</i>	<b>ARCHITECT'S PROJECT NUMBER:</b>	OWNER: <input checked="" type="checkbox"/>
<b>TO OWNER:</b> <i>(Name and address)</i>	<b>CONTRACT FOR:</b>	ARCHITECT: <input checked="" type="checkbox"/>
	<b>CONTRACT DATED:</b>	CONTRACTOR: <input checked="" type="checkbox"/>
		SURETY: <input type="checkbox"/>
		OTHER: <input checked="" type="checkbox"/>

**STATE OF:**  
**COUNTY OF:**

The undersigned hereby certifies that to the best of the undersigned's knowledge, information and belief, except as listed below, the Releases or Waivers of Lien attached hereto include the Contractor, all Subcontractors, all suppliers of materials and equipment, and all performers of Work, labor or services who have or may have liens or encumbrances or the right to assert liens or encumbrances against any property of the Owner arising in any manner out of the performance of the Contract referenced above.

**EXCEPTIONS:**

**SUPPORTING DOCUMENTS ATTACHED HERETO:**

1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.
2. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers, to the extent required by the Owner, accompanied by a list thereof.

**CONTRACTOR:** *(Name and address)*

**BY:**

*(Signature of authorized representative)*

*(Printed name and title)*

Subscribed and sworn to before me on this date:

Notary Public:  
My Commission Expires:

# DRAFT AIA® Document G707™ - 1994

## Consent Of Surety to Final Payment

PROJECT: *(Name and address)*

ARCHITECT'S PROJECT NUMBER:

OWNER:

CONTRACT FOR:

ARCHITECT:

TO OWNER: *(Name and address)*

CONTRACT DATED:

CONTRACTOR:

SURETY:

OTHER:

In accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, the  
*(Insert name and address of Surety)*

on bond of  
*(Insert name and address of Contractor)*

hereby approves of the final payment to the Contractor, and agrees that final payment to the Contractor shall not relieve the Surety of any of its obligations to  
*(Insert name and address of Owner)*

as set forth in said Surety's bond.

IN WITNESS WHEREOF, the Surety has hereunto set its hand on this date:  
*(Insert in writing the month followed by the numeric date and year.)*

\_\_\_\_\_  
*(Surety)*

\_\_\_\_\_  
*(Signature of authorized representative)*

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

Attest:  
(Seal):

**SECTION 01 77 01 - CLOSEOUT FORM A - SUBCONTRACTOR'S AFFIDAVIT OF RELEASE OF LIEN**

**SUBCONTRACTOR'S AFFIDAVIT OF RELEASE OF LIEN**

**STATE OF TEXAS.**

**COUNTY OF \_\_\_\_\_.**

**KNOW ALL MEN BY THESE PRESENTS:**

\_\_\_\_\_, being duly sworn, deposes and says:

That they are the \_\_\_\_\_ of \_\_\_\_\_, the subcontractor who supplied, installed, and/or erected the Work described below, and that, they are duly authorized to make this Affidavit and Subcontractor Release.

**PROJECT: CTE BARRIENTES**

**OWNER: EDINBURG CONSOLIDATED INDEPENDENT SCHOOL DISTRICT**

**ARCHITECT: PBK ARCHITECTS, INC.**

**WORK PERFORMED: \_\_\_\_\_**

**SPECIFICATION SECTION(S): \_\_\_\_\_**

That all Work required under the subject subcontractor of the subject construction project has been performed in accordance with the terms thereof, that all material men, sub-subcontractors, mechanics, and laborers have been paid and satisfied in full and that there are no outstanding claims of any character arising out of the performance of said subcontractor which have not been paid and satisfied in full.

That to the best of his / her knowledge and belief, there are no unsatisfied claims for damages resulting from injury or death to any employees, sub-subcontractors, or the public at large arising out of the performance of said subcontract, or any suits or claims for any other damages of any kind, nature, or description which might constitute a lien upon the property of the School District.

That they have received full payment of all sums due them for materials furnished and services rendered by the undersigned in connection with the performance of said subcontract and has and does hereby release the School District and the Architect and his consultants and the Contractor from any and all claims of any character arising out of or in any way connected with performance of said subcontract.

Name of Subcontractor: \_\_\_\_\_

Attested By: \_\_\_\_\_ Title: \_\_\_\_\_

Jurat

State of Texas.

County of \_\_\_\_\_.

Sworn to and subscribed before me on this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

Notary Public: \_\_\_\_\_ Seal:

**END OF SECTION 01 77 01**

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**SECTION 01 77 02 - CLOSEOUT FORM B - SUBCONTRACTOR HAZARDOUS MATERIAL  
CERTIFICATE**

**SUBCONTRACTOR HAZARDOUS MATERIAL CERTIFICATE**

**THE STATE OF TEXAS.**

**COUNTY OF \_\_\_\_\_.**

**PROJECT NAME: CTE BARRIENTES**

**SCHOOL DISTRICT: EDINBURG CONSOLIDATED INDEPENDENT SCHOOL DISTRICT**

**ARCHITECT: PBK ARCHITECTS, INC.**

**KNOW ALL MEN BY THESE PRESENTS:**

\_\_\_\_\_, being first duly sworn, deposes and says that he/she is the  
\_\_\_\_\_ of \_\_\_\_\_, the subcontractor / supplier who  
constructed or provided the section(s) of Work referenced above, and that they are duly  
authorized to certify to the best of their information, knowledge, and belief no asbestos, lead or  
PCB containing products have been incorporated into the project.

**NAME OF SUBCONTRACTOR: \_\_\_\_\_**

**ATTESTED BY: \_\_\_\_\_ TITLE:**

\_\_\_\_\_

-----  
**JURAT**

**STATE OF TEXAS.**

**COUNTY OF \_\_\_\_\_.**

Sworn to and subscribed before me on this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

Notary Public: \_\_\_\_\_ Seal:

**END OF SECTION 01 77 02**



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**SECTION 01 77 03 - CLOSEOUT FORM C - SUBCONTRACTOR WARRANTY**

**SUBCONTRACTOR WARRANTY**

**STATE OF TEXAS.**

**COUNTY OF \_\_\_\_\_.**

**KNOW ALL MEN BY THESE PRESENTS:**

\_\_\_\_\_, being first duly sworn, deposes and says:

That they are the Subcontractor (or the \_\_\_\_\_ of \_\_\_\_\_ the subcontractor), the subcontractor / supplier who supplied, installed, and / or erected the Work described below, and that, they are duly authorized to make this Subcontractor Warranty:

Project: CTE Barrientes

School District: Edinburg Consolidated Independent School District

Architect: PBK Architects, Inc.

Work Performed: \_\_\_\_\_

Specification Section(s): \_\_\_\_\_

The undersigned Contractor warrants to the School District and Architect that materials and equipment furnished under the Contract are of good quality and new except where otherwise required or permitted by the Contract Documents, that the Work is free from defects not inherent in the quality required or permitted, and that the Work conforms with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. Subcontractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Subcontractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage.

In the event of failure of materials, products, or workmanship, during the specified warranty periods, the Subcontractor shall take appropriate measures to assure correction or replacement of the defective items, whether notified by the Contractor, School District, or Architect.

The Subcontractor warrants the Work performed for a period of \_\_\_\_\_ months from the date of Substantial Completion, except as follows: \_\_\_\_\_

**NAME OF SUBCONTRACTOR:** \_\_\_\_\_

**ATTESTED BY:** \_\_\_\_\_ **TITLE:** \_\_\_\_\_

\_\_\_\_\_

**JURAT**

**STATE OF TEXAS.**

**COUNTY OF \_\_\_\_\_.**

Sworn to and subscribed before me on this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

Notary Public: \_\_\_\_\_ Seal:

**END OF SECTION 01 77 03**

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**SECTION 01 77 04 - CLOSEOUT FORM D - CERTIFICATION OF PROJECT COMPLIANCE**

**CERTIFICATION OF PROJECT COMPLIANCE**

**NOTICE:**

Completion of this form is required under the provisions of the Texas Administrative Code (TAC) Section 61.1040 of (19 TAC 61.1040) for all public school district construction projects. Instructions for completion of this form can be found on the last page.

---

**1. PROJECT INFORMATION**

School District: Edinburg Consolidated Independent School District.

Facility: CTE Barrientes.

Project Address:

1100 East Ebony Ln.  
Edinburg, Texas 78539.

Date District Authorized Project: \_\_\_\_\_.

Architect: PBK Architects, Inc.

Contractor: To Be Determined.

Contract Date: \_\_\_\_\_.

Project Description: \_\_\_\_\_.

---

**2. CERTIFICATION OF DESIGN AND CONSTRUCTION**

The intent of this document is to assure that the School District has provided, to the Architect, the required information and the Architect has reviewed the School Facilities Standards as required by the State of Texas, and used their reasonable professional judgment and care in the architectural/engineering design and that the Contractor has constructed the project in a quality manner in general conformance with the design requirements and that the School District certifies project completion.

---

**3. THE DISTRICT CERTIFIES THE FOLLOWING:**

- 1.) The educational specifications of this facility presented to the school board of trustees were provided to the prime design professional in a timely manner.
- 2.) The long range facility plan was developed presented to the school board and provided in a timely manner to the prime design professional in a timely manner.
- 3.) That a design professional was hired to achieve the goals and expectations of the long range facility plan, and if applicable educational specifications.
- 4.) The safety and security standards were provided as a directive in a timely manner to the architect.

School District: Edinburg Consolidated Independent School District By: \_\_\_\_\_

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

---

**4. THE ARCHITECT CERTIFIES THE FOLLOWING:**

The above information was received from the School District, and that the facilities were designed in accordance with the applicable building codes. Further, the project has been designed in reasonable accordance with the long range facility plan and educational specifications based on the School Facilities Standards as adopted by the Commissioner of

Education, November 1, 2021, and as provided by the School District. This includes the compliance path directives of section (g) or (h) and the safety and security directives in section (k) found in the above standard.

Architect: PBK Architects, Inc. By: \_\_\_\_\_ Date: \_\_\_\_\_

---

**5. THE CONTRACTOR CERTIFIES THE FOLLOWING:**

The project has been built in reasonable accordance with the long range facility plan and educational specifications based on the School Facilities Standards as adopted by the Commissioner of Education, November 1, 2021, and as provided by the School District. This includes the safety and security directives in section (k) found in the above standard. In addition, certifies that the building has been found to not have any violations by the local authority of jurisdiction or third party code inspector.

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

---

**6. THE SCHOOL DISTRICT CERTIFIES THE FOLLOWING:**

Completion of the project (as defined by the Architect and Contractor).

District: Edinburg Consolidated Independent School District By:  
\_\_\_\_\_ Date: \_\_\_\_\_

**INSTRUCTIONS FOR COMPLETION OF "CERTIFICATION OF PROJECT COMPLIANCE FORM"**

---

Section 1: Identify the Following:

- Name and address of the school facility.
- Name of the School District.
- The Architect and Contractor.
- The date of execution of construction contract.
- The date that the school district authorized the superintendent to hire an Architect.
- Scope of Work.

---

Section 2: This section outlines intent of this document. No action required.

---

Section 3: This section shall be executed by the School District upon transmittal of the information (as listed) to the Architect and is to remain in the custody of the School District throughout project.

---

Section 4: This section shall be executed by Architect upon completion of Drawings and Specifications in conjunction with the completion of the review for code compliance (ref. 19 TAC §61.1040, School Facilities Standards) and returned to the School District's files.

---

Section 5: This section shall be executed by Contractor upon substantial completion of the project and retained by the School District.

---

Section 6: The section shall be executed by the School District upon acceptance and occupancy of the project.

---

**NOTE: DO NOT SUBMIT THIS DOCUMENT TO THE TEXAS EDUCATION AGENCY.**

The School District will retain this document indefinitely until review and/or submittal is required by representatives of the Texas Education Agency.

**END OF SECTION 01 77 04**

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## **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.

#### **1.3 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  - 1. Subsystem.
  - 2. System.

#### **1.4 SUBMITTALS**

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section:
  - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
  - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format:
  - 1. Submit operation and maintenance manuals in the following format:
    - a. Submit on digital media acceptable to Architect or by uploading to web-based project software site or by email to Architect. Enable reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal:
  - 1. Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments:
    - a. 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 comments and prior to commencing demonstration and training.
- E. Comply with 01 77 00 - Closeout Procedures for schedule for submitting operation and maintenance documentation. Where applicable use 01 91 13 - General Commissioning Requirements.

#### **1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS**

- A. Manuals, Electronic Files:
  - 1. Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required:



- a. 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.
- b. File names and bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

## **1.6 REQUIREMENTS FOR MANUALS**

- A. Organization of Manuals:
  1. 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:
    - a. Title page.
    - b. Table of contents.
    - c. Manual contents.
- B. Title Page:
  1. Include the following information:
    - a. Subject matter included in manual.
    - b. Name and address of Project.
    - c. Name and address of School District.
    - d. Date of submittal.
    - e. Name and contact information for Contractor.
    - f. Name and contact information for Construction Manager.
    - g. Name and contact information for Architect.
    - h. Name and contact information for Commissioning Authority.
    - i. Names and contact information for major consultants to Architect that designed the systems contained in the manuals.
    - j. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents:
  1. 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:
    - a. 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:
  1. 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:

- a. List of systems and subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- b. 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.
- c. 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 School District's operating personnel for types of emergencies indicated.
- B. Content:
  1. Organize manual into a separate section for each of the following:
    - a. Type of emergency.
    - b. Emergency instructions.
    - c. Emergency procedures.
- C. Type of Emergency:
  1. Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
    - a. Flood.
    - b. Gas leak.
    - c. Water leak.
    - d. Power failure.
    - e. Water outage.
    - f. System, subsystem, or equipment failure.
    - g. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of School District's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures:
  1. Include the following, as applicable:
    - a. Instructions on stopping.
    - b. Shutdown instructions for each type of emergency.
    - c. Operating instructions for conditions outside normal operating limits.
    - d. Required sequences for electric or electronic systems.
    - e. Special operating instructions and procedures.

## **1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS**

- A. Systems and Equipment Operation Manual:
  1. 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:
    - a. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
    - b. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by School District's operating personnel.
- B. Content:
  1. In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
    - a. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
    - b. Performance and design criteria if Contractor has delegated design responsibility.
    - c. Operating standards.

- d. Operating procedures.
  - e. Operating logs.
  - f. Wiring diagrams.
  - g. Control diagrams.
  - h. Piped system diagrams.
  - i. Precautions against improper use.
  - j. License requirements including inspection and renewal dates.
- C. Descriptions:
- 1. Include the following:
    - a. Product name and model number. Use designations for products indicated on Contract Documents.
    - b. Manufacturer's name.
    - c. Equipment identification with serial number of each component.
    - d. Equipment function.
    - e. Operating characteristics.
    - f. Limiting conditions.
    - g. Performance curves.
    - h. Engineering data and tests.
    - i. Complete nomenclature and number of replacement parts.
- D. Operating Procedures:
- 1. 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. Instructions on stopping.
    - f. Normal shutdown instructions.
    - g. Seasonal and weekend operating instructions.
    - h. Required sequences for electric or electronic systems.
    - i. 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:
- 1. 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:
    - a. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
    - b. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by School District'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:
1. Include the following information for each component part or piece of equipment:
    - a. Standard maintenance instructions and bulletins:
      - 1) 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 (1) 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.
    - b. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
    - c. Identification and nomenclature of parts and components.
    - d. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures:
1. Include the following information and items that detail essential maintenance procedures:
    - a. Test and inspection instructions.
    - b. Troubleshooting guide.
    - c. Precautions against improper maintenance.
    - d. Disassembly; component removal, repair, and replacement; and reassembly instructions.
    - e. Aligning, adjusting, and checking instructions.
    - f. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules:
1. 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:
    - a. Scheduled maintenance and service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
    - b. 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:
1. Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds:
    - a. Include procedures to follow and required notifications for warranty claims.
- J. Drawings:
1. 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:
    - a. 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:
  - 1. Include the following, as applicable:
    - a. Product name and model number.
    - b. Manufacturer's name.
    - c. Color, pattern, and texture.
    - d. Material and chemical composition.
    - e. Reordering information for specially manufactured products.
- E. Maintenance Procedures:
  - 1. Include manufacturer's written recommendations and 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. Schedule for routine cleaning and maintenance.
    - e. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds:
  - 1. Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds:
    - a. 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 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 but not limited to:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
  - 4. Miscellaneous record submittals.

#### **1.3 CLOSEOUT SUBMITTALS**

- A. Record Drawings:
  - 1. Number of Copies: Submit one set of marked up record prints.
  - 2. Number of Copies: Submit copies of record Drawings:
    - a. Initial Submittal:
      - 1) Submit PDF electronic files of scanned record prints and one of file prints.
      - 2) Submit record digital data files and one sets of plots.
      - 3) 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 sets of prints.
      - 2) Submit record digital data files and three sets of record digital data file plots.
      - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit one paper copy and one annotated PDF electronic file of the Project Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one paper copy and one annotated PDF electronic file and directory 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: Refer to the individual Specification Sections for miscellaneous record keeping requirements and submittals in connection with various construction activities. Submit one paper copy and annotated PDF electronic files and directories of each submittal.
- E. Reports: Submit written report monthly 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 PROJECT RECORD DOCUMENT PROCEDURES**

- A. 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.
  - 1. Do not use As-Built Drawings and Specifications for Record Drawings and Specifications.
- B. Recording Procedures: Update drawings and specifications on daily bases to record actual conditions. Record information concurrently with construction progress. Do not conceal Work until required information is accurately recorded.
- C. Store Record Documents and samples apart from as built documents used for construction.

1. Label and file Record Documents and samples in accordance with section number listings in Table of Contents. Label each document PROJECT RECORD in neat, large, printed letters.
2. Maintain Record Documents in clean, dry and legible condition.
3. Make Record Documents and samples available for inspection upon request of Architect.

## **PART 2 PRODUCTS**

### **2.1 RECORD DRAWINGS**

- A. Record Prints: Maintain one set of marked up paper copies of the Contract Drawings and Shop Drawings.
  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. Show actual installation conditions where installation varies from that shown originally.
    - a. Give attention to information on concealed elements 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 shop drawings or archive 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 below first floor.
    - 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. Utilize personnel proficient at recording graphic information in production of marked up record prints.
  4. Mark record sets with erasable, red colored pencil. Use colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked up record prints with Architect. When authorized, prepare full set of corrected digital data files of the Contract Drawings:
  1. Format: Same digital data software program, version, and operating system as the original Contract Drawings and annotated PDF electronic file with comment function enabled.
  2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.

3. Refer instances of uncertainty to Architect for resolution.
4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
  - a. Refer to Section 01 33 00 - Submittal Procedures for requirements related to use of Architect's digital data files.
  - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
  1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or modification.
  2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- D. Format: Identify and date each record Drawing; include the designation PROJECT RECORD DRAWING in a prominent location.
  1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Format: Annotated PDF electronic file with comment function enabled.
  3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
  4. Identification: As follows:
    - a. Project name.
    - b. Designation PROJECT RECORD DRAWINGS.
    - c. Name of Architect.
    - d. Name of Contractor.

## 2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications. Indicate actual product installation where installation varies from that indicated in Specifications.
  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 and marked up paper copy of Specifications.

## 2.3 RECORD PRODUCT DATA

- A. 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.
- B. Format: Submit record Product Data as annotated PDF electronic file. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

## **2.4 RECORD SAMPLES**

- A. Record Samples: Determine with Architect and School District which submitted Samples are to be maintained as Record Samples. Maintain and mark one set to indicate date of review and approval by Architect; note any deviations or variations between reviewed sample and installed product or material.

## **2.5 MISCELLANEOUS RECORD SUBMITTALS**

- A. Assemble miscellaneous records required by the individual 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. Include the following:
  1. Reviewed shop drawings, product data, and samples.
  2. Field test reports.
  3. Inspection certificates and manufacturer's certificates.
  4. Inspections by Authorities Having Jurisdiction (AHJ) (AHJ).
  5. Documentation of foundation depths.
  6. Special measurements or adjustments.
  7. Tests and inspections.
  8. Surveys.
  9. Design mixes.
- B. Format: Submit miscellaneous record submittals as scanned PDF electronic file(s) of marked up miscellaneous record submittals. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

## **PART 3 EXECUTION**

### **3.1 RECORDING AND MAINTENANCE**

- 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. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction. 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.

**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 School District's personnel, including the following:
  - 1. Demonstration of operation of systems, subsystems, and equipment.
  - 2. Training in operation and maintenance of systems, subsystems, and equipment.
  - 3. 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 utilizing 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.

#### **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 Contractor.
    - e. Date of video recording.
  - 2. At completion of training, submit complete training manual(s) for School District's use.

#### **1.5 QUALITY ASSURANCE**

- A. 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.

#### **1.6 COORDINATION**

- A. Coordinate instruction schedule with School District's operations. Adjust schedule as required to minimize disrupting School District's operations.
- 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 has been reviewed and approved by Architect.

## **PART 2 PRODUCTS**

### **2.1 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. Operations manuals.
    - c. Maintenance manuals.
    - d. Project record documents.
    - e. Identification systems.
    - f. Warranties and bonds.
    - g. 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.

### **PART 3 EXECUTION**

#### **3.1 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 77 00 - Closeout Procedures.
- B. Set up instructional equipment at instruction location.

#### **3.2 INSTRUCTION**

- A. Engage qualified instructors to instruct School District's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  1. School District will furnish an instructor to describe School District's operational philosophy.
  2. School District will furnish Contractor with names and positions of participants.
- B. 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 School District through Program Manager with at least 10 days' advance notice.
- C. Cleanup: Collect used and leftover educational materials and give to School District. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

#### **3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS**

- A. General: Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
- B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to School District.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

**END OF SECTION 01 79 00**

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## **SECTION 01 91 13 - GENERAL COMMISSIONING 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 establishes general and administrative requirements pertaining to Commissioning (Cx) of equipment, devices, and building systems on the project. Technical requirements for Commissioning of particular systems and components are established in the respective technical sections of this Project Manual.
- B. It is of primary concern that all operable systems installed in the Project perform in accordance with the Contract Documents, the Owner's Project Requirements (OPR), and the Basis of Design (BOD). During Commissioning, Contractor shall systematically demonstrate to School District or Owner's Designated Representative that operable systems have been installed and perform in strict accordance with the Contract Documents.
- C. Commissioning requires cooperation and involvement of all parties throughout the construction process. Contractor shall deliver a successful Commissioning process. Successful Commissioning requires that installation of all building systems complies with Contract Document requirements and that full operational check-out and necessary adjustments are performed prior to Substantial Completion with the exception of Deferred Tests approved in advance by School District.
- D. Commissioning will encompass and coordinate traditionally separate functions of system documentation, installation checkout, System Verification Checklists and start-up, control system calibration and point-to-point checkout, testing, adjusting, and balancing, Functional Performance Tests, Integrated System Tests, Contractor demonstration to School District, and training of School District's personnel. This requires assembling all related documentation into one cohesive collection. Commissioning shall achieve the following specific objectives of the Contract Documents:
  - 1. Verify and document proper installation and intended performance of equipment, systems, and integrated systems.
  - 2. Ensure that Operating and Maintenance (O&M) and Commissioning documentation requirements are complete.
  - 3. Provide School District with functional buildings and systems that meet the Contract Document requirements and the Owner's Project Requirements (OPR) at Substantial Completion.

#### **1.3 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  - 1. Basis of Design (BOD).
  - 2. Commissioning (Cx).
  - 3. Commissioning Authority (CxA).
  - 4. Contract Documents.
  - 5. Control Point and Sensor Calibration Verification.
  - 6. Deferred Testing.
  - 7. Deficiency.
  - 8. Functional Performance Test (FPT).
  - 9. Functional Performance Testing Procedures.
  - 10. Integrated Systems Test (IST).
  - 11. Integrated Systems Testing Procedures.
  - 12. Operational Testing.
  - 13. Owner's Project Requirements (OPR).

14. Project Documents.
15. System Verification Checklist (SVC).
16. Start-up.
17. Training Plan.
18. Trending.

#### **1.4 COMMISSIONING TEAM**

- A. School District shall appoint the following Members:
  1. School District's Project Manager and any other designated representatives of School District's staff.
  2. Commissioning Authority (CxA).
  3. Architect.
  4. Test, Adjust and Balance Firm (TAB) – may be sub-contracted to the CxA.
- B. Contractor shall appoint the following Members:
  1. Individuals, each having authority to act on behalf of the entity they represent, explicitly organized to implement the Commissioning process through coordinated actions. At a minimum, Contractor shall designate a Commissioning Coordinator and each major sub-contractor (Mechanical, Electrical, Plumbing, Building Automation) shall have a dedicated representative.
  2. Vendor representatives (as needed) required for start-up, operational testing, Functional Performance Testing, Integrated Systems Testing, and Owner Training activities.
  3. Representatives of independent testing agencies (Test, Adjust and Balance, Electrical Testing Agency, etc.)

#### **1.5 ROLES AND RESPONSIBILITIES**

- A. Roles and responsibilities of Commissioning Team members related to the Commissioning Process are provided in this Section. Respective entities defined below shall fulfill the listed roles and responsibilities as contained herein. Specific technical roles and responsibilities are defined in other sections of the Project Specifications.
- B. School District's Roles and Responsibilities:
  1. Provide guidance in development of the Owner's Project Requirements (OPR).
  2. Review Technical Specifications containing Commissioning requirements.
  3. Approve the Commissioning Scope of Work and schedule of Commissioning activities.
  4. Assign Owner's Designated Representative(s) and schedule them to participate in Commissioning activities, including the following:
    - a. Commissioning Team meetings.
    - b. Review and approval of the Commissioning Plan, Training Plan, System Verification Checklist templates, Functional Performance Test Procedures, Integrated Systems Test Procedures, Deferred Testing Plans, Final Commissioning Process Report, Systems Manual, Measurement and Verification Plan and other Commissioning documents.
    - c. Attend Owner Training sessions in operation and maintenance of systems and equipment.
    - d. Observation of Contractor's demonstration of systems and equipment operation.
- C. Commissioning Authority's (CxA) Roles and Responsibilities:
  1. Prepare the Commissioning Plan with School District's and Contractor's review and input.
  2. Periodically attend and/or review the proceedings of the regular Construction Meetings hosted by Contractor to understand the progress of construction activities on the project.
  3. Conduct and document Commissioning Team meetings including the Commissioning Kickoff Meeting.
  4. Perform site visits as necessary to observe component and system installations prior to energizing or start-up of equipment and systems.
  5. Review and comment on product data and shop drawing submittals and coordination drawings applicable to systems being commissioned.

6. Following submittal review and approvals by the Architect's team, review the sequences of operation and coordinate with the Contractor and Architect's Team in order to prepare the Functional Performance Test Procedures and Integrated Systems Test procedures. Submit to School District and Contractor for review and comment prior to facilitating FPTs and ISTs on the project.
  7. Upon written notice that equipment or systems are ready for initial energizing or start-up, review the progress of the System Verification Checklist(s) for the respective systems and components and ensure that all requirements have been completed by Contractor to permit energizing or start-up in accordance with the Contract Documents; CxA shall issue written notice to School District and Contractor that equipment is ready to energize or start-up. CxA will witness and ensure proper documentation is provided by Contractor for major equipment energizing and start-ups as executed by Contractor with appropriate notice as indicated herein.
  8. Witness, verify, and document results of Functional Performance Tests and Integrated Systems Tests.
  9. Coordinate resolution of deficiencies identified during site observations, equipment energizing or start-up, Functional Performance Testing, Integrated Systems Testing, Deferred Testing, and during the warranty period.
  10. Review the Operating and Maintenance (O&M) documents to ensure that as-built information and correct data is included prior to School District Training sessions; review final O&M submittal to ensure compliance with the requirements in the project documents and provide written comments to School District.
  11. Review Contractor's Training Plan and individual training agendas for compliance with the requirements in the Contract Documents. Recommend acceptance to School District prior to Contractor scheduling training sessions with School District. Review the attendance and content of the training sessions to ensure the requirements of the project documents are completed. Conduct a survey of School District's personnel to evaluate the effectiveness of the School District Training.
  12. Compile the Final Commissioning Process Report and submit to School District for review and approval.
- D. Architect's Roles and Responsibilities:
1. Specify control sequences of operation within the Contract Documents that comply with the OPR and BOD.
  2. Incorporate Commissioning requirements into the Contract Documents if requested by School District.
  3. Attend Commissioning Team meetings.
  4. Review the Commissioning Plan, System Verification Checklist templates, Functional Performance Test Procedures, Integrated Systems Test Procedures, Deferred Testing Plans, and other Commissioning documents as required by School District or the Contract Documents.
  5. Review Contractor's Training Plan and provide comments to School District.
  6. Approve technical requirements for correction of Deficiencies identified during Commissioning, Deferred Tests, and during the warranty period.
  7. Review Operating and Maintenance Manuals and provide comments to School District.
- E. Contractor's Roles and Responsibilities:
1. Contractor shall review and provide comments on documents produced by the Commissioning Authority, and shall accept the Commissioning Plan, System Verification Checklists, Functional Performance Test Procedures, and Integrated System Test Procedures as approved by School District.
  2. Provide an individual, subject to School District's approval, experienced in construction and Commissioning of building systems to organize, schedule, conduct, and document the Contractor's responsibilities in the Commissioning process. Contractor shall assign this individual to act as the Contractor's Commissioning Coordinator. Contractor's Commissioning Coordinator may have additional duties such as MEP Coordinator, but not



- as Project Manager or Superintendent. Submit qualifications demonstrating the Commissioning Coordinator's technical expertise and experience to School District for approval. In the event that Contractor chooses to subcontract its Commissioning obligations, then Contractor must submit the subcontractor's qualifications and personnel to School District for School District's approval.
3. Furnish and install systems that meet all requirements of the Contract Documents.
  4. Ensure that Commissioning Process activities are incorporated into the Master Project Schedule. Contractor shall coordinate with CxA and School District to determine the required activities, durations and predecessors.
  5. Submit inspection requests, start-up requests and all supporting documentation in accordance with the Contract Documents, General Conditions, and Commissioning Plan.
  6. Cooperate with Owner's Designated Representative(s), provide access to work and provide adequate labor, resources, and time for Commissioning.
  7. Furnish copies of all shop drawings and submittals, manufacturers' literature, maintenance information, and any other information required for the Commissioning process. Contractor must submit installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by the factory or field technicians to School District. This requirement does not supersede any additional requirements contained in the Contract Documents.
  8. Schedule and conduct pre-installation meetings and pre-commissioning meetings with subcontractors and equipment suppliers related to Commissioning. Contractor must invite Architect, School District, and CxA to attend the pre-installation meetings and pre-commissioning meetings.
  9. Provide qualified personnel, including subcontractors as required, to fully perform the testing and operational demonstrations required by the Contract Documents and the Commissioning Plan, including any Deferred Testing or re-testing related to warranty work.
  10. Correct deficiencies identified during any stage of the Commissioning process.
  11. Coordinate with the CxA to develop the Training Plan and submit to School District for approval. Provide training to School District's personnel in accordance with the Contract Documents and the approved Training Plan. Coordinate with School District to schedule training sessions and coordinate subcontractor/vendor participation in all training sessions.
  12. Perform Deferred Testing and make necessary amendments to Operating and Maintenance Manuals and as-built drawings for applicable issues identified during the Deferred Testing.
  13. Perform system maintenance during construction as specified and requested by School District and send the maintenance records to School District for Record.
  14. Document the equipment as it arrives onsite to ensure that the submitted and received equipment is correct as it arrives onsite, including the completion of the system verification sections pertaining to the procurement process.

## **1.6 SYSTEMS TO BE COMMISSIONED**

- A. The following systems shall be commissioned according to the process defined in this Section:
  1. Major HVAC Systems (100% including but not limited to the list below):
    - a. Air Handling Units.
    - b. Fan Coil Units.
    - c. Exhaust Fans.
    - d. Supply Fans.
    - e. Pumps.
    - f. Chillers.
    - g. Boilers.
  2. Terminal Units (10% Sampling).
  3. Building Automation System.

4. Lighting Controls - Occupancy Sensors (25% greater than 25 sensors installed, 100% less than 25 sensors installed).
5. Lighting - Daylight Controls (100%).
6. Lighting - Time Switch Controls (100%).
7. Normal and Emergency Power Systems.

## **PART 2 PRODUCTS**

### **2.1 COMMISSIONING PLAN**

- A. Document developed by CxA that provides structure, schedule, and coordination plan for Commissioning Process from Pre-construction phase through Occupancy Phase. Commissioning Plan shall describe the project and systems to be commissioned, Commissioning Process activities and deliverables, procedures to follow throughout the process, specific roles and responsibilities for each participant, and general description of testing and verification methods.
- B. Commissioning Plan shall comply with the Owner's Project Requirements (OPR).
- C. Commissioning Team shall review the Commissioning Plan prior to Pre-Commissioning Meeting and submit written comments or questions to CxA to be addressed in the meeting.
- D. Following Pre-Commissioning meeting, CxA shall incorporate all changes discussed and agreed upon in Pre-Commissioning meeting and submit Final Commissioning Plan to Commissioning Team for approval and acceptance.
- E. If changes to Commissioning Plan are needed during the Commissioning Process, CxA shall edit the plan and distribute to Commissioning Team for approval and acceptance.
- F. Contractor's acceptance shall constitute acceptance of all parties sub-contracted to Contractor. Contractor shall ensure that all sub-contractors and vendors agree and accept Commissioning Plan.

### **2.2 SYSTEM VERIFICATION CHECKLISTS**

- A. System Verification Checklists (SVCs) are important to ensure that equipment and systems are connected and operational and that Functional Performance Testing proceeds without unnecessary delays. These checklists document inspections and procedures necessary to take a piece of equipment from a static state into an operating state. When combined, these checklists augment manufacturer's start-up checklists to provide a complete document from procurement to start of Functional Performance Testing.
- B. CxA shall develop System Verification Checklist templates for review by Cx Team. Contractor, appropriate Subcontractors, and Vendors shall support CxA in development of SVCs for each system and components by providing any necessary supporting documentation as requested by CxA and reviewing and commenting on the checklist templates in accordance with Project Specifications and Commissioning Plan.
- C. Once the checklist templates are reviewed and accepted, CxA will produce checklists for all equipment and components to be commissioned on the project utilizing an electronic commissioning database that is accessible via web portal or local field tool (i.e., iPad, tablet, laptop, etc.).
- D. CxA shall provide login access and training to Contractor and other members of Cx Team in use of electronic commissioning database.
- E. Contractor shall be responsible for completing required sections of System Verification Checklists utilizing electronic commissioning database and providing all supporting documentation via electronic transmittal to CxA. Additional requirements for completion of SVCs are included in this section and other technical sections of Specifications.
- F. Once equipment arrives on project site, Contractor or sub-contractors shall begin completing individual checklists and continue throughout installation process. Checklists are meant to be progressive and a tool for tracking progress.

- G. Once SVCs are electronically completed, CxA will review and approve checklists and supporting documentation and compile information to include in the Final Commissioning Process Report.

### **2.3 FUNCTIONAL PERFORMANCE TESTING PROCEDURES:**

- A. Functional Performance Testing Procedures are to verify and document that equipment and systems on project individually perform in accordance with the requirements in the Contract Documents and meet Owner's Project Requirements.
- B. CxA shall develop specific script-type test procedures to verify and document proper operation of each piece of equipment and system. Contractor shall provide any supporting information to CxA that may be needed including, but not limited to, product submittals, O&M information, and sequences of operation. Once developed, CxA will issue to Cx Team for review and comment.
- C. Commissioning Team shall review Functional Performance Test procedures and submit written comments or questions to CxA. Contractor shall ensure that sub-contractors and any vendors that would be involved with Functional Performance Testing review the procedures and provide comments.
- D. CxA will coordinate with Cx Team to address any comments and produce final FPT procedures for acceptance by Cx Team. Contractor's acceptance shall constitute acceptance of all parties sub-contracted to Contractor.
- E. Contractor shall utilize the FPT procedures for any pre-testing activities prior to Functional Performance Testing.

### **2.4 INTEGRATED SYSTEMS TESTING PROCEDURES:**

- A. Integrated Systems Testing Procedures are to verify and document that all the integrated equipment and systems on the project perform together in accordance with the requirements in the Contract Documents and meet the Owner's Project Requirements.
- B. CxA shall develop specific script-type test procedures to verify and document proper operation of integrated systems throughout facility. Contractor shall provide any supporting information to CxA that may be needed including, but not limited to, product submittals, O&M information, and sequences of operation. Once developed, CxA will issue to Cx Team for review and comment.
- C. Commissioning Team shall review Integrated Systems Testing procedures and submit written comments or questions to CxA. Contractor shall ensure that sub-contractors and any vendors that would be involved with Integrated Systems Testing review procedures and provide comments.
- D. CxA shall coordinate with Cx Team to address any comments and produce final IST procedures for acceptance by Cx Team. Contractor's acceptance shall constitute acceptance of all parties sub-contracted to Contractor.
- E. CxA shall also develop IST personnel matrix that will be utilized to track individual testing teams involved with IST. CxA will distribute the matrix to Cx Team so that Contractor and School District can assign appropriate personnel to each team.
- F. CxA shall also host a coordination meeting prior to IST to review IST procedures, complete any final coordination, review safety procedures, and answer any questions.
- G. CxA estimates there will be two Integrated Systems Tests on project. Requirements for testing are included in the respective technical sections of Project Manual.
  - 1. First IST shall test \_\_\_\_\_.
- H. IST procedures shall be utilized by Contractor for any pre-testing activities prior to official Integrated Systems Testing.

### **2.5 TRAINING PLAN**

- A. Contractor, in coordination with School District and CxA, shall develop Training Plan with project specific requirements for School District Training, after reviewing the different systems to be installed and commissioned. Training Plan is to specifically communicate required content

and training durations required by School District based upon the type of equipment and School District's past experience.

- B. Contractor shall review all individual technical sections of this Project Manual for specific training requirements.
- C. Contractor shall coordinate with School District to ensure that the proposed training requirements meet School District's needs and expectations.
- D. Contractor shall coordinate with sub-contractors and vendors to ensure School District Training requirements can be achieved and gather any additional information or recommendations.
- E. Any changes to training requirements in this specification must follow contractual protocols.
- F. Training Plan shall include a list of systems and equipment for which training will be provided according to three-tiered training approach outlined in Project Manual.
- G. All training sessions shall have a syllabus indicating the following as a minimum in addition to any other specification requirements:
  - 1. Session Objectives.
  - 2. Proposed Instructor(s).
  - 3. Instructor Qualifications.
  - 4. Training Materials that will be provided.
  - 5. Location and durations of the various parts of the training session (i.e., Classroom, On-site, etc.).
  - 6. Applicable specification sections and O&M Manual sections.
  - 7. Detailed outline of training session content.
- H. Contractor shall coordinate with CxA to organize systemic training sessions comparable to organization of Systems Manual.
- I. School District training must be completed prior to the contractor obtaining substantial completion by School District.

## **2.6 FINAL COMMISSIONING PROCESS REPORT**

- A. CxA shall prepare Final Commissioning Process Report that will include the following:
  - 1. Executive Summary.
  - 2. Participants and Roles.
  - 3. Brief building description.
  - 4. Overview of commissioning and testing scope.
  - 5. General description of testing and verification methods.
  - 6. Appendices with supporting information, issues log, and communications.
- B. Contractor shall coordinate with CxA to provide any additional information that may be needed to complete Final Commissioning Process Report.
- C. Contractor shall resolve any outstanding commissioning items prior to CxA preparing Final Commissioning Report.
- D. CxA shall issue Final Commissioning Process Report to Cx Team for review. School District shall approve Final Commissioning Process Report after any comments or discrepancies are resolved by CxA.

## **PART 3 EXECUTION**

### **3.1 PROJECT SCHEDULE**

- A. Contractor shall integrate all Commissioning activities into detailed Project Schedule. All parties will address scheduling problems and make necessary notifications in a timely manner to expedite Commissioning Process.

### **3.2 COMMISSIONING TEAM MEETINGS**

- A. Upon obtaining School District's approval of the Commissioning Plan, CxA shall coordinate with Cx Team to schedule, plan, and conduct a Pre-Commissioning Meeting with all parties involved

in Commissioning process. Meeting should include major subcontractors, specialty manufacturers/suppliers, Architect, Test, Adjust, and Balance (TAB) Firm, Electrical Testing Agency, and Owner's Designated Representative(s) as participants.

- B. Contractor shall prepare for Pre-Commissioning Meeting by supplying the following documents created by CxA to all applicable sub-contractors and vendors: Commissioning Plan, Example System Verification Checklists, Example Functional Performance Test Procedures, and Example Integrated Systems Test Procedures.
- C. CxA shall conduct Pre-Commissioning Meeting and review all aspects of Commissioning Plan and applicable specifications.
- D. Commissioning Plan shall be reviewed with all attendees and scope of work discussed. Contractor should be prepared to distribute copies of pertinent sections to subcontractors involved in Commissioning process.
- E. Final outcome of the meeting shall be an understanding of commissioning process, roles and responsibilities, and consensus acceptance of Commissioning Plan by Cx Team.
- F. Contractor may request additional meetings with CxA and individual sub-contractors to clarify roles, responsibilities, and procedures as needed.

### **3.3 TEST EQUIPMENT**

- A. Contractor shall provide all specialized tools, test equipment, and instruments required to execute start-up, checkout, and testing of equipment.
- B. All specialized tools, test equipment and instruments required to execute start-up, checkout, and testing of equipment shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.

### **3.4 REPORTING**

- A. Beginning at the procurement stage for equipment included in Cx scope, Contractor shall communicate at least monthly with all members of the Commissioning Team, keeping them apprised of construction progress and scheduling changes.
- B. Contractor shall submit Deficiency reports to School District within five (5) days of the deficiency occurrence. This includes responses to items noted by the Commissioning Authority.

### **3.5 DEFICIENCY RESOLUTION**

- A. CxA shall document any issues noted during observation or testing activities in the Commissioning Issues Log (CxIL). CxIL shall be distributed electronically to Cx Team at regular intervals.
- B. Contractor shall respond in writing to CxA within 10 days to all new CxIL items regardless of the disposition. This response does not constitute a request for re-verification, only an acknowledgement of the outstanding item. Contractor should utilize CxIL responses to update Cx Team on the progress of deficiency resolution.
- C. Contractor shall respond to CxA and School District indicating CxIL items that are completed and ready for CxA to verify completion.
- D. If any item indicated complete by Contractor is found to be incomplete by CxA upon re-verification, Contractor is responsible for all costs and additional compensation resulting from incomplete Cx Issues Log items.

### **3.6 REQUEST FOR ENERGIZING / START-UP OF EQUIPMENT**

- A. School District and/or Owner's Designated Representative may install lockout devices on equipment in addition to Contractor's lockout / tagout devices once permanent power is connected to facility. This lock would be removed once proper start-up notification is received

by School District and/or CxA, and CxA has reviewed the appropriate SVCs and supporting documentation to verify equipment is ready for energizing and/or start-up.

- B. These requirements do not supersede any additional requirements noted elsewhere in the Contract Documents or as required by Authorities Having Jurisdiction (AHJ).
- C. Contractor shall notify School District and CxA in writing to request initial energizing and/or start-up of equipment and systems at least 72 hours (not including weekends or holidays) prior to scheduled start-up.
- D. Contractor shall complete applicable sections of System Verification Checklist(s) evidencing Contractor's thorough inspection of system and readiness for start-up activities as required by Contract Documents and the Commissioning Plan. Contractor shall submit required supporting documentation to School District and/or CxA, including but not limited to, factory testing reports, alignment reports, electrical testing reports and any other documentation required by the Project Documents prior to energizing and/or start-up.
- E. CxA shall review SVCs and supporting documentation within the 72 hour notice period and confirm in writing that the systems and equipment are approved to proceed with energizing and start-up.
- F. CxA and/or School District may witness equipment energizing and/or start-up at scheduled time, but witness is not required, unless noted elsewhere in the Specifications, as long as written approval is received as noted herein.
- G. Contractor shall perform Start-up under supervision of the responsible manufacturer's representative in accordance with manufacturer's instructions and Contract Document requirements.
- H. Contractor shall complete all required factory start-up documentation and applicable items in System Verification Checklists, prior to startup, to ensure compliance with the requirements in Contract Documents.

### **3.7 OPERATIONAL TESTING**

- A. Once the appropriate start-up activities are completed, Contractor shall complete all necessary operational testing requirements included in the Project Documents prior to Functional Performance Testing. Specific requirements for systems and equipment are included in other technical sections of the Specifications.
- B. Contractor shall complete all operational testing items in the System Verification Checklist and submit all supporting documentation to School District and/or CxA for review.
- C. Contractor and manufacturer's representatives shall supervise and coordinate adjustments and balancing of all devices and systems for proper operation prior to requesting a Functional Performance Test(s).
- D. Contractor shall clearly list outstanding items or System Verification Checklist items not completed successfully. Contractor shall obtain from Subcontractor or vendor completed forms documenting any outstanding deficiencies within five (5) days of completion of energizing and/or start-up activities.
- E. Contractor shall review completed deficiencies to determine if outstanding items prevent execution of the Functional Performance Tests and shall issue any necessary responses to School District and/or Commissioning Authority.
- F. Contractor shall notify School District and CxA in writing to request Functional Performance Testing of equipment and systems at least 72 hours (not including weekends or holidays) prior to scheduled activities. School District may require Contractor to reschedule Functional Performance Testing to ensure availability of Owner's Designated Representative(s) as needed.
- G. CxA shall review SVCs and supporting documentation within 72 hour notice period and confirm in writing that systems and equipment are approved to proceed with Functional Performance Testing.

- H. If any item indicated complete by Contractor is found to be incomplete by CxA, upon re-verification, Contractor is responsible for all costs and additional compensation resulting from incomplete System Verification Checklist items.

### **3.8 CONTROL POINT AND SENSOR CALIBRATION VERIFICATION**

- A. Automation systems installed on project must be fully verified for point integrity and sensor calibration prior to Functional Performance Testing. Additional requirements for this verification are listed in other technical sections of the Specifications.
- B. Contractor shall verify these points according to the requirements in the project documents as part of start-up and operational testing of systems.
- C. TAB contractor shall independently verify each sensor and point and document the results to be included in the Final TAB Report.
- D. CxA will witness, at their discretion, this verification and/or independently verify and document results to be included in Final Commissioning Process Report.
- E. These activities must be completed prior to Contractor requesting Functional Performance Testing as indicated herein.

### **3.9 FUNCTIONAL PERFORMANCE TESTING**

- A. Functional Performance Testing is to demonstrate that each system operates according to the requirements in the Project Documents and meets the OPR and BOD.
- B. Contractor shall operate, or cause to be operated, each system, device, or equipment item, both intermittently and continuously, for a duration period as indicated in the Specification Section(s) for each item and/or in accordance with Contract Documents, Commissioning Plan and applicable Functional Performance Testing procedures.
- C. Contractor shall operate each component device and each building system to the full extent of its capability, from minimum to maximum, and under automatic control and manual control.
- D. CxA and members of Cx Team, including School District's personnel, may observe Functional Performance Testing of equipment components and systems. CxA shall facilitate the Functional Performance Testing activities according to the accepted FPT procedures and record results of all testing activities.
- E. CxA shall record any deficiencies noted during the testing in CxIL. If significant deficiencies exist, the School District and/or CxA may request that the testing activities be terminated and re-scheduled after proper verification by Contractor. Contractor is responsible for all costs and additional compensation resulting from deficiencies and incomplete systems noted during scheduled Functional Performance Testing.
- F. All Functional Performance Testing of Integrated Systems must be completed in accordance with Project Documents and Commissioning Plan prior to Contractor scheduling the Integrated Systems Testing activities.

### **3.10 INTEGRATED SYSTEMS TESTING**

- A. The objective of Integrated Systems Testing is to demonstrate that each integrated system operates jointly and/or independently of other systems according to the requirements in the Contract Documents.
- B. Contractor shall operate each system, jointly and independently of other systems, through selected modes of operation (fire alarm integration with HVAC, emergency power modes, equipment failures among related systems, etc.) according to accepted Integrated Systems Testing procedures developed by CxA. CxA shall facilitate and document testing, organizing appropriate testing teams and providing sufficient instruction to all participants to conduct efficient and effective testing activities.
- C. Integrated Systems Testing typically involves multiple teams with representation from CxA, School District, and Contractor. Contractor shall provide any needed communication equipment (i.e., radios) or make available any centralized intercom or paging system for communication

with all testing groups.

- D. Contractor shall provide no less than 7 days (not including weekends or holidays) notice when requesting to conduct the Integrated Systems Testing. All personnel must be assigned to Personnel Matrix by CxA and a coordination meeting held within the 7 day period as prescribed elsewhere in this Section.
- E. Contractor conducts Integrated Systems Testing after all applicable Functional Performance Testing is satisfactorily completed and approved by School District and/or CxA.
- F. CxA shall record any deficiencies noted during testing in CxIL. If significant deficiencies exist, School District and/or CxA may request that testing activities be terminated and re-scheduled after proper verification by Contractor. Contractor is responsible for all costs and additional compensation resulting from deficiencies and incomplete systems noted during scheduled Integrated Systems Testing.

### **3.11 DEMONSTRATION AND OWNER TRAINING**

- A. Contractor, in coordination with School District and CxA, shall develop Training Plan with project specific requirements for School District Training as required throughout various sections of the Specifications.
- B. Specific requirements for scheduling and conducting School District Training are included in other sections of this Project Manual.
- C. School District Training activities shall not occur until Training Plan is approved by School District and Contractor has submitted all O&M information for review and use during the training sessions.
- D. Contractor shall notify the CxA of all training sessions. Contractor shall record training session attendance and School District shall ensure appropriate personnel are in attendance.
- E. CxA shall ensure the content of the School District Training sessions meets the requirements in the Contract Documents.
- F. CxA may conduct surveys of School District's personnel to gauge effectiveness of School District training sessions. If unfavorable surveys are received by School District's personnel indicating unsatisfactory training, School District reserves the right to require Contractor to re-train in those specific areas of non-conformance until requirements in the Contract Documents are satisfactorily completed.
- G. School District training must be completed prior to the contractor obtaining substantial completion by the Owner.

### **3.12 DEFERRED / SEASONAL TESTING**

- A. All Construction phase requirements of the Commissioning Process must be completed prior to Substantial Completion or as indicated elsewhere in this Specification.
- B. If any testing or other requirements cannot be completed prior to Substantial Completion due to the building structure, required occupancy condition, or other condition, performance of such test may be delayed to later in the warranty period, upon School District approval. Contractor shall reschedule testing according to the protocols described in this section and any other operational protocols prescribed by School District.
- C. Contractor shall complete all outstanding commissioning requirements as part of this Contract during the warranty period. Contractor shall schedule all activities with School District and/or CxA.
- D. CxA shall document any deferred testing activities and ensure appropriate Commissioning documents are updated. Contractor shall provide any additional documentation needed by CxA to complete these requirements.

**END OF SECTION 01 91 13**



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## **SECTION 02 41 00 - DEMOLITION**

### **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. Salvage of building elements for reuse or return to School District.
  - 2. Selective demolition of building elements for alteration purposes.

#### **1.3 RELATED REQUIREMENTS**

- A. Section 00 31 00 - Available Project Information: Existing building survey conducted by School District; information about known hazardous materials.
- B. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.
- C. Section 01 10 00 - Summary: Sequencing and staging requirements.
- D. Section 01 10 00 - Summary: Description of items to be removed by School District.
- E. Section 01 10 00 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- F. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- G. Section 01 57 13 - Temporary Erosion and Sediment Control.
- H. Section 01 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- I. Section 01 73 00 - Execution: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- J. Section 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- K. Section 31 10 00 - Site Clearing: Vegetation and existing debris removal.
- L. Section 31 22 13 - Rough Grading: Topsoil removal.
- M. Section 31 22 13 - Rough Grading: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
- N. Section 31 23 00 - Excavation and Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
- O. Section 31 23 00 - Excavation and Fill: Filling holes, pits, and excavations generated as a result of removal operations.

#### **1.4 REFERENCE STANDARDS**

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

#### **1.5 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Site Plan: Showing:
  - 1. Vegetation to be protected.
  - 2. Areas for temporary construction and field offices.

3. Areas for temporary and permanent placement of removed materials.
- C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
  1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
  2. Identify demolition firm and submit qualifications.
  3. Include a summary of safety procedures.

#### **1.6 QUALITY ASSURANCE**

- A. Demolition Firm Qualifications: Company specializing in the type of work required.
  1. Minimum of 5 years of documented experience.

### **PART 2 PRODUCTS**

**NOT USED**

### **PART 3 EXECUTION**

#### **3.1 SCOPE**

- A. As indicated on Drawings.

#### **3.2 GENERAL PROCEDURES AND PROJECT CONDITIONS**

- A. The School District has first right of refusal on all salvaged items. Coordinate with School District prior to demolition.
- B. Comply with other requirements specified in Section 01 73 00 - Execution.
- C. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
  1. Obtain required permits.
  2. Comply with applicable requirements of NFPA 241.
  3. Use of explosives is not permitted.
  4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
  5. Provide, erect, and maintain temporary barriers and security devices.
  6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
  7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
  8. Do not close or obstruct roadways or sidewalks without permit.
  9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
  10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- D. Do not begin removal until receipt of notification to proceed from School District.
- E. Do not begin removal until built elements to be salvaged or relocated have been removed.
- F. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.
- G. Protect existing structures and other elements that are not to be removed.
  1. Provide bracing and shoring.
  2. Prevent movement or settlement of adjacent structures.
  3. Stop work immediately if adjacent structures appear to be in danger.
- H. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

- I. If hazardous materials are discovered during removal operations, stop work and notify the Architect and the School District; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
  1. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.

### **3.3 SELECTIVE DEMOLITION FOR ALTERATIONS**

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
  1. Verify that construction and utility arrangements are as indicated.
  2. Report discrepancies to Architect before disturbing existing installation.
  3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- C. Remove existing work as indicated and as required to accomplish new work.
  1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction.
  2. Remove items indicated on Drawings.
- D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and \_\_\_\_\_): Remove existing systems and equipment as indicated.
  1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
  2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
  3. Refer to Section 01 10 00 - Summary for other limitations on outages and required notifications.
  4. Verify that abandoned services serve only abandoned facilities before removal.
  5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- E. Protect existing work to remain.
  1. Prevent movement of structure; provide shoring and bracing if necessary.
  2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
  3. Repair adjacent construction and finishes damaged during removal work.
  4. Patch as specified for patching new work.

### **3.4 DEBRIS AND WASTE REMOVAL**

- A. Remove debris, junk, and trash from site.
- B. Remove from site all materials not to be reused on site; comply with requirements of Section 01 74 19 - Construction Waste Management and Disposal.
- C. Leave site in clean condition, ready for subsequent work.
- D. Clean up spillage and wind-blown debris from public and private lands.

**END OF SECTION 02 41 00**

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PBK Architects, Inc.  
PBK Project No. 20217  
Issue for Construction

CTE Barrientes  
Edinburg CISD  
June 4, 2024

**SECTION 02 82 00 - ASBESTOS REMEDIATION**

## **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: Requirements including but not limited to:
  - 1. Asbestos material abatement and disposal.
  - 2. Accessories necessary for complete removal.
- B. Related Sections:
  - 1. 01 35 43.13 - Environmental Procedures for Hazardous Materials

### **1.3 SUBMITTAL**

- A. Submit copy of the signed waste manifests indicating the place, time and exact quantity of asbestos, received by an approved landfill.

### **1.4 QUALITY ASSURANCE**

- A. Qualifications: Entity having minimum five (5) years documented experience, holding required current licenses for the removal, transport, and disposal and related activities relative to the work, having the required personal protective equipment and respirators for abatement operations, with current liability insurance, and who employs workers fully trained and knowledgeable in the removal of hazardous materials.
- B. Stop Asbestos Removal
  - 1. If a verbal or written Stop Asbestos Removal Order is given, immediately stop asbestos removal and maintain HEPA filtered negative pressure air flow in the containment and adequately wet any exposed ACM.
  - 2. Do not resume asbestos removal activity until authorized to do so in writing.
  - 3. A stop asbestos removal order may be issued at any time it is determined that abatement conditions/activities are not within regulatory requirements or that an imminent hazard exists to human health or the environment.
  - 4. Work stoppage will continue until conditions have been corrected.

## **PART 2 MATERIALS**

### **NOT USED**

## **PART 3 EXECUTION**

### **3.1 REMEDIATION**

- A. The School District has conducted an asbestos survey and has determined that asbestos may be present in areas where work will be performed. The survey is made available for review.
  - 1. As part of the work, School District requires asbestos removal to be performed under the construction contract.
  - 2. Asbestos may be present in vinyl tile under architectural woodwork or covered by, but not encapsulated, carpet materials and other types of flooring.
  - 3. Asbestos may be present in the ductwork above the ceiling panels.
  - 4. If asbestos is found, stop work in the area and engage an asbestos removal firm to remediate the asbestos from the area. Do not resume work in the affected areas until the abatement is complete and authorization to proceed with work in the affected areas is given. Work in areas not affected by asbestos may continue.
- B. Assume responsibility and liability for compliance with applicable Federal, State, and Local regulations related to the asbestos abatement work.
  - 1. Provide and maintain training, accreditations, medical exams, medical records, personal protective equipment (PPE) including respiratory protection including respirator fit testing, as required by applicable Federal, State and Local regulations.
  - 2. Post required notices prior to the commencement of the work.

3. Restrict access to containment areas to authorized, trained, and protected personnel.
  4. Prepare and post an emergency plan in clean room and equipment room of the decontamination unit.
  5. Do not permit workers to eat, drink, smoke, chew gum or tobacco, or break the protection of the respiratory protection system in the work area.
- C. Entering and Exiting Procedures: Establish procedures for entering and exiting containment area. Provide personnel decontamination unit with disposable coveralls, head covers, and clean respirators. Provide shower room between personnel decontamination area and equipment room.
- D. Decontamination Procedures: Establish procedures for decontamination upon leaving containment are in accordance with federal and state regulations.
- E. Provide negative pressure filtration systems to complete exchange air 4 time per hour. Provide standby system in the event of a machine failure or emergency.
1. Continuously monitor and record the pressure differential between the work area and the building outside of the work area.
- F. Prepare the Affected Area: Remove furnishings and materials to the extent necessary to remediate the asbestos.
- G. Containment of Areas:
1. Provide a secure containment work area in accordance with federal and state regulations. Avoid damage to existing partitions and ceilings scheduled to remain to the extent possible.
    - a. Establish critical barriers over each opening into the work area.
    - b. Close out vents and air ducts to prevent particulates from entering the HVAC system.
- H. Debris:
1. Place contaminated debris in a designated location within the containment area.
    - a. Place debris in minimum 6 mil poly bags before removing from contaminated areas. Pass Clean or decontaminate bags and pass and pass through a double 6 mil flap doorway into another bag or fiber drum. Remove to disposal dumpster/gondola/vehicle. Do not permit unprotected personnel to come in contact with contaminated bags.
    - b. Remove and dispose of contaminated debris in compliance with local regulations.
- I. Testing: Perform required tests and inspections upon completion of the work. Collect air samples and analyze in accordance with regulations. Upon satisfactory conclusion of testing, remove critical barriers.
- J. After thorough decontamination, complete asbestos abatement work upon meeting the regulated area clearance criteria and fulfilling the following:
1. Remove equipment, materials, and debris from the project area.
  2. Package and dispose asbestos waste as required.
  3. Repair or replace all interior finishes damaged during the abatement work.
  4. Fulfill other project closeout requirements as specified elsewhere in this specification.

### **3.2 CERTIFICATE OF COMPLETION BY CONTRACTOR**

- A. Submit a signed Certificate of Completion at the completion of the abatement and decontamination of the regulated area.

**END OF SECTION 02 82 00**



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## **SECTION 03 10 00 - CONCRETE FORMS AND ACCESSORIES**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Formwork for cast-in place concrete.
  - 2. Shoring, bracing, and anchorage.
  - 3. Architectural form liners.
  - 4. Form accessories.
  - 5. Form stripping.
- B. Related Sections:
  - 1. Section 032000 - Concrete Reinforcement.
  - 2. Section 033000 - Cast-in-Place Concrete.

#### **1.2 REFERENCES**

- A. American Concrete Institute:
  - 1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
  - 2. ACI 301 - Specifications for Structural Concrete.
  - 3. ACI 318 - Building Code Requirements for Structural Concrete.
  - 4. ACI 347 - Guide to Formwork for Concrete.
- B. American Forest and Paper Association:
  - 1. AF&PA - National Design Specifications for Wood Construction.
- C. The Engineered Wood Association:
  - 1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.
- D. ASTM International:
  - 1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
  - 2. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- E. West Coast Lumber Inspection Bureau:
  - 1. WCLIB - Standard Grading Rules for West Coast Lumber.

#### **1.3 DESIGN REQUIREMENTS**

- A. Design, engineer and construct formwork, shoring and bracing in accordance with ACI 318 to conform to design and applicable code requirements to achieve concrete shape, line and dimension as indicated on Drawings.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Vapor Retarder Permeance: Maximum .03 perms when tested in accordance with ASTM E96, Procedure A.

## 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 347 ACI 301 ACI 318.
- B. For wood products furnished for work of this Section, comply with AF&PA.
- C. Perform Work in accordance with State Municipality of Highways Public Work's standard.

## 1.6 COORDINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

## PART 2 PRODUCTS

### 2.1 WOOD FORM MATERIALS

- A. Form Materials: At discretion of Contractor.

### 2.2 FORMWORK ACCESSORIES

- A. Vapor Retarder: Where indicated on Drawings, 10 mil thick polyethylene sheet manufacture by:
  - 1. Stego Wrap Class A: by Stego Industries LLC (887) 464-7834
  - 2. Griffolyn by Reef Industries (800) 231-6074
  - 3. VaporBlock 10 by Raven Industries (800) 635-3456
  - 4. Perminator Vapor – May by W.R. Meadows (800) 342-5976
  - 5. Xtreme by Tex-Trude (281) 452-5961
  - 6. Or Equivalent
- B. Bituminous Joint Filler: ASTM D1751.
- C. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.
- D. Water Stops: Rubber Polyvinyl chloride, minimum 1,750 psi tensile strength, minimum 50 degrees F to plus 175 degrees F working temperature range, inch wide, maximum possible lengths, ribbed profile, preformed corner sections, heat welded jointing.

\*\*\*\*\* OR \*\*\*\*\*

- E. Waterstop: Flexible strip of bentonite waterproofing compound in coil form for joints in concrete construction.
  - 1. Colloid Environmental Technologies Company Model.
  - 2. TC MiraDRi Model.
  - 3. Paramount Technical Products Model.
  - 4. Substitutions: Section 016000 - Product Requirements Not Permitted.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.
- C. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Architect/Engineer.

### **3.2 INSTALLATION**

- A. Earth Forms:
  - 1. Earth forms are not permitted.
- B. Formwork - General:
  - 1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
  - 2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
  - 3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
  - 4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
  - 5. Complete wedging and bracing before placing concrete.
- C. Forms for Smooth Finish Concrete:
  - 1. Use steel, plywood or lined board forms.
  - 2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
  - 3. Install form lining with close-fitting square joints between separate sheets without springing into place.
  - 4. Use full size sheets of form lines and plywood wherever possible.
  - 5. Tape joints to prevent protrusions in concrete.
  - 6. Use care in forming and stripping wood forms to protect corners and edges.
  - 7. Level and continue horizontal joints.
  - 8. Keep wood forms wet until stripped.
- D. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301 ACI 318.
- E. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- F. Obtain Architect/Engineer's approval before framing openings in structural members not indicated on Drawings.
- G. Install fillet and chamfer strips on external corners of beams joists columns and.

- H. Install void forms in accordance with manufacturer's recommendations.
  - 1. SureVoid Products, Inc., Englewood, CO (800) 458-5444.
- I. Do not reuse wood formwork more than times for concrete surfaces to be exposed to view. Do not patch formwork.

### **3.3 APPLICATION - FORM RELEASE AGENT**

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.
- D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish". Apply form coatings before placing reinforcing steel.

### **3.4 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS**

- A. Install formed openings for items to be embedded in or passing through concrete work.
- B. Locate and set in place items required to be cast directly into concrete.
- C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.
- D. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.
- G. Form Ties:
  - 1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
  - 2. Place ties at least 1 inch away from finished surface of concrete.
  - 3. Leave inner rods in concrete when forms are stripped.
  - 4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.
- H. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.
- I. Construction Joints:

1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
  2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
  3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
  4. Arrange joints in continuous line straight, true and sharp.
- J. Openings for Items Passing Through Concrete:
1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
  2. Coordinate work to avoid cutting and patching of concrete after placement.
  3. Perform cutting and repairing of concrete required as result of failure to provide required openings.
- K. Screeds:
1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
  2. Slope slabs to drain where required or as shown on Drawings.
  3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.
- L. Screed Supports:
1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which will not puncture membrane.
  2. Staking through membrane is not be permitted.
- M. Cleanouts and Access Panels:
1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
  2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

### **3.5 FORM CLEANING**

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

### **3.6 FORM REMOVAL**

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by Architect/Engineer.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

- C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.
- D. Leave forms in place for minimum number of days as specified in ACI 347.

### **3.7 ERECTION TOLERANCES**

- A. Construct formwork to maintain tolerances required by ACI 301 ACI 318.

\*\*\*\*\* OR \*\*\*\*\*

- B. Camber slabs and beams 1/4 inch per 10 feet in accordance with ACI 301 ACI 318.

### **3.8 FIELD QUALITY CONTROL**

- A. Section 014000 - Quality Requirements 017000 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
- C. Notify Architect/Engineer after placement of reinforcing steel in forms, but prior to placing concrete.
- D. Schedule concrete placement to permit formwork inspection before placing concrete.

**END OF SECTION 03 10 00**

## **SECTION 03 20 00 - CONCRETE REINFORCING**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Reinforcing bars.
  - 2. Welded wire fabric.
  - 3. Reinforcement accessories.
  
- B. Related Sections:
  - 1. Section 031000 - Concrete Forms and Accessories.
  - 2. Section 033000 - Cast-in-Place Concrete.
  - 3. Section 033500 - Concrete: Reinforcement for concrete floor toppings.

#### **1.2 REFERENCES**

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete.
  - 2. ACI 318 - Building Code Requirements for Structural Concrete.
  - 3. ACI 530.1 - Specifications for Masonry Structures.
  - 4. ACI SP-66 - ACI Detailing Manual.
  
- B. ASTM International:
  - 1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
  - 2. ASTM A184/A184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
  - 3. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
  - 4. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
  - 5. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  - 6. ASTM A704/A704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
  - 7. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
  - 8. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
  - 9. ASTM A775/A775M - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
  - 10. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.
  - 11. ASTM A934/A934M - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
  - 12. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
  - 13. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel Bars.



- C. American Welding Society:
  - 1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
- D. Concrete Reinforcing Steel Institute:
  - 1. CRSI - Manual of Standard Practice.
  - 2. CRSI - Placing Reinforcing Bars.

### **1.3 SUBMITTALS**

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules, and supporting and spacing devices.
- C. Certificates: Submit AWS qualification certificate for welders employed on the Work.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
  - 1. Submit certified copies of mill test report of reinforcement materials analysis.

### **1.4 QUALITY ASSURANCE**

- A. Perform Work in accordance with CRSI - Manual of Standard Practice, ACI 301, and ACI 318.
- B. Prepare shop drawings in accordance with ACI SP-66.

### **1.5 QUALIFICATIONS**

- A. Welders: AWS qualified within previous 12 months.

### **1.6 COORDINATION**

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate with placement of formwork, formed openings and other Work.

## **PART 2 PRODUCTS**

### **2.1 REINFORCEMENT**

- A. Deformed and Plain Reinforcement: ASTM A615/A615M; 60 ksi yield strength, steel bars, unfinished.

### **2.2 ACCESSORY MATERIALS**

- A. Tie Wire: Minimum 16 gage annealed.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor retarder puncture.

- C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic tipped steel; size and shape to meet Project conditions.
- D. Reinforcing Splicing Devices: Mechanical type; full tension and compression; sized to fit joined reinforcing.
- E. Epoxy Coating Patching Material: Type as recommended by coating manufacturer.

### **2.3 FABRICATION**

- A. Fabricate concrete reinforcement in accordance with CRSI Manual of Practice, and ACI 318, on and all applicable codes.
- B. Form standard hooks for 180 degree bends, 90 degree bend, stirrup and tie hooks, and seismic hooks as indicated on Drawings.
- C. Form reinforcement bends with minimum diameters in accordance with ACI 318 and all applicable codes.
- D. Fabricate column reinforcement with offset bends at reinforcement splices.
- E. Form spiral column reinforcement from minimum 3/8 inch diameter continuous deformed bar or wire.
- F. Form ties and stirrups from the following:
  - 1. For bars No. 10 and Smaller: No. 3 deformed bars.
  - 2. For bars No. 11 and Larger: No. 4 deformed bars.
- G. Weld reinforcement in accordance with AWS D1.4.
- H. Galvanized Epoxy-Coated Reinforcement: Clean surfaces, weld and re-protect welded joint in accordance with CRSI.
- I. Locate reinforcement splices not indicated on Drawings, at point of minimum stress. Review location of splices with Architect/Engineer.

### **2.4 SOURCE QUALITY CONTROL**

- A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Make completed reinforcement available for inspection at manufacturer's factory prior to packaging for shipment. Notify Architect/Engineer at least seven days before inspection is allowed.
- C. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
  - 1. Specified shop tests are not required for Work performed by approved fabricator.

**PART 3 EXECUTION**

**3.1 PLACEMENT**

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position beyond specified tolerance.
  - 1. Do not weld crossing reinforcement bars for assembly.
- B. Do not displace or damage vapor retarder.
- C. Accommodate placement of formed openings.
- D. Space reinforcement bars with minimum clear spacing in accordance with ACI 318 of one bar diameter, but not less than 1 inch.
  - 1. Where bars are indicated in multiple layers, place upper bars directly above lower bars.
- E. Maintain concrete cover around reinforcement in accordance with ACI 318 applicable code as follows:

Footings and Concrete Formed Against Earth		3 inches
Concrete exposed to earth or weather	No. 6 bars and larger	2 inches
	No. 5 bars and smaller	1-1/2 inches
Supported Slabs, Walls, and Joists	No. 14 bars and larger	1-1/2 inches
	No. 11 bars and smaller	3/4 inches
Beams and Columns		1-1/2 inches
Shell and Folded Plate Members	No. 6 bars and larger	3/4 inches
	No. 5 bars and smaller	1/2 inches

**3.2 ERECTION TOLERANCES**

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Install reinforcement within the following tolerances for flexural members, walls, and compression members:

Reinforcement Depth	Depth Tolerance	Concrete Cover Tolerance
Greater than 8 inches	plus or minus 3/8 inch	minus 3/8 inch
Less than 8 inches	plus or minus 1/2 inch	minus 1/2 inch

- C. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.

### **3.3 FIELD QUALITY CONTROL**

- A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Field inspection and testing will be performed by Owner's testing laboratory in accordance with ACI 318 and the latest edition of the IBC.
- C. Provide free access to Work and cooperate with appointed firm.
- D. Reinforcement Inspection:
  - 1. Placement Acceptance: Specified and ACI 318 material requirements and specified placement tolerances.
  - 2. Welding: Inspect welds in accordance with AWS D1.1.
  - 3. Periodic Placement Inspection: Inspect for correct materials, fabrication, sizes, locations, spacing, concrete cover, and splicing.
  - 4. Weldability Inspection: Inspect for reinforcement weldability when formed from steel other than ASTM A706/A706M.
  - 5. Continuous Weld Inspection: Inspect reinforcement as required by ACI 318.
  - 6. Periodic Weld Inspection: Other welded connections.

### **3.4 SCHEDULES**

- A. Reinforcement For Superstructure Framing Members: Deformed bars, unfinished.
- B. Reinforcement For Foundation Wall Framing Members and Slab-on-Grade: Deformed bars and wire fabric, galvanized finish.
- C. Reinforcement For Parking Structure Framing Members: Deformed bars, epoxy-coated finish.

**END OF SECTION 03 20 00**

## **SECTION 03 30 00 - CAST-IN-PLACE CONCRETE**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section includes cast-in-place concrete for the following:
  - 1. Foundation walls.
  - 2. Supported slabs.
  - 3. Slabs on grade.
  - 4. Control, expansion and contraction joint devices.
  - 5. Equipment pads.
  - 6. Light pole base.
  - 7. Flagpole base.
  
- B. Related Sections:
  - 1. Section 031000 - Concrete Forms and Accessories: Formwork and accessories. Placement of joint device joint device anchors in formwork.
  - 2. Section 032000 - Concrete Reinforcement.
  - 3. Section 033500 - Concrete Finishing.
  - 4. Section 033900 - Concrete Curing.

#### **1.2 REFERENCES**

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete.
  - 2. ACI 305 - Hot Weather Concreting.
  - 3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
  - 4. ACI 308.1 - Standard Specification for Curing Concrete.
  - 5. ACI 318 - Building Code Requirements for Structural Concrete.
  
- B. ASTM International:
  - 1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - 2. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
  - 3. ASTM C33 - Standard Specification for Concrete Aggregates.
  - 4. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  - 5. ASTM C42/C42M - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
  - 6. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
  - 7. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
  - 8. ASTM C150 - Standard Specification for Portland Cement.
  - 9. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
  - 10. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
  - 11. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
  - 12. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
  - 13. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.

14. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
15. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
16. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
17. ASTM C685/C685M - Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing.
18. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
19. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
20. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
21. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
22. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
23. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
24. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
25. ASTM C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
26. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
27. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
28. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
29. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
30. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
31. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
32. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
33. ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
34. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

### **1.3 PERFORMANCE REQUIREMENTS**

- A. Vapor Retarder Permeance: Maximum .03 perm when tested in accordance with ASTM E96.

### **1.4 SUBMITTALS**

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on joint devices, attachment accessories, admixtures.
- C. Design Data:
  1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:

- a. Hot and cold weather concrete work.
  - b. Air entrained concrete work.
  2. Identify mix ingredients and proportions, including admixtures.
  3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.
- D. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent Work.

### **1.5 CLOSEOUT SUBMITTALS**

- A. Section 017000 - Execution Requirements: Closeout procedures.
- B. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

### **1.6 QUALITY ASSURANCE**

- A. Perform Work in accordance with ACI 301 and ACI 318.
- B. Conform to ACI 305 when concreting during hot weather.
- C. Conform to ACI 306.1 when concreting during cold weather.
- D. Acquire cement and aggregate from one source for Work.

### **1.7 COORDINATION**

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

### **1.8 ENVIRONMENTAL REQUIREMENTS**

- A. Section 016000 - Product Requirements: Environmental conditions affecting products on site.
- B. Maintain concrete temperature after installation at minimum 50 degrees F for minimum 7 days.

### **1.9 COORDINATION**

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

**PART 2 PRODUCTS**

**2.1 CONCRETE MATERIALS**

- A. Cement: ASTM C150, Type I - Normal
- B. Normal Weight Aggregates: ASTM C33.
  - 1. Coarse Aggregate Maximum Size: 1.25
- C. Water: ACI 318; potable, without deleterious amounts of chloride ions.

**2.2 ADMIXTURES**

- A. Air Entrainment: ASTM C260.
- B. Fly Ash: ASTM C618 type C or F.
- C. Silica Fume: ASTM C1240.

**2.3 ACCESSORIES**

- A. Vapor Retarder: ASTM E1745 Class A; 10 mil thick; type recommended for below grade application. Furnish joint tape recommended by manufacturer.
- B. Non-Shrink Grout: ASTM C1107, premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

**2.4 JOINT DEVICES AND FILLER MATERIALS**

- A. Joint Filler; Asphalt impregnated fiberboard or felt, tongue and groove profile.

\*\*\*\*\* OR \*\*\*\*\*
- B. Joint Filler: ASTM D1752; Closed cell, resiliency of 95 percent if not compressed more than 50 percent of original thickness.
- C. Sealant: ASTM C309, Type I approved by Asphalt and Vinyl composition Tile Institute, 30% minimum solids content.

**2.5 CONCRETE MIX**

- A. Select proportions for normal weight concrete in accordance with ACI 301 Method 1
- B. Provide concrete for the following criteria:

Material and Property	Measurement
Compressive Strength (7 day)	2100 psi
Compressive Strength (28 day)	3000 psi
Cement Type	ASTM C150



Aggregate Size (maximum)	1.25 inch
Air Content	Do not use air entrainment for concrete mixes.

- C. Admixtures: Include admixture types and quantities indicated in concrete mix designs only when approved by Architect/Engineer.
  - 1. Use accelerating admixtures in cold weather. Use of admixtures will not relax cold weather placement requirements.
  - 2. Do not use calcium chloride nor admixtures containing calcium chloride.
  - 3. Use set retarding admixtures during hot weather.
- D. Site Mixed Concrete: No site mixed concrete is allowed.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify requirements for concrete cover over reinforcement.
- C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

#### 3.2 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Remove laitance, coatings, and unsound materials.
- B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- C. Remove debris and ice from formwork, reinforcement, and concrete substrates.
- D. Remove water from areas receiving concrete before concrete is placed.

#### 3.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301.
- B. Notify testing laboratory and Architect/Engineer minimum 24 hours prior to commencement of operations.
- C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, and are not disturbed during concrete placement.
- D. Install vapor retarder under interior slabs on grade in accordance with ASTM E1643. Lap joints minimum 6 inches and seal watertight by adhesive applied between overlapping edges and ends as per manufacturer recommendations.

- E. Repair vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 6 inches and seal watertight.
- F. Install construction joint devices in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- G. Install joint device anchors. Maintain correct position to allow joint cover to be flush with floor finish.
- H. Install joint covers in one piece longest practical length, when adjacent construction activity is complete.
- I. Deposit concrete at final position. Prevent segregation of mix.
- J. Place concrete in continuous operation for each panel or section determined by predetermined joints.
- K. Consolidate concrete.
- L. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- M. Place concrete continuously between predetermined expansion, control, and construction joints.
- N. Do not interrupt successive placement; do not permit cold joints to occur.
- O. Saw cut joints within 12 hours after placing. Use 3/16 inch thick blade, cut into 1/4 depth of slab thickness.
- P. Screed floors and slabs on grade level, maintaining surface flatness of  $F_r$  of 35.

### **3.4 CONCRETE FINISHING**

- A. Finish concrete floor surfaces to requirements of Section 03350.
- B. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains.

### **3.5 CURING AND PROTECTION**

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
  - 1. Protect concrete footings from freezing for minimum 5 days.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Cure floor surfaces as specified in Section 03390.
- D. Ponding: Maintain 100 percent coverage of water over floor slab areas continuously for 7 days.

- E. Spraying: Spray water over floor slab areas and maintain wet for 7 days.

### **3.6 FIELD QUALITY CONTROL**

- A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Field inspection and testing will be performed by Owner's testing laboratory in accordance with ACI 318
- C. Provide free access to Work and cooperate with appointed firm.
- D. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
- E. Concrete Inspections:
  - 1. Continuous Placement Inspection: Inspect for proper installation procedures.
  - 2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.
- F. Strength Test Samples:
  - 1. Sampling Procedures: ASTM C172.
  - 2. Cylinder Molding and Curing Procedures: ASTM C31/C31M, cylinder specimens, standard cured field cured.
  - 3. Sample concrete and make one set of four cylinders for every 150 cu yds or less of each class of concrete placed each day and for every 5,000 sf of surface area for slabs and walls.
  - 4. When volume of concrete for any class of concrete would provide less than 3 sets of cylinders, take samples from three randomly selected batches, or from every batch when less than 3 batches are used.
  - 5. Make one additional cylinder during cold weather concreting, and field cure.
- G. Field Testing:
  - 1. Slump Test Method: ASTM C143/C143M.
  - 2. Air Content Test Method: ASTM C173/C173M.
  - 3. Temperature Test Method: ASTM C1064/C1064M.
  - 4. Measure slump and temperature for each compressive strength concrete sample.
  - 5. Measure air content in air entrained concrete for each compressive strength concrete sample.
- H. Cylinder Compressive Strength Testing:
  - 1. Test Method: ASTM C39.
  - 2. Test Acceptance: In accordance with ACI 318.
  - 3. Test one cylinder at 7 days.
  - 4. Test three cylinders at 28 days.
  - 5. Dispose remaining cylinders when testing is not required.
- I. Core Compressive Strength Testing:
  - 1. Sampling and Testing Procedures: ASTM C42/C42M.
  - 2. Test Acceptance: In accordance with ACI 318.
  - 3. Drill three cores for each failed strength test from concrete represented by failed strength test.

- J. Water Soluble Chloride Ion Concentration Test Method: ASTM C1218; tested at 28 days.
  - 1. Maximum Concentration: As permitted by applicable code.
- K. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

### **3.7 PATCHING**

- A. Allow Architect/Engineer to inspect concrete surfaces immediately upon removal of forms.
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Architect/Engineer upon discovery.
- C. Patch imperfections as directed by Architect/Engineer

### **3.8 DEFECTIVE CONCRETE**

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by Architect/Engineer.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area.

### **3.9 SCHEDULE - CONCRETE TYPES AND FINISHES**

- A. Foundation Walls: 3,000 psi 28 day concrete, form finish with honeycomb filled surface.
- B. Underside of Supported Floors and Structure Exposed to View: 4,000 psi 28 day concrete, sack rubbed finish.
- C. Exposed Portico Structure: 4,000 psi 28 day concrete, air entrained, smooth stone rubbed finish.

### **3.10 SCHEDULE - JOINT FILLERS**

- A. Basement Floor Slab Perimeter: Joint filler Type A set 1/8 inch below floor slab elevation.
- B. Exterior Retaining Wall at Loading Dock: Joint filler Type F recessed 3/8 inch with sealant cover.

**END OF SECTION 03 30 00**

## **SECTION 03 35 00 - CONCRETE FINISHING**

### **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. Clear coatings.
- B. Related Sections
  - 1. Section 03 30 00 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.
  - 2. Section 03 30 00 - Cast-in-Place Concrete: Curing compounds that also function as sealers.

#### **1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the work with concrete floor placement and concrete floor curing.

#### **1.4 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
- C. Product Data: Manufacturer's published data and installation instructions for concrete polishing system and finishing products, including manufacturer's installation instructions, information on compatibility of different products, and limitations.
- D. Maintenance Data: Provide data on maintenance and renewal of applied finishes.
- E. Warranty Documentation: Manufacturer warranty; ensure that forms have been completed in School District's name and registered with manufacturer.
- F. Specimen Warranty: Manufacturer warranty.

#### **1.5 QUALITY ASSURANCE**

- A. For slabs indicated to receive concrete polishing system, do not proceed with concrete polishing unless manufacturer's representative and specialized equipment is present for every day of placement.

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

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.

#### **1.7 FIELD CONDITIONS**

- A. Maintain light level equivalent to a minimum 200 W light source at 8 feet (2.5 m) above the floor surface over each 20 foot (6 m) square area of floor being finished.
- B. Do not finish floors until interior heating system is operational.
- C. Maintain ambient temperature of 50 degrees F (10 degrees C) minimum.

#### **1.8 WARRANTY**

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Correct defective work within a two-year period commencing on the Date of Substantial Completion.
- C. Finish Warranty: Provide five-year manufacturer warranty against excessive degradation of finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

## **PART 2 PRODUCTS**

### **2.1 CONCRETE FLOOR FINISH APPLICATIONS**

- A. Typical Concrete Finishing:
  - 1. Unless otherwise indicated, all exposed concrete floors are to be finished using high-gloss clear coating.

### **2.2 COATINGS**

- A. High-Gloss Clear Coating: Transparent, non-yellowing, acrylic polymer-based coating.
  - 1. Composition: Solvent-based.
    - a. Nonvolatile Content: 15 percent, minimum, when measured by volume.
    - b. Products:
      - 1) Euclid Chemical Company: ULTRAGUARD: [www.euclidchemical.com/#sle](http://www.euclidchemical.com/#sle).
      - 2) PROSOCO, Inc; LSGuard: [www.prosoco.com/consolideck/#sle](http://www.prosoco.com/consolideck/#sle).
      - 3) W. R. Meadows, Inc; Decra-Seal W/B: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
      - 4) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that floor surfaces are acceptable to receive the work of this section.
- B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

### **3.2 GENERAL**

- A. Apply materials in accordance with manufacturer's instructions.

### **3.3 COATING APPLICATION**

- A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
- B. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.
- C. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

**END OF SECTION 03 35 00**

## **SECTION 03 35 00 - CONCRETE FINISHING**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Finishing concrete floors and floor toppings.
  - 2. Floor surface treatment.
  
- B. Related Sections:
  - 1. Section 033000 - Cast-in-Place Concrete: Prepared concrete floors ready to receive finish; control and formed expansion and contraction joints and joint devices.
  - 2. Section 03360 - Concrete Finishes: Exposed aggregate finish.
  - 3. Section 033900 - Concrete Curing.
  - 4. Section 079513 - Expansion Joint Cover Assemblies.
  - 5. Section 079200 - Joint Sealers.

#### **1.2 REFERENCES**

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete.
  - 2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.
  
- B. ASTM International:
  - 1. ASTM E1155 - Standard Test Method for Determining Floor Flatness and of Levelness Using the F-number System.

#### **1.3 SUBMITTALS**

- A. Section 013300 - Submittal Procedures: Submittal procedures.
  
- B. Product Data: Submit data on concrete hardener, sealer, curing compounds curing papers and slip resistant treatment, compatibilities, and limitations.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Section 017000 - Execution Requirements: Closeout procedures.
  
- B. Operation and Maintenance Data: Submit data on maintenance renewal of applied coatings.

#### **1.5 QUALITY ASSURANCE**

- A. Perform Work in accordance with ACI 301 and ACI 302.1.

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

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
  
- B. Deliver materials in manufacturer's packaging including application instructions.

## **1.7 ENVIRONMENTAL REQUIREMENTS**

- A. Section 016000 - Product Requirements: Environmental conditions affecting products on site.

## **1.8 COMPOUNDS - HARDENERS AND SEALERS**

- A. Chemical Hardener: Magnesium fluorosilicate and zinc fluorosilicate blend

## **PART 2 EXECUTION**

### **2.1 EXAMINATION**

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify floor surfaces are acceptable to receive the Work of this section.

### **2.2 FLOOR FINISHING**

- A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.1.
- B. Wood float surfaces receiving quarry tile, ceramic tile, and cementitious terrazzo with full bed setting system.
- C. Steel trowel surfaces receiving carpeting, resilient flooring, seamless flooring, thin set terrazzo, thin set quarry tile, and thin set ceramic tile.
- D. Steel trowel surfaces which are scheduled to be exposed.

### **2.3 TOLERANCES**

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Measure for F(F) and F(L) tolerances for floors in accordance with ASTM E1155, within 48 hours after slab installation.
- C. Finish concrete to achieve the following tolerances:
  - 1. Under Glazed Tile on Setting Bed: F(F) 35 and F(L) 20.
  - 2. Under Resilient Finishes: F(F) 75 and F(L) 50.
  - 3. Exposed to View and Foot Traffic: F(F) 75 and F(L) 40.
  - 4. Correct slab surface when actual F(F) or F(L) number for floor installation measures less than required.
- D. Correct defects in defined traffic floor by grinding or removal and replacement of defective Work. Areas requiring corrective Work will be identified. Re-measure corrected areas by same process.

**END OF SECTION 03 35 00**



## **SECTION 03 39 00 - CONCRETE CURING**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section includes initial and final curing of horizontal and vertical concrete surfaces.
- B. Related Sections:
  - 1. Section 033000 - Cast-In-Place Concrete.
  - 2. Section 033500 - Concrete Finishing.

#### **1.2 REFERENCES**

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete.
  - 2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.
  - 3. ACI 308.1 - Standard Specification for Curing Concrete.
  - 4. ACI 318 - Building Code Requirements for Structural Concrete.
- B. ASTM International:
  - 1. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
  - 2. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  - 3. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
  - 4. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting.

#### **1.3 SUBMITTALS**

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on curing compounds, mats, paper, film, compatibilities, and limitations.

#### **1.4 QUALITY ASSURANCE**

- A. Perform Work in accordance with ACI 301.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. Membrane Curing Compound Type 1.
- B. Membrane Curing Compound: ASTM C1315 Type I.
- C. Water: Potable, not detrimental to concrete.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify substrate surfaces are ready to be cured.

#### **3.2 INSTALLATION - HORIZONTAL SURFACES**

- A. Cure concrete in accordance with ACI 308.1.
- B. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 4 days.

\*\*\*\*\* OR \*\*\*\*\*

- C. Spraying: Spray water over floor slab areas and maintain wet for 7 days.

\*\*\*\*\* OR \*\*\*\*\*

- D. Absorptive Mat: Spread cotton fabric over floor slab areas. Spray with water until mats are saturated, and maintain in saturated condition for 7 days.

\*\*\*\*\* OR \*\*\*\*\*

- E. Absorptive Mat: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place for 7 days.

#### **3.3 PROTECTION OF FINISHED WORK**

- A. Section 017000 - Execution Requirements: Protecting finished Work.
- B. Do not permit traffic over unprotected floor surface.

#### **3.4 SCHEDULES**

- A. Storage Area Slabs: Absorptive mats, burlap-polyethylene type.
- B. Retaining Walls: Membrane curing compound, acrylic type, clear color.
- C. Concrete Pavement: Membrane curing compound, opaque color.
- D. Other Floor Areas: Membrane curing compound, acrylic type, translucent color.

**END OF SECTION 03 39 00**

## **SECTION 03 54 00 - CAST UNDERLAYMENT**

### **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:
- B. Related Sections:
  - 1. Section 01 73 00 - Execution: Alteration project procedures; selective demolition for remodeling.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.
- B. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2023.
- C. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- D. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.
- E. ASTM C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars; 2021.
- F. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete; 2020.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

#### **1.4 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets documenting physical characteristics and product limitations of underlayment materials. Include information on surface preparation, environmental limitations, and installation instructions.
- C. Manufacturer's Instructions.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep dry and protect from direct sun exposure, freezing, and ambient temperature greater than 105 degrees F (41 degrees C).

#### **1.6 FIELD CONDITIONS**

- A. Do not install underlayment until floor penetrations and peripheral work are complete.
- B. Maintain minimum ambient temperatures of 50 degrees F (10 degrees C) 24 hours before, during and 72 hours after installation of underlayment.
- C. During the curing process, ventilate spaces to remove excess moisture.

### **PART 2 PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Specifications are based on products named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.

1. Gypsum-Based Underlayment:
    - a. ARDEX Engineered Cements; ARDEX K 22 F with ARDEX P51 Primer: [www.ardexamericas.com/#sle](http://www.ardexamericas.com/#sle).
    - b. Maxxon Corporation; Gyp-Crete 2000/3.2K: [www.maxxon.com/#sle](http://www.maxxon.com/#sle).
    - c. USG; Levelrock® Series 2500 Floor Underlayment: [www.usg.com/#sle](http://www.usg.com/#sle).
  2. Cementitious Underlayment:
    - a. ARDEX Engineered Cements; ARDEX V 1200 with ARDEX P51 Primer: [www.ardexamericas.com/#sle](http://www.ardexamericas.com/#sle).
    - b. BASF Construction Chemicals; MBT Mastertop 110 Plus Underlayment.
    - c. LATICRETE International, Inc; LATICRETE DRYTEK Skimcoat with DRYTEK LEVELEX Primer: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
    - d. LATICRETE International, Inc; LATICRETE NXT Level Plus with NXT Primer: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
    - e. LATICRETE International, Inc; LATICRETE NXT Skim: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
    - f. LATICRETE International, Inc; LATICRETE SUPERCAP SC500 with LATICRETE SUPERCAP Primer Plus: [www.laticretesupercap.com/#sle](http://www.laticretesupercap.com/#sle).
    - g. The QUIKRETE Companies: [www.quikrete.com/#sle](http://www.quikrete.com/#sle).
    - h. SILPRO Corporation; SilFlo 220: [www.silpro.com/#sle](http://www.silpro.com/#sle).
    - i. USG; Durock® Quik-Top Self-Leveling Underlayment: [www.usg.com/#sle](http://www.usg.com/#sle).
    - j. W. R. Meadows, Inc; Floor-Top STG: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

## 2.2 MATERIALS

- A. Cast Underlayments, General:
  1. Comply with applicable code for combustibility or flame spread requirements.
- B. Gypsum-Based Underlayment: Gypsum based mix, that when mixed with water in accordance with manufacturer's directions will produce self-leveling underlayment with the following properties:
  1. Compressive Strength: Minimum 2500 pounds per square inch (17.24 MPa), tested per ASTM C472.
  2. Density: Maximum 130 pounds per cubic foot (2082 kg/cu m).
  3. Final Set Time: 1 to 2 hours, maximum.
  4. Thickness: 3/4 inch (19 mm) to maximum 3-1/2 inch (89 mm).
  5. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E84.
- C. Cementitious Underlayment: Blended cement mix, that when mixed with water in accordance with manufacturer's instructions will produce self-leveling underlayment with the following properties:
  1. Compressive Strength: Minimum 4000 pounds per square inch (27.6 MPa) after 28 days, tested per ASTM C109/C109M.
  2. Flexural Strength: Minimum 1000 psi (6.9 MPa) after 28 days, tested per ASTM C348.
  3. Density: 125 pounds per cubic foot (2002 kg/cu m), nominal.
  4. Final Set Time: 1-1/2 to 2 hours, maximum.
  5. Thickness: Capable of thicknesses from feather edge to maximum 3-1/2 inch (89 mm).
  6. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E84.
- D. Aggregate: Dry, well graded, washed silica aggregate, approximately 1/8 inch (3 mm) in size and acceptable to underlayment manufacturer.
- E. Reinforcement: Galvanized metal lath complying with recommendations of underlayment manufacturer for specific project circumstances.
- F. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to underlayment mix materials.

- G. Primer: Manufacturer's recommended type.
- H. Joint and Crack Filler: Latex based filler, as recommended by manufacturer.

### **2.3 MIXING**

- A. Site mix materials in accordance with manufacturer's instructions.
- B. Add aggregate for areas where thickness will exceed 1/2 inch (12.7 mm). Mix underlayment and water for at least two minutes before adding aggregate, and continue mixing to assure that aggregate has been thoroughly coated.
- C. Mix to self-leveling consistency without over-watering.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum byproducts, or other compounds detrimental to underlayment material bond to substrate.

### **3.2 PREPARATION**

- A. Concrete: Mechanically prepare steel troweled concrete to create a textured surface necessary to achieve the best bond; acceptable methods include bead blasting and scarifying. Do not use acid etching.
- B. Wood: Install metal lath for reinforcement of underlayment.
- C. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.
- D. Vacuum clean surfaces.
- E. Prime substrate in accordance with manufacturer's instructions. Allow to dry.
- F. Close floor openings.

### **3.3 APPLICATION**

- A. Install underlayment in accordance with manufacturer's instructions.
- B. Pump or pour material onto substrate. Do not retemper or add water.
  - 1. Pump, move, and screed while the material is still highly flowable.
  - 2. Be careful not to create cold joints.
  - 3. Wear spiked shoes while working in the wet material to avoid leaving marks.
- C. Place to indicated thickness, with top surface level to 1/8 inch in 10 ft (1:1000).
- D. For final thickness over 1-1/2 inches (38 mm), place underlayment in layers. Allow initial layer to harden to the point where the material has lost its evaporative moisture. Immediately prime and begin application of the subsequent layer within 24 hours.
- E. Place before partition installation.
- F. Where additional aggregate has been used in the mix, add a top layer of neat mix (without aggregate), if needed to level and smooth the surface.
- G. If a fine, feathered edge is desired, steel trowel the edge after initial set, but before it is completely hard.

### **3.4 CURING**

- A. Once underlayment starts to set, prohibit foot traffic until final set has been reached.
- B. Air cure in accordance with manufacturer's instructions.

### **3.5 PROTECTION**

- A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking.
- B. Do not permit traffic over unprotected floor underlayment surfaces.

**END OF SECTION 03 54 00**

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## **SECTION 03 60 00 - GROUTING**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Portland cement grout.
  - 2. Rapid curing epoxy grout.
  - 3. Non-shrink cementitious grout.
- B. Related Sections:
  - 1. Section 033000 - Cast-in-Place Concrete.

#### **1.2 REFERENCES**

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete.
  - 2. ACI 318 - Building Code Requirements for Structural Concrete.
- B. American Society of Testing and Materials:
  - 1. ASTM C33 - Standard Specification for Concrete Aggregates.
  - 2. ASTM C40 - Test Method for Organic Impurities in Fine Aggregates for Concrete.
  - 3. ASTM C150 - Standard Specification for Portland Cement.
  - 4. ASTM C191 - Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.
  - 5. ASTM C307 - Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.
  - 6. ASTM C531 - Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
  - 7. ASTM C579 - Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, monolithic Surfacing and Polymer Concretes.
  - 8. ASTM C827 - Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.
- C. U. S. Army Corps of Engineers Concrete Research Division (CRD):
  - 1. CRD C621 - Non-Shrink Grout.

### **PART 2 PRODUCTS**

#### **2.1 PORTLAND CEMENT GROUT MATERIALS**

- A. Portland Cement: ASTM C150, Type I and II.
- B. Water:
  - 1. Potable; containing no impurities, suspended particles, algae or dissolved natural salts in quantities capable of causing:
    - a. Corrosion of steel.
    - b. Volume change increasing shrinkage cracking.
    - c. Efflorescence.

- d. Excess air entraining.
- C. Fine Aggregate:
  - 1. Washed natural sand.
  - 2. Gradation in accordance with ASTM C33 and represented by smooth granulometric curve within required limits.
  - 3. Free from injurious amounts of organic impurities as determined by ASTM C40.
- D. Mix:
  - 1. Portland cement, sand and water. Do not use ferrous aggregate or staining ingredients in grout mixes.

**2.2 RAPID CURING EPOXY GROUT**

- A. Rapid Curing Epoxy Grout: High strength, three component epoxy grout formulated with thermosetting resins and inert fillers. Rapid-curing, high adhesion, and resistant to ordinary chemicals, acids and alkalies.

Compressive Strength	ASTM C579	12,000 psi at 7 days
Tensile Strength	ASTM C307	2,000 psi minimum
Coefficient of Expansion	ASTM C531	30x10-6 in per degree F
Shrinkage	ASTM C827	None

**2.3 NON-SHRINK CEMENTITIOUS GROUT**

- A. Properties: Certified to maintain initial placement volume or expand after set and meet the following minimum properties when tested in accordance with CRD-C621, for Type D non-shrink grout:

Property	Test	Time	Result
Setting Time	ASTM C191	Initial	2 hours (Approx)
		Final	3 hours (Approx)
Expansion			0.10% - 0.4% Maximum
Compressive Strength	CRD-C621	1 day	4,000 psi
		7 days	7,000 psi
		28 days	10,000 psi to 10,800 psi

**2.4 FORMWORK**

- A. Refer to Section 031000 for formwork requirements.

**2.5 CURING**

- A. Prevent rapid loss of water from grout during first 48 hours by use of approved membrane curing compound or with use of wet burlap method.



## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.
- B. Rough concrete lightly, but not enough to interfere with placement of grout.
- C. Remove foreign materials from metal surfaces in contact with grout.
- D. Align, level and maintain final positioning of components to be grouted.
- E. Saturate concrete surfaces with clean water; remove excess water, leave none standing.

### **3.2 MIXING**

- A. Portland Cement Grout:
  - 1. Use proportions of 2 parts sand and 1 part cement, measured by volume.
  - 2. Prepare grout with water to obtain consistency to permit placing and packing.
  - 3. Mix water and grout in two steps; pre-mix using approximately 2/3 of water; after partial mixing, add remaining water to bring mix to desired placement consistency and continue mixing 2 to 3 minutes.
  - 4. Mix only quantities of grout capable of being placed within 30 minutes after mixing.
  - 5. Do not add additional water after grout has been mixed.
  - 6. Capable of developing minimum compressive strength of 2400 psi in 48 hours and 7000 psi in 28 days.

\*\*\*\*\* [OR] \*\*\*\*\*

### **3.3 PLACING GROUT**

- A. Place grout material quickly and continuously.
- B. Do not use pneumatic-pressure or dry-packing methods.
- C. Apply grout from one side only to avoid entrapping air.
- D. Do not vibrate placed grout mixture, or permit placement when area is being vibrated by nearby equipment.
- E. Thoroughly compact final installation and eliminate air pockets.
- F. Do not remove leveling shims for at least 48 hours after grout has been placed.

### **3.4 CURING**

- A. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. After grout has attained its initial set, keep damp for minimum of 3 days.

**3.5 FIELD QUALITY CONTROL**

- A. Submit proposed mix design of each class of grout to inspection and testing firm for review prior to commencement of Work.
- B. Tests of grout components may be performed to ensure conformance with specified requirements.

**END OF SECTION 03 60 00**

## **SECTION 04 01 20 - MAINTENANCE OF UNIT MASONRY**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes special requirements for maintenance of existing unit masonry, including:
  - 1. Repairing unit masonry, including replacing units.
  - 2. Re-anchoring veneers.
  - 3. Repointing joints.
- B. Related Sections:
  - 1. Section 04 05 00 - Common Work Results for Masonry: Quality assurance requirements, mortar, grout, ties and anchors, reinforcement, embedded flashing, masonry water repellent, masonry accessories, and masonry cleaning.
  - 2. Section 04 20 00 - Unit Masonry: Brick veneer unit masonry.

#### **1.3 SUBMITTALS**

- A. Product Data: Technical data for each type of product, including material descriptions and application instructions and test data substantiating that products comply with requirements.
- B. Shop Drawings for the Following:
  - 1. Provisions for expansion joints or other sealant joints.
  - 2. Replacement and repair of anchors. Include details of anchors within individual masonry units, with locations of anchors and dimensions of holes and recesses in units required for anchors.
  - 3. Field investigation report outlining work required after existing construction is removed from masonry surface.

#### **1.4 QUALITY ASSURANCE**

- A. Cleaning Program:
  - 1. Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, and equipment to be used; protection of surrounding materials; and control of runoff during operations. Include provisions for supervising worker performance and preventing damage:
    - a. If materials and methods other than those indicated are proposed for any phase of cleaning work, add a written description of such materials and methods, including evidence of successful use on comparable projects and demonstrations to show their effectiveness.
- B. Mockups:
  - 1. Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution:
    - a. Clean an area approximately 25 square feet (2.3 sq. m) for each type of masonry and surface condition:
      - 1) Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not test cleaners and methods known to have deleterious effect.
      - 2) Allow a waiting period of not less than seven (7) days after completion of sample cleaning to permit a study of sample panels for negative reactions.
    - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- C. Preconstruction Testing Service:

1. Engage one (1) or more chemical cleaner and paint remover manufacturer(s) to perform pre-construction testing on masonry surfaces:
  - a. Use test areas as indicated and representative of proposed materials and existing construction.
  - b. Propose changes to materials and methods to suit.
- D. Pre-Installation Conference:
  1. Conduct conference at Project site:
    - a. Review methods and procedures related to cleaning masonry including, but not limited to, the following:
      - 1) Verify masonry cleaning equipment and facilities needed to make progress and avoid delays.
      - 2) Materials, material application, and sequencing.
      - 3) Cleaning program.
      - 4) Coordination with building occupants.

## **PART 2 PRODUCTS**

### **2.1 CLEANING MATERIALS**

- A. Refer to Section 04 05 00 - Common Work Results for Masonry.

### **2.2 ACCESSORY MATERIALS**

- A. Refer to Section 04 05 00 - Common Work Results for Masonry.

## **PART 3 EXECUTION**

### **3.1 FIELD CONDITIONS**

- A. Weather Limitations: Proceed with installation when existing and forecasted weather conditions permit masonry cleaning work to be performed according to product manufacturers' written instructions and specified requirements.
- B. Clean masonry surfaces only when air temperature is 40 degrees F (4 degrees C) and above and is predicted to remain so for at least seven (7) days after completion of cleaning.

### **3.2 SEQUENCING AND SCHEDULING**

- A. Perform masonry cleaning work in the following sequence:
  1. Remove plant growth.
  2. Inspect for open mortar joints. Where repairs are required, delay further cleaning work until after repairs are completed, cured, and dried to prevent the intrusion of water and other cleaning materials into the wall.
  3. Remove paint.
  4. Clean masonry surfaces.
  5. Where water repellents are to be used on or near masonry, delay application of chemicals until after cleaning.

### **3.3 PROTECTION**

- A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent paint removers and chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by contact:
  1. Cover adjacent surfaces with materials that are proven to resist paint removers and chemical cleaners used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents according to manufacturer's written instructions. Do not apply liquid strippable masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
  2. Do not apply chemical solutions during winds of enough force to spread them to unprotected surfaces.

3. Neutralize alkaline and acid wastes before disposal.
  4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
- B. Remove gutters and/or downspouts and associated hardware adjacent to immediate work area and store during masonry cleaning. Reinstall when masonry cleaning is complete:
1. Provide temporary rain drainage during work to direct water away from building.

### **3.4 CLEANING MASONRY**

- A. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 20 feet (6 m) away by Architect.
- B. Proceed with cleaning working from top to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.
- C. Use cleaning methods indicated for each masonry material and location:
1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.
  2. Spray equipment:
    - a. Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage surfaces, including joints:
      - 1) Equip units with pressure gages.
      - 2) For chemical cleaner spray application, use low pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone shaped spray.
      - 3) For water spray application, use fan shaped spray that disperses water at an angle of 25 to 50 degrees.
      - 4) For high pressure water spray application, use fan shaped spray that disperses water at an angle of at least 40 degrees.
      - 5) For heated water spray application, use equipment capable of maintaining temperature between 140 degrees F and 160 degrees F (60 degrees C and 71 degrees C) at flow rates indicated.
      - 6) For steam application, use steam generator capable of delivering live steam at nozzle.
- D. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.
- E. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed, so cleaned surfaces blend smoothly into surrounding areas.
- F. Water Application Methods:
1. Water soak application: Soak masonry surfaces by applying water continuously and uniformly to limited area for time indicated. Apply water at low pressures and low volumes in multiple fine sprays using perforated hoses or multiple spray nozzles. Erect a protective enclosure constructed of polyethylene sheeting to cover area being sprayed.
  2. Water spray applications: Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from masonry surface and apply water in horizontal back and forth sweeping motion, overlapping previous strokes to produce uniform coverage.
- G. Steam Cleaning: Apply steam to masonry surfaces at the very low pressures indicated for each type of masonry. Hold nozzle at least 6 inches (150 mm) from masonry surface and apply steam in horizontal back and forth sweeping motion, overlapping previous strokes to produce uniform coverage.

- H. Chemical Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical cleaner manufacturer's written instructions; use brush or spray application. Do not spray apply at pressures exceeding 50 psi (345 kPa). Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
- I. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed:
  - 1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.
- J. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

### 3.5 PRELIMINARY CLEANING

- A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open joints to whatever depth they occur.
- B. Preliminary Cleaning:
  - 1. Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, calking, asphalt, and tar:
    - a. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
    - b. Remove paint and sealant with alkaline paint remover:
      - 1) Comply with requirements.
      - 2) Repeat application up to two (2) times if needed.
    - c. Remove asphalt and tar with solvent type paste paint remover:
      - 1) Comply with requirements.
      - 2) Apply paint remover only to asphalt and tar by brush without prewetting.
      - 3) Allow paint remover to remain on surface for 10 to 30 minutes.
      - 4) Repeat application if needed.

### 3.6 CLEANING MASONRY

- A. Cold Water Soak:
  - 1. Apply cold water by intermittent spraying to keep surface moist.
  - 2. Use perforated hoses or other means that apply a fine water mist to entire surface being cleaned.
  - 3. Apply water in cycles of 5 minutes on and 20 minutes off.
  - 4. Continue spraying until surface encrustation has softened enough to permit its removal by water wash, as indicated by cleaning tests.
- B. Cold Water Wash: Use cold water applied by low, medium, or high pressure spray.
- C. Hot Water Wash: Use hot water applied by low, medium, or high pressure spray.
- D. Steam Cleaning: Apply steam at very low pressures not exceeding 80 psi (550 kPa). Remove dirt softened by steam with wood scrapers, stiff nylon or fiber brushes, or cold-water wash, as indicated by cleaning tests.
- E. Detergent Cleaning:
  - 1. Wet surface with water applied by low pressure spray.
  - 2. Scrub surface with detergent solution using medium soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used, and that surface remains wet.
  - 3. Rinse with water applied by high pressure spray to remove detergent solution and soil.

4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.
- F. Mold, Mildew, and Algae Removal:
1. Wet surface with water applied by low pressure spray.
  2. Apply mold, mildew, and algae remover by brush.
  3. Scrub surface with medium soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used, and that surface remains wet.
  4. Rinse with cold water applied by medium pressure spray to remove mold, mildew, and algae remover and soil.
  5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.
- G. Non-Acidic Gel Chemical Cleaning:
1. Wet surface with cold water applied by low pressure spray.
  2. Apply gel cleaner in 1/8 inch (3 mm) thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.
  3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
  4. Remove bulk of gel cleaner.
  5. Rinse with water applied by low pressure spray to remove chemicals and soil.
  6. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.
- H. Nonacidic Liquid Chemical Cleaning:
1. Wet surface with water applied by low pressure spray.
  2. Apply cleaner to surface in two (2) applications by brush or low pressure spray.
  3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
  4. Rinse with cold water applied by medium pressure spray to remove chemicals and soil.
  5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.
- I. Mild Acid Chemical Cleaning:
1. Wet surface with cold water applied by low pressure spray.
  2. Apply cleaner to surface in two (2) applications by brush or low pressure spray.
  3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
  4. Rinse with cold water applied by medium pressure spray to remove chemicals and soil.
  5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.
- J. Acidic Chemical Cleaning:
1. Wet surface with cold water applied by low pressure spray.
  2. Apply cleaner to surface in two (2) applications by brush or low pressure spray.
  3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
- K. Two-Part Chemical Cleaning:
1. Wet surface with hot water applied by low pressure spray.
  2. Apply alkaline prewash cleaner to surface by brush or roller.

3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer unless otherwise indicated.
4. Rinse with cold water applied by medium pressure spray to remove chemicals and soil.
5. Apply acidic afterwash cleaner to surface in two (2) applications, while surface is still wet, using low pressure spray equipment, deep nap roller or soft fiber brush. Let neutralizer remain on surface for period recommended in writing by manufacturer unless otherwise indicated.
6. Rinse with cold water applied by medium pressure spray to remove chemicals and soil.
7. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once.

### **3.7 FIELD QUALITY CONTROL**

- A. Manufacturer Field Service: Engage paint remover manufacturer's and chemical cleaner manufacturer factory authorized service representatives for consultation and Project site inspection, to perform preconstruction product testing, and provide onsite assistance when requested by Architect. Have paint remover manufacturer and chemical cleaner manufacturer factory authorized service representatives visit site not less than once to observing progress and quality of the work.

### **3.8 FINAL CLEANING**

- A. Clean adjacent non-masonry surfaces of spillage and debris. Use detergent and soft brushes or cloths.
- B. Remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
- C. Remove masking materials, leaving no residues that could trap dirt.

**END OF SECTION 04 01 20**



## **SECTION 04 05 00 - COMMON WORK RESULTS FOR MASONRY**

### **PART 1 GENERAL**

#### **1.1 GENERAL REQUIREMENTS**

- 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. Mortar and grout for masonry assemblies.
  - 2. Ties and anchors.
  - 3. Embedded flashing.
  - 4. Penetrating water repellents.
  - 5. Miscellaneous masonry accessories.
  - 6. Cleaning exposed unit masonry surfaces.
- B. Related Sections:
  - 1. Section 04 01 20 - Maintenance of Unit Masonry: Cleaning of Masonry.
  - 2. Section 04 20 00 - Unit Masonry: Brick veneer unit masonry.
  - 3. Section 05 50 00 - Metal Fabrications: Steel embeds and lintels.
  - 4. Section 07 92 00 - Joint Sealants: Sealants for control and expansion joints.

#### **1.3 REFERENCE STANDARDS:**

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- C. ASTM A580/A580M - Standard Specification for Stainless Steel Wire; 2018.
- D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- E. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.
- F. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement; 2016.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- H. ASTM B32 - Standard Specification for Solder Metal; 2020.
- I. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- J. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction; 2022.
- K. ASTM C5 - Standard Specification for Quicklime for Structural Purposes; 2018.
- L. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.
- M. ASTM C114 - Standard Test Methods for Chemical Analysis of Hydraulic Cement; Current Edition.
- N. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
- O. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- P. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.

- Q. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
- R. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.
- S. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- T. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).
- U. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2023.
- V. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2018.
- W. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.
- X. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry; 2020.
- Y. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017 (Reapproved 2023).
- Z. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber; 2020.
- AA. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

#### 1.4 DEFINITIONS

- A. Very Low Pressure Spray: Under 100 psi (690 kPa).
- B. Low Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Mix design for mortar and grout shall be submitted for review.
- C. Supplier's certificates indicating materials comply with the specifications below. They shall include, but are not necessarily limited to:
  - 1. Aggregates.
  - 2. Cement.
  - 3. Admixtures.
- D. Shop Drawings:
  - 1. For the following:
    - a. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- E. Samples for Initial Selection:
  - 1. Colored mortar.
  - 2. Weep holes/vents.
- F. Samples for Verifications:
  - 1. For each type and color of the following:
    - a. Pigmented and colored-aggregate mortar. Make samples using same sand and mortar ingredients to be used on Project.
    - b. Weep holes and vents.
    - c. Accessories embedded in masonry.
- G. Material Certificates:
  - 1. For each type and size of the following:
    - a. Cementitious materials. Include brand, type, and name of manufacturer.

- b. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  - c. Grout mixes. Include description of type and proportions of ingredients.
  - d. Anchors, ties, and metal accessories.
- H. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

## 1.6 QUALITY ASSURANCE

- A. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- B. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 - Project Management and Coordination.
- C. Tests and Inspections:
- 1. All tests and inspections herein are to be performed by an independent testing laboratory approved by the building official.
  - 2. Mortar and grout tests:
    - a. At the beginning of masonry work, at least one (1) test sample each of mortar and grout shall be taken on three (3) successive working days, then once per week with at least one sample taken for each 5,000 square feet of wall area, or fraction thereof:
      - 1) Test specimens shall be made in accordance with ASTM C1019 for grout and ASTM C780 for mortar.
      - 2) Test specimens shall be continuously stored in moist air until tested.
      - 3) Mortar shall show a compressive strength of not less than 1,800 psi at 28 days. Grout shall show a compressive strength of not less than 2,000 psi at 28 days.
- D. Paint Remover Manufacturer Qualifications: Firm having minimum five (5) years' documented experience who regularly engages in producing masonry cleaners, and with factory authorized service representatives who are available for consultation and site inspection, preconstruction product testing, and onsite assistance.
- E. Chemical Cleaner Manufacturer Qualifications: Firm having minimum five (5) years' documented experience who is regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory authorized service representatives who are available for consultation and site inspection, preconstruction product testing, and onsite assistance.
- F. Cleaning Program:
- 1. Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, and equipment to be used; protection of surrounding materials; and control of runoff during operations. Include provisions for supervising worker performance and preventing damage:
    - a. If materials and methods other than those indicated are proposed for any phase of cleaning work, add a written description of such materials and methods, including evidence of successful use on comparable projects and demonstrations to show their effectiveness.
- G. Pre-Installation Conference:
- 1. Conduct conference at Project site:
    - a. Verify masonry cleaning equipment and facilities needed to make progress and avoid delays.
    - b. Materials, material application, and sequencing.
    - c. Cleaning program.
    - d. Coordination with building occupants.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- C. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

## PART 2 PRODUCTS

### 2.1 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
  - 1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.
- B. Hydrated Lime: ASTM C207, Type N or S as indicated in masonry section.
- C. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime, complying with specified requirements and containing no other ingredients.
- D. Colored Portland Cement-Lime Mixes: Packaged blend of Portland cement and hydrated lime and mortar pigments, complying with specified requirements and containing no other ingredients.
  - 1. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
    - a. CEMEX.
    - b. LafargeHolcim.
    - c. Lehigh Hanson.
- E. Masonry Cement: ASTM C91/C91M.
- F. Quicklime: ASTM C5.
- G. Lime Putty:
  - 1. Made from hydrated lime or quicklime:
    - a. If made from quicklime, other than processed pulverized quicklime, slake lime and then screen through a No. 16 mesh sieve. Before using, store and protect slaked and screened lime putty for not less than 10 days.
    - b. Processed pulverized quicklime shall be slaked for not less than 48 hours, and shall be cool when used.
    - c. Lime putty prepared from hydrated lime may be used immediately after mixing.
    - d. Lime putty prepared from quicklime or pulverized quicklime shall have a plasticity figure, after slaking and screening, of not less than 200, and shall weigh not less than 83 pounds per cubic foot. Lime putty prepared from hydrated lime shall conform to ASTM C207, Type S.
- H. Aggregate:
  - 1. For mortar: ASTM C144.
  - 2. For grout: ASTM C404.
- I. Admixtures:
  - 1. Cold Weather Admixture:

- a. Non-chloride, non-corrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated:
  - 1) Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
    - (a) BASF Corporation.
    - (b) Euclid Chemical.
    - (c) GCP Applied Technologies.
  - 2) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- J. Mortar Pigments:
  1. 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:
    - a. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
      - 1) Davis Colors.
      - 2) Lanxess Corporation.
      - 3) Solomon Colors, Inc.
    - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- K. Water: Potable.

## 2.2 MORTAR MIXES

- A. General:
  1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated:
    - a. Do not use calcium chloride in mortar.
    - b. Use masonry cement or mortar cement mortar unless otherwise indicated.
    - c. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Pre-Blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
  1. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
    - a. SPEC MIX Preblended Mortar Mix, by E-Z Mix, Inc.
  2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide Type S or Type N as indicated in related Section.
  1. Type S mortar shall have a 28 day compressive strength of not less than 1,800 psi.
- D. Pigmented Mortar:
  1. Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products:
    - a. Pigments shall not exceed ten percent (10%) of portland cement by weight.
    - b. Pigments shall not exceed five percent (5%) of masonry cement or mortar cement by weight.

- E. Colored-Aggregate Mortar:
  - 1. Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color:
- F. Mortar shall be made with admixtures that are proportioned, added and mixed in strict accordance with manufacturer's directions.
- G. Mortar mix shall be proportioned by volume; one-part portland cement, not less than 1/4-part nor more than 1/2-part lime putty, and sand totaling not less than 2-1/4 nor more than three (3) times sum of volumes of cement and lime used:
  - 1. Total clay content shall not exceed 2 percent of sand content or six percent 6 percent of cement content.

### 2.3 GROUT MIXES

- A. Grout for Unit Masonry: Comply with ASTM C476.
  - 1. Grout shall have a 28-day compressive strength of not less than 2,000 psi (14 MPa). Proportion by volume and with sufficient water to produce consistency for pouring without segregation so that grout will flow into masonry joints.
  - 2. Proportion by volume and with sufficient water to produce consistency for pouring without segregation so that grout will flow into masonry joints.
- B. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that complies with TMS 402/602 for dimensions of grout spaces and pour height.
  - 1. Fine Grout:
    - a. One-part portland cement, to which may be added not more than 1/10 part lime putty, and three-parts sand.
    - b. Fine grout shall be used for all grout spaces less than 3 inches wide.
  - 2. Coarse Grout:
    - a. One-part portland cement, to which may be added not more than 1/10 part lime putty, three-parts sand, and not less than one-part nor more than two-parts pea gravel (3/8 inch maximum aggregate size).
    - b. Coarse grout shall be used in grout spaces 3 inches wide or more.
- C. Grout Additive:
  - 1. Sika Grout Aid admixture to grout at the rate of 1 pound per 100 pounds cementitious material.

### 2.4 REINFORCEMENT

- A. Masonry Joint Reinforcement, General: ASTM A951/A951M.
  - 1. Masonry joint reinforcement used in exterior walls shall be hot-dipped galvanized, conforming to ASTM A153/A153M, Class B, minimum coating of 1.5 ounce for square foot.
- B. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch diameter, hot-dip galvanized, carbon-steel continuous wire.
- C. Reinforcing Bars:
  - 1. Uncoated Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60 (Grade 420).
- D. Reinforcing Bar Positioners:
  - 1. Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Form units from 0.148 inch (3.77 mm) steel wire, hot dip galvanized after fabrication. Provide units designed for number of bars indicated:
  - 2. Manufacturers:
    - a. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.

- 1) Heckmann Building Products, Inc.
- 2) Hohmann & Barnard, Inc.
- 3) Wire-Bond.

## 2.5 TIES AND ANCHORS

- A. General:
  1. Sheet Metal Anchors and Ties - ASTM A1008/A1008M:
    - a. Sheet metal anchors and ties used in exterior walls shall be hot-dipped galvanized, conforming to ASTM A153/A153M, Class B.
- B. Wire Ties and Anchors:
  1. General:
    - a. Provide ties and anchors made from materials complying with the following unless otherwise indicated:
      - 1) Stainless Steel Wire: ASTM A580/A580M, Type 306.
  2. Individual Wire Ties:
    - a. W-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches (50 mm) long.
    - b. Wire: Fabricate from #9AWG corrosion resistant wire.
- C. Adjustable Masonry-Veneer Anchors:
  1. General:
    - a. Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
      - 1) Structural Performance Characteristics: Capable of withstanding a 100 lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
  2. Contractor's Option:
    - a. Unless otherwise indicated, provide any of the following types of anchors:
      - 1) Screw-attached, masonry-veneer anchors: Units consisting of a wire tie and a metal anchor section.
      - 2) Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
        - (a) Heckmann Building Products, Inc.
        - (b) Hohman & Barnard.
      - 3) Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches wide by 3 inches high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section.
      - 4) Anchor Section: Sheet metal plate, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch wide by 5-1/2 inches long, stamped into center to provide a slot between strap and plate for inserting wire tie.
      - 5) Anchor Section: Gasketed sheet metal plate, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch wide by 6 inches long, stamped into center to provide a slot between strap and plate for inserting wire tie. Provide anchor manufacturer's standard, self-adhering, modified bituminous gaskets manufactured to fit behind anchor plate and extend beyond pronged legs.
      - 6) Anchor Section: Corrosion-resistant, self-drilling, eye-screw designed to receive wire tie. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and has gasketed washer head that covers hole in

- sheathing.
- 7) Fabricate sheet metal anchor sections and other sheet metal parts from 0.075 inch thick, steel sheet, galvanized after fabrication.
  - 8) Wire Ties: Triangular, rectangular, or T-shaped wire ties fabricated from 0.187 inch diameter, hot-dip galvanized steel wire.
3. Polymer-coated, steel drill screws for steel studs:
    - a. 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 (3) exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B117:
      - 1) Products are subject to compliance with requirements; available products that may be incorporated into the Work include, but are not limited to, the following:
        - (a) ITW Buildex: Teks Maxiseal with Climaseal finish.
        - (b) Leland Industries Inc.: Master Drillers with DT2000 Longlife Coating and Master Seal Bonded Washer.
        - (c) Elco: Dril-Flex with Stalgard finish.
  4. Stainless-steel drill screws for steel studs:
    - a. Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with 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 (3) exposed threads:
      - 1) Products are subject to compliance with requirements; available products that may be incorporated into the Work include, but are not limited to, the following:
        - (a) ITW Buildex: Teks Scots.

## **2.6 MISCELLANEOUS ANCHORS**

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.
- B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034 inch galvanized steel sheet.

## **2.7 EMBEDDED FLASHING MATERIALS**

- A. Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and/or Section 07 62 00 - Roof Related Sheet Metal and as follows:
  1. Stainless Steel: ASTM A240/A240M, Type 304, 0.016 inch thick.
  2. Copper: ASTM B370, Temper H00, cold-rolled copper sheet, 16 ounces per square foot weight or 0.0216 inch thick or ASTM B370, Temper H01, high-yield copper sheet, 12 ounces per square foot weight or 0.0162 inch thick.
  3. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
  4. Fabricate through-wall metal flashing embedded in masonry from copper, with ribs at 3 inch intervals along length of flashing to provide an integral mortar bond:
    - a. Products are subject to compliance with requirements; available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Cheney Flashing Company: Cheney Flashing (Dovetail).
      - 2) Keystone Flashing Company, Inc: Keystone 3-Way Thruwall Flashing.
    - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  5. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
  6. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
  7. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 1/4 inch to form a stop for retaining sealant backer rod.



8. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.
  9. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
  10. Metal sealant stop: Fabricate from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
  11. Metal expansion-joint strips: Fabricate from stainless steel to shapes indicated.
- B. Flexible Flashing:
1. Use one of the following unless otherwise indicated:
    - a. Copper-Laminated Flashing: 5 ounces per square foot copper sheet bonded between two (2) layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry:
      - 1) Products are subject to compliance with requirements; available products that may be incorporated into the Work include, but are not limited to, the following:
        - (a) Hohmann & Barnard, Inc.
        - (b) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
      - b. Asphalt-Coated Copper Flashing: 7 ounces per square foot copper sheet coated with flexible asphalt. Use only where flashing is fully concealed in masonry:
        - 1) Products are subject to compliance with requirements; available products that may be incorporated into the Work include, but are not limited to, the following:
          - (a) Advanced Building Products Inc.
          - (b) Hohmann & Barnard, Inc.
          - (c) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
        - 2) Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- C. Application:
1. Unless otherwise indicated, use the following:
    - a. Where flashing is indicated to receive counterflashing, use metal flashing.
    - b. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
    - c. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge with a sealant stop or flexible flashing with a metal sealant stop.
    - d. Where flashing is fully concealed, use flexible flashing.
- D. Solder and Sealants for Sheet Metal Flashings:
1. Solder for stainless steel: ASTM B32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
  2. Solder for copper: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead.
- E. 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.

## 2.8 LIQUID SURFACE TREATMENTS

- A. Penetrating Water Repellent:
1. Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components, odorless, that penetrates, hardens, and densifies concrete surfaces:
  2. Manufacturers:
    - a. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years'

experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.

- 1) Moxie International Inc.
- b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures .
3. Basis of Design: Moxie Shield 1400 Surface Sealer or Moxie Shield Shield 1300 Brick Sealer as manufactured by Moxie International Inc.

## 2.9 MISCELLANEOUS MASONRY 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.
- B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).
- C. Weep/Vent Products - Use one of the following unless otherwise indicated:
  1. Wicking Material: Absorbent rope, made from cotton or UV-resistant synthetic fiber, 1/4 inch to 3/8 inch in diameter, in length required to produce 2 inch exposure on exterior and 18 inches in cavity. Use only for weeps.
  2. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8 inch OD by 4 inches long.
  3. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 inch by 1-1/2 inches by 3-1/2 inch.
  4. Mesh Weep/Vent:
    - a. Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard:
    - b. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
      - 1) Mortar Net Solutions.
    - c. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- D. Cavity Drainage Material:
  1. Free draining mesh, made from polymer strands that will not degrade within the wall cavity.
  2. Manufacturers: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
    - a. Advanced Building Products Inc.
    - b. Heckmann Building Products, Inc.
    - c. Hohmann & Barnard, Inc.
    - d. Mortar Net Solutions.
    - e. Wire-Bond.
  3. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  4. Configuration:
    - a. Strips, full depth of cavity and 10 inches (250 mm) high, with dovetail shaped notches 7 inches (175 mm) deep that prevent clogging with mortar droppings.

## 2.10 CLEANING MATERIALS (VERIFY WITH LOCAL ORDINANCE)

- A. Water: Potable.
- B. Hot Water: Water heated to a temperature of 140 degrees F to 160 degrees F (60 degrees C to 71 degrees C).

- C. Detergent Solution - Job Mixed: Solution prepared by mixing two cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every five gallons (20 L) of solution required.
- D. Mold, Mildew, and Algae Remover - Job Mixed: Solution prepared by mixing two cups (0.5 L) of tetrasodium pyrophosphate (TSPP), five quarts (5 L) of five percent (5%) sodium hypochlorite (bleach), and 15 quarts (15 L) of hot water for every five gallons (20 L) of solution required.
- E. Non-Acidic Gel Cleaner:
  - 1. Gel formulation, with pH between six (6) and nine (9) that contains detergents with chelating agents and is specifically formulated for cleaning masonry surfaces:
  - 2. Manufacturers: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered:
    - a. AHI Supply Co.
    - b. PROSOCO, Inc.
  - 3. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- F. Non-Acidic Liquid Cleaner:
  - 1. Mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood:
  - 2. Manufacturers: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered:
    - a. AHI Supply Co.
    - b. Diedrich Technologies, Inc.
    - c. PROSOCO, Inc.
  - 3. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- G. Mild acid cleaner containing no muriatic (hydrochloric), hydrofluoric, or sulfuric acid; or ammonium bifluoride or chlorine bleaches:
  - 1. Manufacturers: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered:
    - a. AHI Supply, Inc.
    - b. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
    - c. PROSOCO, Inc.
  - 2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- H. Acidic masonry cleaner composed of hydrofluoric acid or ammonium bifluoride blended with other acids, detergents, wetting agents, and inhibitors:
  - 1. Manufacturers: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered:
    - a. AHI Supply Co.
    - b. American Building Restoration Products, Inc.
    - c. PROSOCO, Inc.
  - 2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

- I. Two-part chemical cleaner system consisting of potassium - or sodium hydroxide based, alkaline prewash cleaner and acidic afterwash cleaner that does not contain hydrofluoric acid:
  1. Manufacturers: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered:
    - a. AHI Supply Co.
    - b. Diedrich Technologies, Inc.
    - c. PROSOCO, Inc.
  2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

## **2.11 CHEMICAL CLEANING SOLUTIONS**

- A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical cleaner manufacturer.
- B. Acidic Cleaner Solution for Non-Glazed Masonry and Unpolished Stone:
  1. Dilute acidic cleaner with water to produce hydrofluoric acid content of three percent (3%) or less, but not greater than that recommended in writing by chemical-cleaner manufacturer:
    - a. Stones: Use only on unpolished granite, unpolished dolomite marble, and siliceous sandstone.
- C. Acidic Cleaner for Galzed Masonry Glazed Masonry and Polished Stone:
  1. Dilute acidic cleaner with water to concentration demonstrated by testing that does not etch, or otherwise damage glazed or polished surface, but not greater than that recommended in writing by chemical-cleaner manufacturer:
    - a. Stones: Use only on polished granite and polished dolomite marble.

## **2.12 MASKING MATERIALS**

- A. Liquid Strippable Masking Agent:
  1. Liquid, film forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners:
  2. Manufacturers: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered:
    - a. American Building Restoration Products, Inc.
    - b. Price Research, Ltd.
    - c. PROSOCO, Inc.
  3. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

## **PART 3 EXECUTION**

### **3.1 PROJECT CONDITIONS**

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

- B. Stain Prevention:
  - 1. Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry:
    - a. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
    - b. Protect sills, ledges, and projections from mortar droppings.
    - c. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
    - d. 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. Cold-Weather Requirements:
  - 1. Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 402/602:
    - a. Cold-weather cleaning: Use liquid cleaning methods only when air temperature is 40 degrees F and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 402/602.

### **3.2 COORDINATION**

- A. Build openings and chases for heating, plumbing, electrical ducts, pipes, and conduits into masonry walls as necessary. Install bolts, toggles, flashings, beams, anchors, hangers, nailing strips, wall plugs, and frames as necessary:
  - 1. Coordinate related work incorporating installation of work to prevent subsequent cutting and patching.
  - 2. Coordinate installation of steel reinforcement for reinforced masonry.
  - 3. Coordinate dampproofing, waterproofing, and air infiltration membrane activities with masonry construction.
  - 4. Coordinate placement of concrete in masonry beams, lintels, soffits, and pilasters.

### **3.3 EXAMINATION**

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

### **3.4 MORTAR AND GROUT**

- A. Mixing Mortar and Grout
  - 1. Accurately measure materials in suitably calibrated devices; shovel measurements are not acceptable. Each 94 pound sack of Portland cement will be considered as 1 cubic foot.
  - 2. Place sand, cement, and water in mixer, in that order, and mix for at least 2 minutes. Add lime putty and continue mixing as long as necessary to secure a uniform mass, but in no case less than 10 minutes.

3. Use mixers of at least 01 sack capacity; batches requiring fractional sacks will not be permitted unless cement is weighed for each batch.
- B. Grouting Procedures
  1. As specified in Related Section(s).
- C. Retempering
  1. When necessary to retemper mortar, add water and remix; retempering by dashing water over mortar will not be permitted.
  2. Any mortar that is unused within 30 minutes after initial mixing and any mortar that has begun to set shall not be used.
- D. Defective Mortar or Grout
  1. Should the strength of mortar or grout fall below that specified, remainder of Work shall be adjusted to reach required strength. Work in place representing inferior grout and mortar and indicating a strength less than the minimum specified shall be tested by taking and testing core samples. Number and location of cores shall be determined by Structural Engineer.
  2. Should compression tests of cores fail to meet required strength, masonry shall be deemed to be defective and shall be removed and replaced at no cost to School District.
  3. Costs relative to taking and testing of core samples shall be paid by School District and will be deducted from Contract amount. Cost of patching core holes shall be borne by Contractor.

### **3.5 INSTALLATION, GENERAL**

- A. Construct masonry veneer in compliance with TMS 402/602.
- B. Thickness: Build single wythe walls to actual widths of masonry units, using units of widths indicated.
- C. Build chases and recesses to accommodate items specified in this and other Sections.
- D. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- E. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- F. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures:
  1. Mix units from several pallets or cubes as they are placed.
- G. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- H. All masonry shall be laid true, level, plumb, and as indicated on Drawings.

### **3.6 TOLERANCES, GENERAL**

- 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 feet, 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 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, 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 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
  5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, 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 feet, 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; do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
  2. For exposed bed joints, do not vary from bed joint thickness of adjacent courses by more than 1/8 inch (3 mm).
  3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
  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.

### **3.7 LAYING MASONRY, GENERAL REQUIREMENTS**

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond. Do not use units with less than nominal 4 inch (100 mm) horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified. Fill in solidly with masonry around built-in items.
- E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- G. Fill all cores in hollow CMU with grout.

### **3.8 MORTAR BEDDING AND JOINTING**

- A. Lay masonry units as indicated in appropriate Section.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- C. Cut joints flush for masonry walls to receive plaster or other direct applied finishes (other than paint) unless otherwise indicated.
- D. Cut joints flush where indicated to receive waterproofing, cavity wall insulation, or air barriers unless otherwise indicated.

### **3.9 MASONRY JOINT REINFORCEMENT**

- A. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
  - 1. Space reinforcement not more than 16 inches (406 mm) o.c.
  - 2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
  - 3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond opening in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T shaped units.
- D. Provide continuity at corners by using prefabricated L shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

### **3.10 ANCHORED VENEERS**

- A. Ties and Anchors: Extend ties and anchors a minimum 1-1/2 inches (38 mm) into veneer but with at least a 5/8-inch (16 mm) cover on outside face.
- B. Provide not less than 1/2 inch of airspace between back of masonry veneer and face of masonry:
  - 1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

### **3.11 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE**

- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
  - 1. Provide an open space not less than 2 inches wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
  - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.
  - 3. Anchor masonry with anchors embedded in masonry joints and attached to structure.
- B. Anchor veneers to concrete masonry backup with masonry anchor ties and veneer ties as indicated on the Drawings. Comply with the following requirements:
  - 1. Embed anchor ties in masonry joints as indicated on Drawings.
  - 2. Fasten veneer ties to masonry backup through loops of anchor ties projecting from masonry surface.
  - 3. Space anchors ties as indicated, but not more than 12 inches o.c. vertically and 12 inches o.c. horizontally, with not less than one (1) anchor for each 1 square foot of wall area. Install additional anchors at openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.

### **3.12 ANCHORING MASONRY VENEERS**

- A. Anchor masonry veneers to wall framing and concrete backup with seismic masonry-veneer anchors to comply with the following requirements:
  - 1. Fasten screw-attached and seismic anchors through sheathing to wall framing and to concrete backup with metal fasteners of type indicated. Use two (2) fasteners unless anchor design only uses one (1) fastener.
  - 2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one (1) anchor at each stud in each horizontal joint between sheathing boards.



3. BIA Technical Notes 28B recommends 2 inches (50 mm) of air space. Wider air spaces require closer tie spacing.
4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
5. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one (1) anchor for each 2 square feet of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
6. Space anchors as indicated, but not more than 16 inches o.c. vertically and 24 inches o.c. horizontally with not less than one (1) anchor for each 3-1/2 square feet of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

### **3.13 CONTROL AND EXPANSION JOINTS**

- A. Install expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.
- B. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 92 00 - Joint Sealants, but not less than 3/8 inch:
  1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

### **3.14 LINTELS**

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

### **3.15 FLASHING, WEEPS, CAVITY DRAINAGE, AND VENTS**

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
  1. Install flashing as follows unless otherwise indicated:
    - a. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
    - b. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under building paper or building wrap, lapping at least 4 inches.
    - c. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
    - d. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant for application indicated.
    - e. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
    - f. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
  2. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

- B. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
  - 1. Use specified weep/vent products to form weep holes.
  - 2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
  - 3. Space weep holes 24 inches o.c. unless otherwise indicated.
  - 4. Retain last subparagraph above if weep holes other than plastic tubing or wicking are used. Retain first subparagraph below if plastic tubing or wicking is used.
  - 5. Space weep holes formed from plastic tubing or wicking material 16 inches o.c.
  - 6. Trim wicking material flush with outside face of wall after mortar has set.
- D. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches, to maintain drainage.
- E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" article.
- F. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents:
  - 1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

### **3.16 FIELD QUALITY CONTROL**

- A. Testing and Inspecting: School District will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Inspections:
  - 1. Special inspections according to Level C in TMS 402/602:
    - a. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
    - b. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
    - c. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One (1) set of tests.
- D. Testing Frequency: One (1) set of tests for each 5,000 square feet (464 sq. m) of wall area or portion thereof.
- E. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for compressive strength.
- F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.
- G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

### **3.17 REPAIRING, POINTING, AND CLEANING**

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

- C. In-Progress Cleaning: During construction, minimize any mortar or grout stains on the wall. Immediately remove any staining or soiling that occurs:
  - 1. For precision or textured units, except as noted below, clean masonry by dry brushing before tooling joints.
  - 2. For burnished, glazed, or pre-finished concrete masonry units, immediately remove any green mortar smears or soiling with a damp sponge.
- D. Final Cleaning - After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. After mortar is thoroughly set and cured, clean exposed masonry:
    - a. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.
    - b. Test cleaning methods on sample wall panel; leave 1/2 of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
    - c. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
    - d. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
    - e. Clean brick by bucket-and-brush hand-cleaning method described in "BIA Technical Notes 20."
    - f. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
    - g. Do not use acids on concrete masonry units.
    - h. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
- E. At completion of masonry work, remove all scaffolding and equipment used during construction, and remove all debris, refuse, and surplus masonry material from the site:
  - 1. Comply with Construction Waste Management plan.

### **3.18 MASONRY WASTE DISPOSAL**

- A. Refer to Section 01 74 19 - Construction Waste Management and Disposal.
- B. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off School District's property.

### **3.19 WATER REPELLENT APPLICATION**

- A. Cleaning shall be complete and accepted by Architect, and wall surfaces shall be thoroughly dry prior to application.
- B. Apply water repellent in strict accordance with water repellent manufacturer's instructions.

**END OF SECTION 04 05 00**

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## **SECTION 04 05 14 - MASONRY MORTAR AND GROUT**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section includes mortar and grout for masonry.
- B. Related Sections:
  - 1. Section 042016 - Reinforced Unit Masonry Assemblies: Installation of mortar and grout.

#### **1.2 REFERENCES**

- A. American Concrete Institute:
  - 1. ACI 530 - Building Code Requirements for Masonry Structures.
  - 2. ACI 530.1 - Specifications for Masonry Structures.
- B. ASTM International:
  - 1. ASTM C5 - Standard Specification for Quicklime for Structural Purposes.
  - 2. ASTM C91 - Standard Specification for Masonry Cement.
  - 3. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
  - 4. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
  - 5. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
  - 6. ASTM C150 - Standard Specification for Portland Cement.
  - 7. ASTM C199 - Standard Test Method for Pier Test for Refractory Mortars.
  - 8. ASTM C206 - Standard Specification for Finishing Hydrated Lime.
  - 9. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
  - 10. ASTM C387 - Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
  - 11. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
  - 12. ASTM C476 - Standard Specification for Grout for Masonry.
  - 13. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
  - 14. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
  - 15. ASTM C1019 - Standard Test Method for Sampling and Testing Grout.
  - 16. ASTM C1142 - Standard Specification for Extended Life Mortar for Unit Masonry.
  - 17. ASTM C1314 - Standard Test Method for Constructing and Testing Masonry Prisms Used to Determine Compliance with Specified Compressive Strength of Masonry.
  - 18. ASTM C1329 - Standard Specification for Mortar Cement.
  - 19. ASTM C1357 - Standard Test Method for Evaluating Masonry Bond Strength.

#### **1.3 SUBMITTALS**

- A. Section 01330 - Submittal Procedures: Submittal requirements.
- B. Design Data: Submit design mix when Property specification of ASTM C270 is to be used, required environmental conditions, and admixture limitations.

#### **1.4 QUALITY ASSURANCE**

- A. Perform Work in accordance with ACI 530 and ACI 530.1.

#### **1.5 ENVIRONMENTAL REQUIREMENTS**

- A. Section 016000 - Product Requirements.
- B. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F.
- C. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

### **PART 2 PRODUCTS**

#### **2.1 COMPONENTS**

- A. Portland Cement: ASTM C150, Type I
- B. Calcium chloride is not permitted.

#### **2.2 MIXES**

- A. Mortar Mixes:
  - 1. Extended Life Mortar: ASTM C1142, Type RS
- B. Mortar Mixing:
  - 1. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.
  - 2. Achieve uniformly damp sand immediately before mixing process.
  - 3. Re-temper only within two hours of mixing.
- C. Grout Mixes:
  - 1. Grout for Non-Structural Masonry: 2,500 psi strength at 28 days; 8-11 inches slump; mixed in accordance with ASTM C476 grout.
  - 2. Grout for Structural Masonry: 2,500 psi strength at 28 days; 8-11 inches slump; mixed in accordance with ASTM C476 grout.
  - 3. Application:
    - a. Coarse Grout: For grouting spaces with minimum 4 inches dimension in every direction.
    - b. Fine Grout: For grouting other spaces.
- D. Grout Mixing:
  - 1. Mix grout in accordance with ASTM C94/C94M, modified to use ingredients complying with ASTM C476.
  - 2. Add admixtures; mix uniformly.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Request inspection of spaces to be grouted.

#### **3.2 INSTALLATION**

- A. Install mortar and grout in accordance with ACI 530.1 Specifications for Masonry Structures.

#### **3.3 FIELD QUALITY CONTROL**

- A. Establishing Mortar Mix: In accordance with ASTM C270.
- B. Testing Frequency: One set of specified tests for every 5,000 sf of completed wall area.
- C. Testing of Mortar Mix: In accordance with ASTM C780 for aggregate ratio and water content, air content, consistency, and compressive strength.
- D. Testing of Grout Mix: In accordance with ASTM C1019 for compressive strength, and in accordance with ASTM C143/C143M for slump.
- E. Test compressive strength of mortar and masonry to ASTM C1314; test in accordance with masonry unit sections specified.

**END OF SECTION 04 05 14**

## **SECTION 04 20 00 - UNIT MASONRY**

### **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. Clay facing brick.
  - 2. Common brick.
  - 3. Mortar and grout.
  - 4. Reinforcement and anchorage.
  - 5. Flashings.
  - 6. Lintels.
  - 7. Accessories.
- B. Related Sections:
  - 1. Section 03 10 00 - Concrete Forming and Accessories: Dovetail slots for masonry anchors.
  - 2. Section 03 20 00 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
  - 3. Section 03 30 00 - Cast-in-Place Concrete: Installation of dovetail slots for masonry anchors.
  - 4. Section 05 50 00 - Metal Fabrications: Loose steel lintels.
  - 5. Section 06 10 00 - Rough Carpentry: Nailing strips built into masonry.
  - 6. Section 07 21 00 - Thermal Insulation: Insulation for cavity spaces.
  - 7. Section 07 27 26 - Fluid-Applied Air Barriers: Water-resistive barriers applied to exterior face of backing sheathing or unit masonry substrate.
  - 8. Section 07 62 00 - Roof-Related Sheet Metal: Through-wall masonry flashings.
  - 9. Section 07 84 13 - Penetration Firestopping: Firestopping at penetrations of fire-rated masonry and at top of fire-rated walls.
  - 10. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- D. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.
- E. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale); 2023.
- F. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale); 2023.
- G. ASTM E11 - Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves; 2022.
- H. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.
- I. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.
- J. ICC-ES AC380 - Acceptance Criteria for Termite Physical Barrier Systems; 2021, with Editorial Revision (2022).



- K. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).
- L. UL (FRD) - Fire Resistance Directory; Current Edition.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Refer to Section 01 31 00 - Project Management and Coordination for additional requirements.
- B. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

#### **1.5 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system.
  - 1. Include calculations or selections from the manufacturer's prescriptive design tables that indicate compliance with the applicable building code and project conditions.
  - 2. Include the design engineer's stamp or seal on each sheet of shop drawings.
- D. Samples: Submit four samples of decorative block units to illustrate color, texture, and extremes of color range.
- E. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- F. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.
- G. Provide FM Approvals for the following:
- H. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.
- I. Designer's Qualification Statement.
- J. Manufacturer's Qualification Statement.
- K. Installer's Qualification Statement.
- L. Maintenance Materials: Furnish the following for School District's use in maintenance of project.
  - 1. Refer to Section 01 60 00 - Product Requirements, for additional provisions.

#### **1.6 QUALITY ASSURANCE**

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
  - 1. Maintain one copy of each document on project site.
- B. Fire Rated Assemblies: Comply with applicable code for UL (FRD) Assembly No. E119.
- C. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- D. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.
- E. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

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

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

- B. Handle and store unit masonry in protective cartons or trays. Do not remove from protective packaging until ready for installation.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
  - 1. Concrete Masonry Units:
    - a. ACME Block & Brick: [www.acmeblockandbrick.com/#sle](http://www.acmeblockandbrick.com/#sle).
    - b. Best Block: [www.bestblock.com/#sle](http://www.bestblock.com/#sle).
    - c. Boral Industries Company:
    - d. Concrete Products Group (The): [www.concreteproductsgroup.com/#sle](http://www.concreteproductsgroup.com/#sle).
    - e. Omni Block, Inc.: [www.omniblock.com/#sle](http://www.omniblock.com/#sle).
    - f. Revels Block & Brick Company:
    - g. Texas Building Products, Inc.:
  - 2. Brick Masonry Units:
    - a. ACME Block & Brick: [www.acmeblockandbrick.com/#sle](http://www.acmeblockandbrick.com/#sle).
    - b. Belden Brick: [www.beldenbrick.com/#sle](http://www.beldenbrick.com/#sle).
    - c. Endicott Clay Products Co: [www.endicott.com/#sle](http://www.endicott.com/#sle).
    - d. General Shale Brick: [www.generalshale.com/#sle](http://www.generalshale.com/#sle).
    - e. Interstate Brick:
    - f. Meridian Brick LLC: [www.meridianbrick.com/#sle](http://www.meridianbrick.com/#sle).
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

### **2.2 CONCRETE MASONRY UNITS**

#### **2.3 BRICK UNITS**

- A. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.
  - 1. Color and texture: Castle Brown / Heritage Texture manufactured by Acme Block & Brick.
  - 2. Nominal size: Modular.
  - 3. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.
- B. Building (Common) Brick: ASTM C62, Grade SW; solid units.
  - 1. Nominal size: As indicated on drawings.

#### **2.4 MORTAR AND GROUT MATERIALS**

- A. Mortar and Grout: As specified in Section 04 05 11.

#### **2.5 REINFORCEMENT AND ANCHORAGE**

- A. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi) (280 MPa), deformed billet bars; galvanized.
- B. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- C. Single Wythe Joint Reinforcement: ASTM A951/A951M.
- D. Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
- E. Adjustable Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
- F. Strap Anchors: Bent steel shapes, 1-1/2 inch (38 mm) width, 0.105 inch (2.7 mm) thick, 24 inch (610 mm) length, with 1-1/2 inch (38 mm) long, 90 degree bend at each end to form a U or Z shape or with cross pins, hot dip galvanized to ASTM A153/A153M Class B.

- G. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch (16 mm) of mortar coverage from masonry face.
- H. Residential Wall Ties: Corrugated formed sheet metal, 7/8 inch (22 mm) wide by 0.05 inch (1.22 mm) thick, hot dip galvanized to ASTM A 153/A 153M, Class B, sized to extend at least 1-1/2 inches (38 mm) into the veneer with at least 5/8 inch (16 mm) of mortar coverage from masonry face.
- I. Two-Piece Wall Ties: Formed steel wire, 0.1875 inch (4.8 mm) thick, adjustable, eye and pintle type, hot dip galvanized to ASTM A 153/A 153M, Class B, sized to provide not less than 5/8 inch (16 mm) of mortar coverage from masonry face and to allow vertical adjustment of up to 1-1/4 in (32 mm).
- J. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
  - 1. Anchor plates: Not less than 0.075 inch (1.91 mm) thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
  - 2. Wire ties: Manufacturer's standard shape, 0.1875 inch (4.75 mm) thick.
  - 3. Vertical adjustment: Not less than 3-1/2 inches (89 mm).
- K. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws; corrosion resistant finish or hot dip galvanized to ASTM A153/A153M.

## 2.6 FLASHINGS

- A. Metal Flashing Materials:
  - 1. Stainless Steel Flashing: ASTM A666, Type 304, soft temper; 26 gauge, 0.0187 inch (0.48 mm) thick; finish 2B to 2D.

## 2.7 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
- B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; in maximum lengths available.
- C. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
  - 1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
- D. Cavity Vents:
  - 1. Type: Preformed aluminum vents with sloping louvers.
  - 2. Color(s): As selected by Architect from manufacturer's full range.
- E. Termite-Excluding Weep and Vent:
  - 1. Type: Polytetrafluoroethylene (PTFE) vent body with stainless-steel mesh closure.
  - 2. Termite Resistance: 100 percent when tested in accordance with ICC-ES AC380.
  - 3. Stainless Steel Mesh: ASTM E11 ; opening size 0.018 inch (0.44 mm), maximum.
- F. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

## 2.8 LINTELS

- A. Prefabricated Steel Lintels:

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.

- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

### **3.2 PREPARATION**

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

### **3.3 COLD AND HOT WEATHER REQUIREMENTS**

- A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

### **3.4 COURSING**

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
  - 1. Bond: As indicated on Drawings.
  - 2. Coursing: One unit and one mortar joint to equal 8 inches (200 mm).
  - 3. Mortar Joints: Concave.
- D. Brick Units:
  - 1. Bond: As indicated on Drawings.
  - 2. Coursing: Three units and three mortar joints to equal 8 inches (200 mm).
  - 3. Mortar Joints: Concave.

### **3.5 PLACING AND BONDING**

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
- F. Interlock intersections and external corners, except for units laid in stack bond.
- G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- I. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- J. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- K. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

### **3.6 WEEPS/CAVITY VENTS**

- A. Install weeps in veneer and cavity walls at 24 inches (600 mm) on center horizontally, maximum, on top of through-wall flashing \_\_\_\_\_.
- B. Install cavity vents in veneer and cavity walls at 24 inches (600 mm) on center horizontally below shelf angles and lintels and near top of walls.

### **3.7 CAVITY MORTAR CONTROL**

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

- B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- C. Install cavity mortar control panels continuously throughout full height of exterior masonry cavities during construction of exterior wythe, complying with manufacturer's installation instructions.
  - 1. Verify that airspace width is no more than 3/8 inch (9 mm) greater than panel thickness.
  - 2. Hold cavity mortar control panel tight to face wythe.
  - 3. Install horizontally between joint reinforcement.
  - 4. Stagger end joints in adjacent rows.
  - 5. Fit to perimeter construction and penetrations without voids.
- D. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

### **3.8 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHER MASONRY, AND CAVITY WALL MASONRY**

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches (400 mm) on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches (400 mm) each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch (16 mm) mortar cover on each side.
- E. Lap joint reinforcement ends minimum 6 inches (150 mm).
- F. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches (400 mm) on center.
- G. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches (900 mm) horizontally and 24 inches (600 mm) vertically.
- H. Embed ties and anchors in mortar joint and extend into masonry unit a minimum of 1-1/2 inches (38 mm) with at least 5/8 inch (16 mm) mortar cover to the outside face of the anchor.

### **3.9 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER**

### **3.10 REINFORCEMENT AND ANCHORAGES - MULTIPLE WYTHER UNIT MASONRY**

### **3.11 MASONRY FLASHINGS**

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

### **3.12 LINTELS**

- A. Install loose steel lintels over openings.
- B. Maintain minimum \_\_\_\_ inch (\_\_\_\_ mm) bearing on each side of opening.

### **3.13 GROUDED COMPONENTS**

- A. Refer to Structural.

### **3.14 CONTROL AND EXPANSION JOINTS**

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

### **3.15 BUILT-IN WORK**

- A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.

- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
  - 1. Fill adjacent masonry cores with grout minimum 12 inches (300 mm) from framed openings.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

### **3.16 TOLERANCES**

- A. Install masonry within the site tolerances found in TMS 402/602.
- B. Maximum Variation from Alignment of Columns: 1/4 inch (6 mm).
- C. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).
- D. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more.
- E. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.
- F. Maximum Variation from Level Coursing: 1/8 inch in 3 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).
- G. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch (minus 6.4 mm, plus 9.5 mm).
- H. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch (6 mm).

### **3.17 CUTTING AND FITTING**

- A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

### **3.18 FIELD QUALITY CONTROL**

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.

### **3.19 CLEANING**

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

### **3.20 PROTECTION**

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

**END OF SECTION 04 20 00**

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## **SECTION 04 20 16 - REINFORCED UNIT MASONRY ASSEMBLIES**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section includes concrete masonry units, reinforcement, anchorage, and accessories.
- B. Related Sections:
  - 1. Section 040514 - Masonry Mortar and Grout: Mortar and grout.

#### **1.2 REFERENCES**

- A. American Concrete Institute:
  - 1. ACI 530 - Building Code Requirements for Masonry Structures.
  - 2. ACI 530.1 - Specifications for Masonry Structures.
- B. ASTM International:
  - 1. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - 2. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - 3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
  - 4. ASTM A580/A580M - Standard Specification for Stainless Steel Wire.
  - 5. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  - 6. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - 7. ASTM A951 - Standard Specification for Masonry Joint Reinforcement.
  - 8. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.
  - 9. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
  - 10. ASTM C27 - Standard Classification of Fireclay and High-Alumina Refractory Brick.
  - 11. ASTM C34 - Standard Specification for Structural Clay Load-Bearing Wall Tile.
  - 12. ASTM C55 - Standard Specification for Concrete Brick.
  - 13. ASTM C56 - Standard Specification for Structural Clay Non-Load-Bearing Tile.



14. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale).
15. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
16. ASTM C73 - Standard Specification for Calcium Silicate Face Brick (Sand-Lime Brick).
17. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
18. ASTM C126 - Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.
19. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units.
20. ASTM C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units.
21. ASTM C212 - Standard Specification for Structural Clay Facing Tile.
22. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
23. ASTM C315 - Standard Specification for Clay Flue Linings.
24. ASTM C530 - Standard Specification for Structural Clay Non-Loadbearing Screen Tile.
25. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
26. ASTM C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).
27. ASTM C744 - Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
28. ASTM C1261 - Standard Specification for Firebox Brick for Residential Fireplaces.
29. ASTM C1283 - Standard Practice for Installing Clay Flue Lining.
30. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
31. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
32. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

C. National Fire Protection Association:

1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

D. Underwriters Laboratories Inc.:

1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

### 1.3 PERFORMANCE REQUIREMENTS

A. Concrete Masonry Compressive Strength

1. Concrete Masonry Units: 1900 psi minimum net area compressive strength.

### 1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Submittal requirements.

B. Shop Drawings: Indicate bars sizes, spacings, locations, reinforcement quantities, bending and cutting schedules, supporting and spacing devices for reinforcement.

C. Product Data:

1. Submit data for masonry units and fabricated wire reinforcement.

### 1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 530 and ACI 530.1.

### 1.6 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three years experience.

### 1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 016000 - Product Requirements.

B. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F.

C. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

## PART 2 PRODUCTS

### 2.1 COMPONENTS

A. Hollow Load Bearing Concrete Masonry Units (CMU): ASTM C90; normal weight.

### 2.2 ACCESSORIES

A. Single Wythe Joint Reinforcement: ASTM A951; ladder type; 0.148 inch diameter side rods with 0.148 inch diameter cross ties.

B. Reinforcing Steel: ASTM A615/A615M, 60 ksi yield grade, deformed billet bars.

- C. Anchor Rods: ASTM A307; Grade C; J-shaped or L-shaped; complete with washers and heavy hex nuts; sized for minimum 15 inch embedment.
  - 1. Hot-Dipped Galvanizing: ASTM A153/A153M.
  - 2. Mechanical Galvanizing: ASTM B695; Class 55.
- D. Mortar and Grout: As specified in Section 04065.
- E. Joint Filler: Closed cell rubber; oversized 50 percent to joint width; self expanding.

### **2.3 SOURCE QUALITY CONTROL**

- A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Test brick efflorescence in accordance with ASTM C67. Brick rated greater than “slightly effloresced” is not acceptable.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify field conditions are acceptable and are ready to receive work.
- C. Verify items provided by other sections of work are properly sized and located.
- D. Verify built-in items are in proper location, and ready for roughing into masonry work.

### **3.2 PREPARATION**

- A. Direct and coordinate placement of metal anchors supplied to other Sections.
- B. Furnish temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent support.
- C. Wet clay and shale brick before laying when initial rate of absorption is greater than 30 grams when tested in accordance with ASTM C67.

### **3.3 INSTALLATION**

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.
- C. Coursing of Concrete Masonry Units:
  - 1. Bond: Running.
  - 2. Coursing: One unit and one mortar joint to equal 8 inches.
  - 3. Mortar Joints: Concave.
- D. Placing And Bonding:

1. Lay solid masonry units in full bed of mortar, with full head joints.
2. Lay hollow masonry units with face shell bedding on head and bed joints.
3. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
4. Remove excess mortar as Work progresses.
5. Interlock intersections and external corners.
6. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment is required, remove mortar and replace.
7. Perform job site cutting of masonry units with proper tools to assure straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
8. Isolate masonry from vertical structural framing members with movement joint.
9. Isolate top of masonry from horizontal structural framing members and slabs or decks.

E. Joint Reinforcement And Anchorage:

1. Install horizontal joint reinforcement 16 inches oc.
2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
3. Place joint reinforcement continuous in first and second joint below top of walls.
4. Lap joint reinforcement ends minimum 6 inches.
5. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
6. Embed anchors embedded in concrete attached to structural steel members. Embed anchorages in every sixth brick.

F. Lintels:

1. Install precast concrete lintels over openings.
2. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled or indicated.
3. Openings Up To 42 inches Wide: Reinforce openings as indicated on Drawings.
4. Openings From 42 inches Up To 78 inches Wide: Reinforce openings as indicated on Drawings.
5. Openings Over 78 inches: Reinforce openings as indicated on Drawings.
6. Do not splice reinforcing bars.
7. Support and secure reinforcing bars from displacement.

8. Place and consolidate grout fill without displacing reinforcing.
  9. Allow masonry lintels to attain specified strength before removing temporary supports.
  10. Maintain minimum 8 inches bearing on each side of opening.
- G. Grouted Components:
1. Reinforce bond beam with 1, No. 5 bar.
  2. Reinforce pilaster with 1, No. 6 bar in each cell.
  3. Lap splices bar diameters required by code.
  4. Support and secure reinforcing bars from displacement.
  5. Place and consolidate grout fill without displacing reinforcing.
  6. At bearing locations, fill masonry cores with grout for minimum 12 inches either side of opening.
- H. Reinforced Masonry:
1. Lay masonry units with cells vertically aligned and cavities between wythes clear of mortar and unobstructed.
  2. Place reinforcing, reinforcement bars, and grout as indicated on Drawings.
  3. Splice reinforcement in accordance with Section 03200.
  4. Support and secure reinforcement from displacement.
  5. Place and consolidate grout fill without displacing reinforcing.
  6. Place grout in accordance with ACI 530.1 Specification for Masonry Structures.
- I. Control And Expansion Joints:
1. Install control and expansion joints at the following maximum spacings, unless otherwise indicated on Drawings:
    - a. Exterior Walls: 20 feet on center and within 10 feet on one side of each interior and exterior corner.
    - b. Interior Walls: 30 feet on center.
    - c. At changes in wall height.
  2. Do not continue horizontal joint reinforcement through control and expansion joints.
  3. Install preformed control joint device in continuous lengths. Seal butt and corner joints.
  4. Size control joint in accordance with Section 07900 for sealant performance.

5. Form expansion joint by omitting mortar and cutting unit to form open space.
- J. Cutting And Fitting:
1. Obtain Architect/Engineer's approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

### **3.4 ERECTION TOLERANCES**

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Maximum Variation From Alignment of Pilasters: 1/4 inch.
- C. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- D. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- E. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- F. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- G. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.
- H. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.
- I. Maximum Variation for Steel Reinforcement:
  1. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.
  2. Plus or minus 1/2 inch when distance from centerline of steel to opposite face of masonry is 8 inches or less.
  3. Plus or minus 1 inch when distance is between 8 and 24 inches.
  4. Plus or minus 1-1/4 inch when distance is greater than 24 inches.
  5. Plus or minus 2 inches from location along face of wall.

### **3.5 FIELD QUALITY CONTROL**

- A. Concrete Masonry Units: Test each type in accordance with ASTM C140.

### **3.6 CLEANING**

- A. Section 017000 - Execution Requirements: Final cleaning.
- B. Remove excess mortar and mortar smears as work progresses.
- C. Replace defective mortar. Match adjacent work.
- D. Clean soiled surfaces with cleaning solution.
- E. Use non-metallic tools in cleaning operations.

**3.7 PROTECTION OF FINISHED WORK**

- A. Section 017000 - Execution Requirements: Requirements for protecting finished Work.
- B. Protect exposed external corners subject to damage.
- C. Protect base of walls from mud and mortar splatter.
- D. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.
- E. Protect tops of masonry work with waterproof coverings secured in place without damaging masonry. Provide coverings where masonry is exposed to weather when work is not in progress.

**END OF SECTION 04 20 16**

## **SECTION 05 12 00 - STRUCTURAL STEEL FRAMING**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Structural shapes.
  - 2. Channels and angles.
  - 3. Hollow structural sections.
  - 4. Structural pipe.
  - 5. Structural plates and bars.
  - 6. Fasteners, connectors, and anchors.
  - 7. Fasteners, connectors, and anchors.
  - 8. Grout.
  
- B. Related Sections:
  - 1. Section 036000 - Grout: Grout for setting base plates.
  - 2. Section 052100 - Steel Joists.
  - 3. Section 053123 - Steel Roof Deck
  - 4. Section 055000 – Metal Fabrications: Steel Fabrications affecting structural steel work.

#### **1.2 REFERENCES**

- A. American Institute of Steel Construction:
  - 1. AISC Code of Standard Practice for Steel Buildings and Bridges.
  - 2. AISC Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings.
  - 3. AISC Load and Resistance Factor Design Specification for Single-Angle Members.
  - 4. AISC Seismic Provisions for Structural Steel Buildings.
  - 5. AISC Specification for Allowable Stress Design of Single-Angle Members.
  - 6. AISC Specification for the Design of Steel Hollow Structural Sections.
  - 7. AISC Specification for Structural Steel Buildings Allowable Stress Design, and Plastic Design.
  
- B. ASTM International:
  - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
  - 2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - 3. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
  - 4. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 5. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - 6. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
  - 7. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
  - 8. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.



9. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
  10. ASTM A449 - Standard Specification for Quenched and Tempered Steel Bolts and Studs.
  11. ASTM A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
  12. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
  13. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
  14. ASTM A514/A514M - Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding.
  15. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality.
  16. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
  17. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
  18. ASTM A588/A588M - Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4-in. (100-mm) Thick.
  19. ASTM A618 - Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing.
  20. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
  21. ASTM A847 - Standard Specification for Cold-Formed Welded and Seamless High Strength, Low Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance.
  22. ASTM A852/A852M - Standard Specification for Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi (485 MPa) Minimum Yield Strength to 4 in. (100 mm) Thick.
  23. ASTM A913/A913M - Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST).
  24. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.
  25. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
  26. ASTM E94 - Standard Guide for Radiographic Examination.
  27. ASTM E164 - Standard Practice for Ultrasonic Contact Examination of Weldments.
  28. ASTM E165 - Standard Test Method for Liquid Penetrant Examination.
  29. ASTM E709 - Standard Guide for Magnetic Particle Examination.
  30. ASTM F436 - Standard Specification for Hardened Steel Washers.
  31. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
  32. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
  33. ASTM F1852 - Standard Specification for Twist Off Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- C. American Welding Society:
1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
  2. AWS D1.1 - Structural Welding Code - Steel.

- D. Research Council on Structural Connections:
  - 1. RCSC - Specification for Structural Joints Using ASTM A325 or A490 Bolts.
  
- E. SSPC: The Society for Protective Coatings:
  - 1. SSPC - Steel Structures Painting Manual.
  - 2. SSPC Paint 15 - Steel Joist Shop Paint.
  - 3. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).
  - 4. SSPC SP 3 - Power Tool Cleaning.
  - 5. SSPC SP 6 - Commercial Blast Cleaning.
  - 6. SSPC SP 10 - Near-White Blast Cleaning.

### **1.3 SUBMITTALS**

- A. Section 01330 - Submittal Procedures: Requirements for submittals.
  
- B. Shop Drawings:
  - 1. Indicate profiles, sizes, spacing, and locations of structural members, openings, attachments, and fasteners.
  - 2. Connections.
  - 3. Cambers
  - 4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
  
- C. Mill Test Reports: Submit indicating structural strength and destructive and non-destructive test analysis.
  
- D. Manufacturer's Mill Certificate: Certify products meet or exceed specified requirements.
  
- E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualifications within previous 12 months.

### **1.4 QUALITY ASSURANCE**

- A. Perform Work in accordance with the following:
  - 1. AISC Code of Standard Practice for Steel Buildings and Bridges.
  - 2. AISC Code of Standard Practice for Steel Buildings and Bridges. Section 10.
  - 3. AISC Seismic Provisions for Structural Steel Buildings.
  - 4. AISC Specification for Structural Steel Buildings Allowable Stress Design, and Plastic Design.
  - 5. AISC Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings.
  - 6. AISC Specification for the Design of Steel Hollow Structural Sections.
  - 7. AISC Specification for Allowable Stress Design of Single-Angle Members.
  - 8. AISC Load and Resistance Factor Design Specification for Single-Angle Members.
  - 9. RCSC Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.
  - 10. ASCE 19.

### **1.5 COORDINATION**

- A. Section {013000 - Administrative Requirements}: Requirements for coordination.

## **PART 2 PRODUCTS**

### **2.1 STRUCTURAL STEEL**

- A. Structural W-Shapes: ASTM A992/A992M; Grade 50
- B. Structural M-Shapes: ASTM A36/A36M; Grade 50
- C. Structural T-Shapes: Cut from structural W-shapes.
- D. Channels and Angles: ASTM A36/A36M.
- E. Round Hollow Structural Sections: ASTM A500, Grade B.
- F. Square and Rectangular Hollow Structural Sections: ASTM A500, Grade B.
- G. Structural Plates and Bars: ASTM A36/A36M.

### **2.2 FASTENERS, CONNECTORS, AND ANCHORS**

- A. Bolts: ASTM A307; Grade A or B.
  - 1. Finish: Unfinished
- B. High Strength Bolts: ASTM A325; Type 1 or ASTM A490; Type 1.
  - 1. Finish: Unfinished
- C. Nuts: ASTM A563 heavy hex type.
  - 1. Finish: Unfinished
- D. Washers: ASTM F436; Type 1, circular
  - 1. Finish: Unfinished
- E. Threaded Rods: ASTM A36/A36M; Grade A.
  - 1. Finish: Unfinished
- F. Forged Structural Steel Hardware:
  - 1. Clevises and Turnbuckles: ASTM A108; Grade 1085.
  - 2. Eye Nuts and Eye Bolts: ASTM A108; Grade 1030.
  - 3. Sleeve Nuts: ASTM A108; Grade 1018.
  - 4. Rod Ends, Yoke Ends and Pins, Cotter Pins, and Coupling Nuts: Carbon steel.

### **2.3 WELDING MATERIALS**

- A. Welding Materials: AWS D1.1; type required for materials being welded.

### **2.4 ACCESSORIES**

- A. Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing minimum compressive strength of 7,000 psi at 28 days

- B. Shop and Touch-Up Primer: SSPC Paint 15, Type 1, red oxide.

## **2.5 FABRICATION**

- A. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- B. Fabricate connections for bolt, nut, and washer connectors.
- C. Develop required camber for members.

## **2.6 FINISH**

- A. Prepare structural component surfaces in accordance with SSPC SP 3.
- B. Shop prime structural steel members.
- C. Galvanizing for Structural Steel Members: ASTM A123/A123M; minimum 1.2 oz/sq ft coating thickness; galvanize after fabrication.
- D. Galvanizing for Fasteners, Connectors, and Anchors:
  - 1. Hot-Dipped Galvanizing: ASTM A153/A153M.
  - 2. Mechanical Galvanizing: ASTM B695; Class 50 minimum.

## **2.7 SOURCE QUALITY CONTROL AND TESTS**

- A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Shop test bolted and welded connections as specified for field quality control tests.
- C. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
  - 1. Specified shop tests are not required for Work performed by approved fabricator.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify bearing surfaces are at correct elevation.
- C. Verify anchors rods are set in correct locations and arrangements with correct exposure for steel attachment.

### **3.2 PREPARATION**

- A. Furnish templates for installation of anchor rods and embedments in concrete and masonry work.

### **3.3 ERECTION**

- A. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in alignment until completion of erection and installation of permanent bracing.
- B. Field weld components and shear connectors indicated on Drawings.
- C. Field connect members with threaded fasteners; tighten to snug tight for bearing type connections.
- D. Do not field cut or alter structural members without approval of Architect/Engineer.
- E. After erection, touch up welds and abrasions to match shop finishes.

### **3.4 GROUT INSTALLATION**

- A. Grout [under base plates in accordance with Section 036000.
- B. Shim bearing plates and equipment supports to proper elevation, snug tighten anchor bolts.
- C. Fill void under bearing surface with grout. Install and pack grout to remove air pockets.
- D. Moist cure grout.
- E. Remove forms after grout is set. Trim grout edges to form smooth surface, splayed 45 degrees.
- F. Tighten anchor bolts after grout has cured for a minimum of 3 days.

### **3.5 ERECTION TOLERANCES**

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- C. Maximum Offset From Alignment: 1/4 inch.

### **3.6 FIELD QUALITY CONTROL**

- A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Bolted Connections: Inspect in accordance with AISC specifications.
  - 1. Visually inspect all bolted connections.
  - 2. For Direct Tension Indicators, comply with requirements of ASTM F959. Verify that gaps are less than gaps specified in Table 2.

- C. Welding: Inspect welds in accordance with AWS D1.1.
  - 1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
  - 2. Visually inspect all welds.
  - 3. Ultrasonic Inspection: ASTM E164; perform on all full penetration welds.
  - 4. Liquid Penetrant Inspection: ASTM E165.
- D. Correct defective bolted connections and welds.

**END OF SECTION 05 12 00**

## **SECTION 05 31 23 - STEEL ROOF DECKING**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Steel roof deck and accessories.
  - 2. Bearing plates and angles.
  
- B. Related Sections:
  - 1. Section 033000 - Cast-in-Place Concrete.
  - 2. Section 035216 – Lightweight Insulating Concrete.
  - 3. Section 051200 - Structural Steel.
  - 4. Section 052100 - Steel Joists.

#### **1.2 REFERENCES**

- A. American Society of Civil Engineers:
  - 1. ASCE 3 - Standard Practice for the Construction and Inspection of Composite Slabs.
  
- B. ASTM International:
  - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
  - 2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - 3. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
  - 4. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
  
- C. American Welding Society:
  - 1. AWS D1.1 - Structural Welding Code - Steel.
  
- D. Steel Deck Institute:
  - 1. SDI 29 - Design Manual for Composite Decks, Form Decks and Roof Decks.
  
- E. SSPC: The Society for Protective Coatings:
  - 1. SSPC Paint 15 - Steel Joist Shop Paint.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Design metal deck in accordance with SDI 29 Design Manual and ASCE 3.
  
- B. Calculate to structural working stress design and maximum vertical deck deflection of L/240.
  
- C. Design deck with maximum lateral diaphragm deflection of L/500 of story height.

#### **1.4 SUBMITTALS**

- A. Section 013300 - Submittal Procedures: Submittal requirements.
- B. Shop Drawings: Indicate deck plan, support locations, Projections, openings and reinforcement, pertinent details, and accessories.
- C. Product Data: Submit deck profile characteristics and dimensions, structural properties, and finishes
- D. Manufacturer's Installation Instructions: Submit manufacturer's installation instructions.
- E. Manufacturer's Certificates: Certify Products meet or exceed specified requirements.
- F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

#### **1.5 QUALITY ASSURANCE**

- A. Perform Work in accordance with ASCE 3 for composite decks.

#### **1.6 QUALIFICATIONS**

- A. Design deck layout, spans, fastening, and joints under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State of Texas.

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

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Cut plastic wrap to encourage ventilation.
- C. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. Sheet Steel: ASTM A653, Grade 50 Structural Quality; with G90 galvanized coating conforming to ASTM A525.
- B. Bearing Plates or Angles: ASTM A36 steel.
- C. Welding Materials: AWS D1.1.

#### **2.2 FABRICATION**

- A. Metal Deck: Sheet steel, configured as follows:
  - 1. Span Design: multiple
  - 2. Minimum Metal Thickness Excluding Finish: 22 gage.
  - 3. Minimum Allowable Diaphragm Shear: 250 plf.
  - 4. Nominal Height: 1-1/2 inch



5. Side Joints: lapped

**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.

**3.2 INSTALLATION**

- A. Erect metal deck in accordance with SDI Manual.
- B. Bear deck on steel supports with 1-1/2 3 inch minimum bearing. Align and level.
- C. Fasten ribbed deck to steel support members at ends and intermediate supports with as indicated on drawings.
- D. Weld in accordance with AWS D1.1.
- E. Seal deck joints, laps, ends, and penetrations with sealant to achieve permanent air seal consistent with air barrier system specified in Section 07270.
- F. Reinforce steel deck openings from 6 to 18 inches in size with 2 x 2 x 1/4 inch steel angles. Place framing angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and mechanically attach to deck at each flute.
- G. Install wet concrete stops at roof edge upturned to top surface of slab to contain wet concrete. Install stops of sufficient strength to remain stationary under wet concrete without distortion.
- H. Install sheet steel closures and angle flashings to close openings between deck and walls, columns, and openings.
- I. Position roof sump pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
- J. Place metal cant strips in position and mechanically attach.
- K. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up prime paint.

**3.3 FIELD QUALITY CONTROL**

- A. Welding: Inspect welds in accordance with AWS D1.1.

**END OF SECTION 05 31 23**

## **SECTION 05 40 00 - COLD FORMED METAL FRAMING**

### **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 requirements including but not limited to:
  - 1. Load bearing wall framing.
  - 2. Exterior non-load bearing wall framing.
  - 3. Floor joist framing.
  - 4. Roof rafter framing.
  - 5. Ceiling joist framing.
  - 6. Soffit framing.
  - 7. Accessories necessary for a complete installation.
- B. Related Sections:
  - 1. Section 03 30 00 - Cast in Place Concrete.
  - 2. Section 05 50 00 - Metal Fabrications.
  - 3. Section 09 21 16 - Gypsum Board Assemblies.
  - 4. Section 09 90 00 - Painting and Coating.

#### **1.3 REFERENCE STANDARDS**

- A. ACI 318 - Building Code Requirements for Structural Concrete; 2019 (Reapproved 2022).
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- D. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
- E. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2023.
- F. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
- G. ASTM C1513 - Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections; 2018.
- H. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- I. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.
- J. ASTM E1190 - 2021 Edition, November 15, 2021 Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members; 2021 Edition, November 15, 2021.
- K. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- L. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: General Contractor shall engage a qualified professional engineer, licensed in the State of Texas, to design cold formed steel framing.
- B. Structural Performance - Delegated design engineer shall provide cold-formed steel framing designs capable of withstanding all code required design loads within limits and under

conditions indicated on the construction documents and within this Specification:

1. Design loads: Designs shall be capable of withstanding the worst case loading as indicated on the structural drawings, and/or as required by the locally adopted Building Code. The design shall cover the worst case loading in all instances.
  2. Coordinate the requirements on the structural and architectural Drawings with the requirements of this Section. If a conflict exists, notations on the structural drawings take precedence.
  3. The following document governs the Work, except where more restrictive items are specified:
    - a. AISI Design of Cold-Formed Steel Structural Members Wind Load:
      - 1) Minimum design loads for exterior and/or load bearing and/or soffit applications:
        - (a) As required by code officials having jurisdiction.
        - (b) Deflection: 1/600 for clear simple spans.
        - (c) Deflection: 1/300 for cantilever conditions and roof parapets.
        - (d) Gauge: 16 gauge minimum, unless noted otherwise.
      - 2) Minimum design loads for interior and/or exterior suspended furr-downs with a maximum vertical drop on either side of 5 feet or greater:
        - (a) As required by Authorities Having Jurisdiction (AHJ).
        - (b) Deflection: 1/600 for clear simple spans.
        - (c) Deflection: 1/300 for cantilever conditions and roof parapets.
        - (d) Gauge: 20 gauge minimum, unless noted otherwise.
  4. It is a common practice for studs thinner than 20 gauge to be crimped and/or ribbed to increase the strength of the overall stud cross section for various loading applications. These studs are typically noted by manufacturer as "equivalent" to a thicker gauge. These "equivalent" type studs are not allowed in a vertically suspended application with greater than 5 feet of vertical wall drop, 20 gauge is the minimum thickness allowed for these applications.
  5. Welding qualifications: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure."
  6. Studs, tracks, channels, and other light gauge framing members shall conform to requirements of ASTM C955.
  7. Fire-Rated Assemblies: Where framing units are components of assemblies indicated for a fire-resistance rating, including those required for compliance with governing regulations, provide units that have been approved by governing authorities that have jurisdiction.
  8. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 degrees F (87 degrees C).
  9. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure:
    - a. Upward and downward movement of 1-1/2 inch (38 mm).
  10. Design exterior non-load bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold Formed Steel Framing Design Standards:
1. Wall studs: AISI S211.
  2. Headers: AISI S212.
  3. Lateral design: AISI S213.

## 1.5 SUBMITTALS

- A. Product Data: Technical data for cold formed steel framing product and accessories including factory applied primers.
- B. Shop Drawings:

1. Submit layout, spacings, sizes, thickness, and types of cold formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners:
  - a. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
  - b. Shall bear the seal of a Registered Professional Engineer, licensed in the State of Texas.
- C. Supplementary Design Details: The general design is presumed adequate to permit compliance with the specified performance. Provide engineering calculations and shop drawings to supplement the general design. Calculations shall bear the seal of a Registered Professional Engineer, licensed in the State of Texas. Calculations and shop drawings must show design will withstand wind loading commiserate with class and rating of the Project.

## 1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
  1. Welding qualifications:
    - a. Qualify procedures and personnel according to the following:
      - 1) AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
      - 2) CCFSS Technical Bulletin: "AISI Specification Provision for Screw Connections."
  2. Comply with AISI North American Specification for the Design of Cold Formed Steel Structural Members and Standard for Cold Formed Steel Framing - General Provisions:
    - a. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.
  3. Fire Resistance Ratings: ASTM E119; testing by a UL. Identify products with appropriate markings of applicable testing agency. Indicate design designations from UL Fire Resistance Directory.
  4. Installer qualifications: Company specializing in the installation of cold formed metal framing components with minimum five (5) years' documented experience.
  5. Install system to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
  6. Install system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
  7. 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, and galvanized-coating thickness.
- B. Professional Engineer Qualifications:
  1. A professional engineer who is legally qualified to practice in the State of Texas and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold formed metal framing that are similar to those indicated in material, design, and extent:
    - a. Engineering Responsibility: Preparation of shop drawings, design calculations, and structural data.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience

manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.

1. CEMCO.
2. ClarkDietrich Building Systems.
3. Consolidated Fabricators Corp.
4. SCAFCO Corporation.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

## 2.2 LOAD BEARING WALL FRAMING

A. Steel Studs:

1. C-shaped steel studs, of web depths indicated, punched, with stiffened flanges:
  - a. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
  - b. Flange Width: 1-5/8 inches (41 mm).
  - c. Section Properties: As indicated on Drawings.

B. Steel Track:

1. U-shaped steel track, of web depths indicated, unpunched, with straight flanges:
  - a. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
  - b. Flange Width: 1-1/4 inches (32 mm).

C. Steel Box or Back to Back Headers:

1. C-shape used to form header beams, of web depths indicated, unpunched, with stiffened flanges:
  - a. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
  - b. Flange Width: 1-5/8 inches (41 mm).

D. Steel Single or Double L Headers:

1. L-shapes used to form header beams, of web depths indicated:
  - a. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
  - b. Top Flange Width: 1-5/8 inches (41 mm).
  - c. Section Properties: As indicated on Drawings.

## 2.3 EXTERIOR NONLOAD BEARING WALL FRAMING

A. Steel Studs:

1. C-shaped steel studs, of web depths indicated, punched, with stiffened flanges:
  - a. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
  - b. Flange Width: 1-5/8 inches (41 mm).
  - c. Section Properties: As indicated on Drawings.

B. Steel Track:

1. U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
  - a. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
  - b. Flange Width: 1-1/4 inches (32 mm).

C. Vertical Deflection Clips:

1. Head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web:
  - a. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and

comply with Division 01 requirements regarding substitutions to be considered.

- 1) ClarkDietrich Building Systems.
- 2) SCAFCO Corporation.
- 3) Simpson Strong-Tie Co., Inc.
- 4) Steeler, Inc.
- 5) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

D. Single Deflection Track:

1. Single, deep leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure:
  - a. Minimum base metal thickness: 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
  - b. Flange width: One inch (25 mm) plus the design gap for one story structures and one inch (25 mm) plus twice the design gap for other applications.

E. Double Deflection Tracks:

1. Double, deep leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges:
  - a. Outer track - Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure:
    - 1) Minimum base metal thickness: 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
    - 2) Flange width: 1 inch (25 mm) plus the design gap for one story structures and 1 inch (25 mm) plus twice the design gap for other applications.
2. Inner track - of web depth indicated:
  - a. Minimum base metal thickness: 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
  - b. Flange width: 1 inch (25 mm) plus the design gap for one story structures and 1 inch (25 mm) plus twice the design gap for other applications.

- F. Drift Clips: Bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

## 2.4 CEILING JOIST FRAMING

A. Steel Ceiling Joists:

1. C-shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges:
  - a. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm).
  - b. Flange Width: 2 inches (51 mm), minimum.

## 2.5 SOFFIT FRAMING

A. Exterior Soffit Frame:

1. C-shaped steel sections, of web depths indicated, with stiffened flanges:
  - a. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm).
  - b. Flange Width: 1-5/8 inches (41 mm) minimum.

## 2.6 FRAMING ACCESSORIES

- A. Fabricate steel framing accessories from steel sheet, ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of appropriate thickness and configuration, unless otherwise indicated:
  1. Supplementary framing.
  2. Bracing, bridging, and solid blocking.
  3. Web stiffeners.
  4. Anchor clips.

5. End clips.
  6. Foundation clips.
  7. Gusset plates.
  8. Stud kickers and knee braces.
  9. Joist hangers and end closures.
  10. Hole reinforcing plates.
  11. Backer plates.
- C. Anchors, Clips, and Fasteners:
1. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot dip process according to ASTM A123/A123M.
  2. 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 E488/E488M conducted by a qualified testing agency.
  3. Power actuated anchors: Fastener system of type suitable for application indicated, fabricated from corrosion resistant materials, with allowable load capacities calculated, greater than or equal to the design load, as determined by testing per ASTM E1190 conducted by a qualified testing agency.
  4. Mechanical fasteners:
    - a. ASTM C1513 ASTM C1513, corrosion resistant coated, self-drilling, self-tapping, steel drill screws:
      - 1) Head type: Low profile head beneath sheathing.
  5. Welding electrodes: Comply with AWS standards.
- D. Miscellaneous Materials:
1. Galvanizing Repair Paint: SSPC-Paint 20 or ASTM C780.
  2. Non-Metallic, Non-Shrink Grout: Premixed, non-metallic, non-corrosive, non-staining grout containing selected silica sands, portland cement, shrinkage compensating agents, and plasticizing and water reducing agents, complying with ASTM C1107/C1107M, with fluid consistency and 30-minute working time.
  3. Shims: Load bearing, high density multimonomer plastic, and non-leaching; or of cold formed steel of same grade and coating as framing members supported by shims.
  4. Sealer Gaskets: Closed cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from standard widths to match width of bottom track or rim track members.

## 2.7 FABRICATION

- A. Fabricate cold formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI specifications and standards, manufacturer written instructions, and specified requirements:
1. Fabricate framing assemblies using jigs or templates.
  2. Cut framing members by sawing or shearing; do not torch cut.
  3. Fasten cold formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted:
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to shop drawings, with screw penetrating joined members by no fewer than three (3) exposed screw threads.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances:
1. Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in ten (10) feet (1:960) and as follows:

- a. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
- b. Squareness: Fabricate each cold formed steel framing assembly to a maximum out of square tolerance of 1/8 inch (3 mm).

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

#### **3.2 PREPARATION**

- A. Before sprayed fire resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire resistive materials, remove only as much as necessary to complete installation of cold formed framing without reducing thickness of fire resistive materials below required thickness to obtain fire resistance rating indicated. Protect remaining fire resistive materials from damage.
- C. Install load bearing shims or grout between the underside of load bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

#### **3.3 ERECTION**

- A. General:
  1. Track Anchors: Install anchors maximum 4 feet on center; design anchors and spacing to carry live, dead, and wind loads.
  2. Track Splices: Provide channel inserts or weld track splices.
  3. Erection: Install members plumb, level, and in a true plane.
  4. Fastenings: Make assembly rigid and secure, with welds free of voids and burnouts.
- B. Install metal framing systems in accordance with stud manufacturer's printed instructions.
- C. Runner Tracks:
  1. Install continuous tracks sized to match studs.
  2. Align tracks accurately to layout at base and tops of studs.
  3. Secure tracks as recommended by stud manufacturer, except do not exceed 24 inches on center for nail or power-driven fasteners, nor 16 inches on center for other types of attachment.
  4. Provide fasteners at corners and ends of tracks.
  5. Tracks shall be anchored to structural steel prior to installing sprayed on insulation.
  6. Provide deflection track (DT), at top of stud walls at floor or roof above, typically. Allow for 1/2 inch movement of primary structure. Do not attach studs directly to deflection track.
  7. Vertical deflection clips: Provide manufacturer's standard bypass and head clips, capable of accommodating upward and downward vertical displacement of primary structure.
- D. Secure studs to top track and bottom runner track by means of approved self-drilling screws or welding at both inside and outside flanges of 14 gauge or heavier material. Screws and welds shall be of sufficient size to insure strength of connection. All welding shall comply with American Welding Society "Specification for Welding Sheet Steel in Structures."
- E. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
- F. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure. Use Zee clips as specified above. Weld "Z" shaped clips to



structural members as shown on drawings. Maximum 2 feet on center vertical.

- G. Install supplementary framing, blocking, and bracing in the metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with the stud manufacturer's recommendations and industry standards in each case, considering the weight or loading resulting from the item supported.
- H. Frame wall openings with extra studs, equal to the number of studs interrupted by wall openings, placed at each side of wall openings. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with shoes or by welding, and space jack studs same as full-height studs of the wall. Secure stud system all around to wall opening frame in the manner indicated.
- I. Install bracing/bridging in accordance with manufacturer's instructions and design conditions.
- J. Touch up field welds and damaged galvanized coating, except touch up of field cut studs is not required.
- K. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.
- L. Install horizontal stiffeners in stud system, space (vertical distance) at no more than 54 inches on center. Weld at each intersection.

### **3.4 JOIST INSTALLATION**

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track:
  - 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
  - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel stud sections as indicated on shop drawings.
- C. Space joists not more than 2 inches (51 mm) from abutting walls:
  - 1. Joist Spacing: 16 inches (406 mm).
- D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on shop drawings:
  - 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated on shop drawings. Fasten bridging at each joist intersection as follows:
  - 1. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold down angles, anchors, and fasteners, to provide a complete and stable joist framing assembly.

**END OF SECTION 05 40 00**

## **SECTION 05 50 00 - METAL FABRICATIONS**

### **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. Bollards.
    - a. Door Device Mounting Post.
    - b. Metal Pipe Bollards, \_\_\_\_\_, Fixed, and Removable.
    - c. Pipe/downspout guards.
  - 2. CMU Partition Head Supports.
  - 3. Downspout boots.
  - 4. Equipment guards.
  - 5. Folding metal gates.
  - 6. Loose steel lintels.
  - 7. Loose bearing and leveling plates.
  - 8. Metal ladders.
  - 9. Miscellaneous steel, including steel angle corner guards, steel edgings, and loading dock edge angles.
  - 10. Shelf angles.
  - 11. Slotted channel framing.
  - 12. Trim.
    - a. Angels for vent grilles.
    - b. Cast-in pit and edge Angles.
    - c. Miscellaneous steel trim.
  - 13. Accessories as necessary for complete installation.
- B. Related Sections:
  - 1. Section 04 20 00 - Unit Masonry: CMU partitions.

#### **1.3 REFERENCE STANDARDS**

- A. 2012 TAS - Texas Accessibility Standards; 2012.
- B. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).
- C. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2022.
- D. ASTM A27/A27M - Standard Specification for Steel Castings, Carbon, for General Application; 2020.
- E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- F. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- G. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
- H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

- J. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- K. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- L. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2024.
- M. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- N. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- O. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- P. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.
- Q. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- R. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- S. ASTM A741 - Standard Specification for Metallic-Coated Steel Wire Rope and Fittings for Highway Guardrail; 2011.
- T. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
- U. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates; 2015 (Reapproved 2021).
- V. ASTM A793 - Standard Specification for Rolled Floor Plate, Stainless Steel; 1996.
- W. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- X. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
- Y. ASTM B36/B36M - Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar; 2023.
- Z. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- AA. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- BB. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- CC. ASTM B455/B455M - Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes; 2020.
- DD. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications; 2022.
- EE. ASTM B632/B632M - Standard Specification for Aluminum-Alloy Rolled Tread Plate; 2018.
- FF. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- GG. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.
- HH. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- II. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

- JJ. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).
- KK. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.
- LL. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2022.
- MM. {RSTEMP#1218}
- NN. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.
- OO. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric; 2016.
- PP. ASTM F2329/2329M - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners; 2015.
- QQ. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
- RR. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- SS. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- TT. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- UU. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel; 2017, with Amendment (2021).

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design ladders and countertop supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance of Ladders: Provide ladders and landings capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
- C. Structural Performance:
  - 1. Countertops 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:  $L/1000$  times span or 1/8 inch whichever is less.
- D. Thermal Movements:
  - 1. Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss:
    - a. Temperature change (range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

#### 1.5 SUBMITTALS

- A. Product Data: Submit data for miscellaneous metal fabrications and paint, coatings, and grout accessories.
- B. Shop Drawings:

1. 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:
  - a. 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.
- C. 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.
- D. Welding Certificates.
- E. Paint Compatibility Certificates: Submit manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

## **1.6 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  1. Building Code: Comply with applicable requirements of the IBC for metal fabrications.
  2. Welding - qualify procedures and personnel according to the following:
    - a. AWS D1.1/D1.1M Structural Welding Code – Steel.
    - b. AWS D1.2/D1.2M Structural Welding Code - Aluminum.
    - c. AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
    - d. AWS D1.6/D1.6M Structural Welding Code - Stainless Steel.
    - e. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Fabricator/Installer Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this work 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.
- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction 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 in material, design, and extent.

## **1.7 FIELD CONDITIONS**

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.
  1. Established Dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
  2. Provide allowance for trimming and fitting at site.

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

- A. Store metal fabrications in a dry, well ventilated, weathertight place. Deliver and handle to prevent any type of damage to the fabricated work.

## **1.9 COORDINATION**

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

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### A. Metal Surfaces, General:

1. Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
2. Slotted Channel Framing: Cold formed metal box channels (struts) complying with MFMA-4.
  - a. Size of Channels: 1-5/8 inches by 1-5/8 inches (41 mm by 41 mm).
  - b. Material: Galvanized steel ASTM A653/A653M, commercial steel, Type B. with G90 (Z275) coating; 0.108 inch (2.8 mm) nominal thickness.
  - c. Cold Formed Metal Channels: Flange edges returned toward web and with 9/16 inch (14.3 mm) wide slotted holes in webs at 2 inches (51 mm) o.c.
  - d. Width of Channels: 1-5/8 inches (41 mm).
  - e. Depth of Channels: As indicated on Drawings.
  - f. Metal and Thickness: Galvanized steel complying with ASTM A653/A653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating; 0.108 inch (2.8 mm) nominal thickness.
  - g. Finish: Hot dip galvanized after fabrication.
3. Fasteners: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
  - a. Provide stainless steel fasteners for fastening aluminum.
  - b. Provide stainless steel fasteners for fastening stainless steel.
  - c. Provide stainless steel fasteners for fastening nickel silver.
  - d. Provide bronze fasteners for fastening bronze.
  - e. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563/A563M; and, where indicated, flat washers.
  - f. Steel Bolts and Nuts: Regular hexagon head bolts, ASTM A325/A325M, Type 3; with hex nuts, ASTM A563/A563M, Grade C3 (ASTM A563M, Class 8S3); and, where indicated, flat washers.
  - g. Stainless Steel Bolts and Nuts: Regular hexagon head annealed stainless steel bolts, ASTM F1554 (ASTM F738M); with hex nuts, {RS#1218} (ASTM F836M); and, where indicated, flat washers; Alloy.
  - h. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563/A563M; and, where indicated, flat washers.
    - 1) Hot dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
  - i. Anchors: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
  - j. Cast in Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot dip galvanized per ASTM F2329/2329M.
  - k. Post Installed Anchors:
    - 1) Material for Interior Locations: Carbon steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
    - 2) Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) or Group 2 (A4) stainless steel bolts, ASTM F593 ASTM

F593 (ASTM F738M), and nuts, {RS#1218} (ASTM F836M).

- I. Slotted Channel Inserts: Cold-formed, hot-dip galvanized steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee head bolts, complete with washers and nuts, all zinc plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts
4. Provide materials to complete installation of building products and/or miscellaneous products, i.e. stairs, ramps, and leveling devices, to meet the requirements of the CBC, DSA, and School District requirements (where applicable).
- B. Aluminum:
  1. Aluminum Plate and Sheet: ASTM B209/B209M, Alloy 6061-T6.
  2. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.
  3. Aluminum Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
  4. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.
- C. Cast Iron:
  1. Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.
- D. Nickel:
  1. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500.
  2. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).
- E. Stainless Steel:
  1. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.
  2. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.
  3. Rolled Stainless Steel Floor Plate: ASTM A793.
- F. Steel:
  1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
  2. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
  3. Steel Tubing: ASTM A500/A500M, cold formed steel tubing.
  4. Rolled Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.
- G. Zinc Coated Steel Wire Rope: ASTM A741:
  1. Wire Rope Fittings: Hot dip galvanized steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- H. Abrasive Surface Floor Plate:
  1. Steel plate with abrasive granules rolled into surface or with abrasive material metallurgically bonded to steel:
    - a. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
      - 1) IKG Industries, a division of Harsco Corporation.
      - 2) SlipNOT Metal Safety Flooring; W.S. Molnar Company.
- I. Fasteners:
  1. Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required:
    - a. Provide stainless steel fasteners for fastening aluminum.
    - b. Provide stainless steel fasteners for fastening stainless steel.

- c. Provide stainless steel fasteners for fastening nickel silver.
  - d. Provide bronze fasteners for fastening bronze.
  - e. Steel Bolts and Nuts: Regular hexagon head bolts, ASTM A307, Grade A with hex nuts, ASTM A563/A563M and, where indicated, flat washers.
  - f. Steel Bolts and Nuts: Regular hexagon head bolts, ASTM F3125/F3125M, Type 3 with hex nuts, ASTM A563/A563M, Grade C3 and, where indicated, flat washers.
  - g. Stainless Steel Bolts and Nuts: Regular hexagon head annealed stainless steel bolts, ASTM F593 with hex nuts, {RS#1218} and, where indicated, flat washers; alloy.
  - h. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563/A563M and, where indicated, flat washers:
    - 1) Hot dip galvanize or provide mechanically deposited zinc coating where item being fastened is indicated to be galvanized.
  - i. Anchors: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
  - j. Post Installed Anchors: Torque controlled expansion anchors or chemical anchors
    - 1) Material for interior locations: Carbon steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
    - 2) Material for exterior locations and where stainless steel is indicated: Alloy; Group 1 (A1) or Group 2 (A4), ASTM F593, and nuts, {RS#1218}.
  - k. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot dip galvanized per ASTM F2329/2329M.
  - l. Slotted Channel Inserts: Cold-formed, hot-dip galvanized steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee head bolts, complete with washers and nuts, all zinc plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.
- J. Miscellaneous Materials:
- 1. Shop Primer for Ferrous Metal: Universal primer, organic zinc rich primer, complying with SSPC-Paint 20 and compatible with topcoat. Provide 10-99 (red) or 10-09 (gray) by Tnemec Company.
  - 2. Universal Shop Primer: Fast curing, lead and chromate free, universal modified alkyd primer and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc rich primer.
  - 3. Water Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel and compatible with topcoat.
  - 4. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc coated metal and compatible with finish paint systems indicated.
  - 5. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20. Provide Tneme-Zinc 90-97 by Tnemec Company.
  - 6. Bituminous Paint: Cold applied asphalt emulsion complying with SSPC-Paint 12, containing no asbestos fibers, or cold applied asphalt emulsion complying with ASTM D1187/D1187M.
  - 7. Non-shrink, Non-Metallic Grout: Factory packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
  - 8. Concrete Materials and Properties: Composed of ASTM C150/C150M Type I Portland cement, ASTM C33/C33M sand and coarse aggregates and potable water to produce a



low slump mix suitable for placement. Grade coarse aggregate from 1/8 inch with at least 95 percent passing a 3/8-inch sieve and not more than 10 percent passing a No. 8 sieve. Fill shall be proportioned to provide a minimum 28-day compressive strength of 3,000 psi (20 MPa).

## 2.2 FABRICATION

### A. Shop Assembly:

1. Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation:
  - a. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
  - b. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
  - c. Form exposed work with accurate angles and surfaces and straight edges.
  - d. Weld corners and seams continuously to comply with the following:
    - 1) Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
    - 2) Obtain fusion without undercut or overlap.
    - 3) Remove welding flux immediately.
    - 4) At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
  - e. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
  - f. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
  - g. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
  - h. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
  - i. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 inch by 1-1/2 inches (3.2 mm by 38 mm), with a minimum 6 inch (150 mm) embedment and 2 inch (50 mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.
  - j. Galvanize miscellaneous framing and supports at exterior locations; prime paint miscellaneous framing and supports at interior locations.
2. Miscellaneous Framing and Supports: Provide steel framing and supports necessary to complete the work and which are not a part of the structural framework, including but not limited to framing and supports for elevator hoistway beams, elevator sills, overhead lobby door frames, sliding doors, countertop and vanities, ceiling hung toilet compartments, and tube framing for partial height walls, CMU partition head supports, mechanical and electrical equipment.
  - a. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction. Cut, drill, and tap units to receive hardware, hangers, and similar items.
    - 1) Fabricate units from slotted channel framing where indicated.
    - 2) Furnish inserts for units installed after concrete is placed.

- b. CMU Partition Head Supports: Fabricate supports from 4 inch x 4 inch x 1/4 inch by 36 inch (100 mm by 100 mm by 6 mm by 900 mm) long structural steel angles. Drill supports a maximum of 12 inches (300 mm) o.c. to receive expansion bolts.
- c. Galvanize miscellaneous framing and supports at exterior locations; prime paint miscellaneous framing and supports at interior locations.

### 2.3 BOLLARDS

- A. Pipe Bollards:
  1. Fabricate metal bollards from Schedule 40 steel pipe or 1/4 inch (6.4 mm) wall thickness rectangular steel tubing.
  2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
  3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
  4. Where bollards are to be installed on structural slab or existing paving:
    - a. Fabricate bollards with 3/8 inch (9.5 mm) thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4 inch (19 mm) anchor bolts.
    - b. Where bollards are anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
  5. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4 inch (6.4 mm) thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard.

### 2.4 DOWNSPOUT BOOTS

- A. Basis of Design:
  1. Model N-6616CX manufactured by J.R. Hoe & Sons,
- B. Material: Cast Iron complying with ASTM A48/A48M Class 30 CI.
- C. Angle: 90 degrees.
- D. Size:
  1. Inlet: 6 by 6 inches.
  2. Overall Height: 16 inches.
  3. Outlet: 5-7/8 inches.

### 2.5 FOLDING METAL GATES

- A. Description: Steel scissor-type gate.
  1. Type: Scissor-Type single, pair, and door gate.
  2. Finish: Galvanized Steel.
  3. Webbing: Heavy-duty, 14 gauge, U-channel riveted back-to-back with zinc-plated rivets.
  4. Frame: Heavy-Duty, 12 Gauge, 1-1/2 inch x 1-1/2 inch Vertical Angle Frame.
  5. Casters: Solid Steel.
  6. Locking:
    - a. Single Gate shall include heavy-duty 12 gauge zinc-plated angle locking bar with 3/16 inch padlock hasp. Lock shall be on right unless noted otherwise.
    - b. Paired Gate shall meet in middle and lock with 3/16 inch padlock hasp.
    - c. Door Gate shall include heavy-duty 12 gauge zinc-plated angle locking bar with 3/16 inch padlock hasp which shall lock to right wall unless noted otherwise.
  7. Mounting: Can be mounted to wall, door frame, or attached to free standing.
  8. Size:
    - a. Height: 8 feet, unless noted otherwise.
    - b. Width: As required.
  9. Basis of Design: "Heavy-Duty Folding Gates" manufactured by Illinois Engineered Products.

## 2.6 GUARDS

- A. Equipment Guards:
  - 1. Provide metal tube framing for security and public safety around equipment where indicated on Drawings.
  - 2. Fabricate equipment guards from 1-1/2 inch O.D. steel tube.
  - 3. Finish Paint Federal Yellow or add stripe caution reflective tape.
- B. Pipe and Downspout Guards:
  - 1. Fabricate pipe and downspout guards from 3/8 inch (9.5 mm) thick by 12 inch (300 mm) wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with two-inch (50 mm) clearance between pipe and pipe guard. Drill each end for two (2) 3/4-inch (19 mm) anchor bolts.
  - 2. Galvanize and prime pipe, downspout guards.

## 2.7 LADDERS

- A. Comply with ANSI A14.3. For elevator pit ladders, comply with ASME A17.1/CSA B44
- B. Steel Ladders:
  - 1. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
  - 2. Siderails: Continuous, 1/2 inch by 2-1/2 inch (12.7 mm by 64 mm) steel flat bars, with eased edges.
  - 3. Rungs: 1 inch (25 mm) diameter steel bars.
  - 4. Fit rungs in centerline of siderails; plug weld and grind smooth on outer rail faces.
  - 5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum oxide granules set in epoxy resin adhesive or by using a type of manufactured rung filled with aluminum oxide grout.
  - 6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallicly bonded to rung.
    - a. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
      - 1) Harsco Industrial IKG, a division of Harsco Corporation.
      - 2) SlipNOT Metal Safety Flooring; W.S. Molnar Company.
  - 7. Provide platforms as indicated fabricated from welded or pressure locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
  - 8. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
  - 9. Galvanize ladders, including brackets and fasteners.

## 2.8 MISCELLANEOUS FRAMING AND SUPPORTS

- A. Provide steel framing and supports necessary to complete the work and which are not a part of the structural framework, including but not limited to the following:
  - 1. CMU partition head.
  - 2. Loose bearing and leveling plates
  - 3. Loose steel lintels.
  - 4. Shelf angles.
- B. Fabrication, General:
  - 1. Fabricate from steel shapes, plates, and bars of welded construction unless otherwise indicated.
  - 2. Fabricate to sizes, shapes, and profiles indicated on Drawings and as necessary to receive adjacent construction. Cut, drill, and tap units to receive hardware, hangers, and similar items:
  - 3. Cut, drill, and tap units to receive hardware, hangers, and similar items.

4. Fabricate units from slotted channel framing where indicated.
  5. Provide inserts for units installed after concrete is placed.
- C. CMU Partition Head Supports:
1. Fabricate supports from 4 inch x 4 inch x 1/4 inch by 36 inch (100 mm by 100 mm by 6 mm by 900 mm) long structural steel angles. Drill supports a maximum of 12 inches (300 mm) o.c. to receive expansion bolts.
- D. Loose Bearing and Leveling Plates:
1. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction.
    - a. Drill plates to receive anchor bolts and for grouting.
    - b. Galvanize plates.
- E. Shelf Angles:
1. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4 inch (19 mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
    - a. Provide mitered and welded units at corners.
    - b. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.
    - c. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
    - d. Galvanize and prime shelf angles located in exterior walls.
    - e. Prime shelf angles located in exterior walls with zinc rich primer.
    - f. Furnish wedge type concrete inserts, complete with fasteners, to attach shelf angles to cast in place concrete.

## 2.9 TRIM

- A. U-Channel:
1. Basis of Design:
    - a. U-Edging manufactured by McNichols.
  2. Material: Stainless steel, Type 304.
  3. Thickness: 0.0750 inches.
  4. Finish: Mill.
  5. Size: 1/8 inch open, 1 inch width.

## 2.10 SHEET AND PLATE MATERIALS

- A. Perforated Sheet:
1. Basis of Design:
    - a. Perforated Metal manufactured by McNichols.

## 2.11 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).
- C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).
- D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).
- E. Maximum Deviation from Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

## 2.12 FINISHES

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

## 2.13 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.
- B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.
  - 1. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

## 2.14 STAINLESS STEEL FINISHES

- A. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. Bright, Directional Polish: No. 4 finish.
- C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## 2.15 STEEL AND IRON FINISHES

- A. Galvanizing:
  - 1. Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products:
    - a. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- D. Preparation for Shop Priming:
  - 1. Prepare surfaces to comply with requirements indicated below:
    - a. Exterior items: SSPC SP6/NACE No. 3, "Commercial Blast Cleaning."
    - b. Items indicated to receive zinc-rich primer: SSPC SP6/NACE No. 3, "Commercial Blast Cleaning."
    - c. Items indicated to receive primers specified in Section 09 96 00 - High-Performance Coatings: SSPC SP6/NACE No. 3, "Commercial Blast Cleaning."
    - d. Other items: SSPC SP3, "Power Tool Cleaning."
- E. Shop Priming:
  - 1. Apply shop primer to comply with SSPC PA1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting:
    - a. Stripe paint corners, crevices, bolts, welds, and sharp edges.

## PART 3 EXECUTION

### 3.1 COORDINATION

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

### 3.2 FIELD CONDITIONS

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

- a. Established dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
- b. Provide allowance for trimming and fitting at site.

### **3.3 INSTALLATION, GENERAL**

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation, with edges and surfaces level, plumb, true, and free of rack, and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding:
  1. Comply with the following requirements:
    - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
    - b. Obtain fusion without undercut or overlap.
    - c. Remove welding flux immediately.
    - d. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection:
  1. Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
    - a. Cast aluminum: Heavy coat of bituminous paint.
    - b. Extruded aluminum: Two (2) coats of clear lacquer.

### **3.4 INSTALLING BEARING AND LEVELING PLATES**

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with non-shrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### **3.5 INSTALLING BOLLARDS**

- A. Fill metal capped bollards solidly with concrete and allow concrete to cure seven days before installing.
  1. Do not fill removable bollards with concrete.
- B. Install plumb.
- C. Backfill as indicated on Drawings.

### **3.6 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS**

- A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on shop drawings.
- B. Anchor supports for CMU partition head supports securely to, and rigidly braced from, building structure.
  - 1. CMU Partition Head Supports: Unless otherwise indicated place partition head supports on alternate faces of CMU partitions every 6 feet o.c. and expansion bolt to underside of structure. Do not bolt to CMU partitions.

### **3.7 ERECTION TOLERANCES**

- A. Maximum Variation from Plumb: 1/4 inch (6mm) per story, noncumulative.
- B. Maximum Offset from True Alignment: 1/4 inch (6mm).
- C. Maximum Out of Position: 1/4 inch (6mm).

### **3.8 ADJUSTING AND CLEANING**

- A. Touchup Painting:
  - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC PA1 for touching up shop painted surfaces:
    - a. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.
  - 2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 90 00 - Painting and Coating.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

**END OF SECTION 05 50 00**

## **SECTION 05 75 00 - DECORATIVE FORMED METAL**

### **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. Finishing and edge-protection profiles for walls and countertops.
- B. Related Sections:
  - 1. Section 09 21 16 - Gypsum Board Assemblies.
  - 2. Section 09 30 00 - Tiling.
  - 3. Section 09 68 00 - Carpeting.

#### **1.3 REFERENCE STANDARDS**

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
- B. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
- C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- D. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- G. ASTM B247 - Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings; 2020.
- H. ASTM B247M - Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings (Metric); 2020.
- I. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2020.

#### **1.4 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures.
- 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. Installation methods.
  - 4. Warranty.
- C. Verification Samples: For each finish product specified, minimum size 6 inches (305 mm) square, representing actual product in color and texture.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
  - 1. Package for protection against transportation damage.
  - 2. Provide markings to identify components consistently with drawings.
- B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.



1. Store in well-ventilated space out of direct sunlight.
2. Protect from moisture and condensation.
3. Avoid contact with other materials that might cause staining, denting, or other surface damage.

## **1.6 WARRANTY**

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
1. C.R. Laurence Co., Inc.: [www.crlaurence.com](http://www.crlaurence.com).
  2. Fry Reglet Corporation: [www.fryreglet.com](http://www.fryreglet.com).
  3. Genesis APS International: [www.genesis-gs.com](http://www.genesis-gs.com).
  4. Schluter Systems: [www.schluter.com](http://www.schluter.com).
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

### **2.2 FINISHING AND EDGE-PROTECTION PROFILES FOR WALLS AND COUNTERTOPS**

- A. Decorative Trim, Type 1 (DT-1):
1. Basis of Design Product: JOLLY manufactured by Schluter.
  2. Description: L-shaped profile with 1/8 inch (3.2 mm) wide top section and vertical wall section that together form the visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
  3. Anchoring Leg: Provide with straight or special radius anchoring leg as required.
  4. Material and Finish: AE - Satin anodized
  5. Height: Height as required.

### **2.3 MATERIALS**

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B209/B209M.
  2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221/ASTM B221M, Alloy 6063-T5/T52.
  3. Extruded Structural Pipe and Tubes: ASTM B429/B429M, Alloy 6063-T6.
  4. Drawn Seamless Tubing: ASTM B210/B210M, Alloy 6063-T832.
  5. Plate and Sheet: ASTM B209/B209M, Alloy 6061-T6.
  6. Die and Hand Forgings: ASTM B247/ASTM B247M, Alloy 6061-T6.
  7. Castings: ASTM B26/B26M, Alloy A356.0-T6.
- B. Factory Finish:
1. Clear Anodic Coating: AA-M12C22A41, AAMA 611, Architectural Class I Clear Anodic Coating.

## **PART 3 EXECUTION**

### **3.1 APPLICATION**

- A. Consult manufacturer's current technical literature for proper design and installation instructions.

**END OF SECTION 05 75 00**

## **SECTION 06 10 00 - ROUGH CARPENTRY**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes rough carpentry, light hardware, and miscellaneous items of work not included in another Section. This Section also includes:
  - 1. Structural wood supports, grounds, backing, and blocking required for millwork and casework items that are an integral part of wall, floor, and/or ceiling construction.
  - 2. Plywood sheathing.
- B. Related Sections:
  - 1. Section 03 10 00 - Concrete Forming and Accessories.
  - 2. Section 03 30 00 - Cast-In-Place Concrete.
  - 3. Section 07 21 00 - Thermal Insulation.
  - 4. Section 07 92 00 - Joint Sealants.
  - 5. Section 09 21 16 - Gypsum Board Assemblies.
  - 6. Section 09 24 00 - Cement Plastering.
  - 7. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- B. WCLIB (GR) - Standard Grading Rules for West Coast Lumber No. 17; 2018.

#### **1.4 QUALITY ASSURANCE**

- A. Lumber and plywood shall be grade or quality marked by WWPA, WCLIB, APA, AWPB, or by other grading and inspection agencies acceptable to Architect. Grade marks shall include the designation "S-DRY"(or "MC-15" as applies) where applicable. Grade and quality marks shall not be apparent on surfaces exposed in the finished work.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store kiln dried materials in enclosed areas, protected from moisture and separated from contact with concrete or soil.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. Temporary Construction: Clean lumber at Contractor's option, rough or smooth, as usage requires.
- B. Lumber Not Otherwise Specified or Noted:
  - 1. Douglas fir or larch, graded and grademarked, according to Reference Standard 1.02 A or B, #1 grade:
    - a. Boards: Construction grade.
- C. Plywood for Walls and Roofs; as Indicated on Drawings:
  - 1. Unless glue type is otherwise specified, exterior plywood, interior plywood exposed to continuing moisture, and pressure treated plywood shall be fabricated with exterior glue. Plywood with interior glue shall be fully protected from soaking or continuing moisture at all times.
- D. Rough Hardware:
  - 1. Nails, spikes, bolts, screws, tacks, and framing connectors of standard manufacture as required. Hot dip galvanize items exposed to moisture or to exterior and those items that

are in contact with wood pressure treated with waterborne salts:

- a. Bolts and Nuts: ASTM A307, Grade A.
  - b. Lag Bolts: Fed. Spec. FF-B-561. Pre-drill per CBC.
  - c. Nails: Fed. Spec. FF-N-101, common unless otherwise noted or specified.
  - d. Joist Hangers and Framing Connectors: Simpson or approved equal, unless otherwise noted.
  - e. Power Driven Fasteners: Hilti, Ramset, or approved equal, each use and fastener type subject to prior approval of Architect.
- E. Pressure Treatment (Decay and Termite Prevention):
1. Pressure treat for decay and termite prevention, Douglas fir or larch wood materials that are embedded in or set against concrete.
  2. Treat in accordance with Reference Standard 1.02 E and quality mark as per Reference Standard 1.02 F.
  3. Treat with any of the following processes at Contractor option. Creosote type preservatives are not permitted:
    - a. Penta in an LPG carrier (Cellon) or Penta in Hydrocarbon Solvent-Type D (Dow Process) AWPB LP-4 quality marked.
    - b. Ammoniacal copper arsenate (ACA) or chromated copper arsenate (CCA) in a water carrier (AWPB LP-2 quality marked).
    - c. Disodium Octaborate Tetrahydrate (DOT) such as Advance Guard/Hi-bor by Osmose, Inc.
    - d. Members treated with waterborne salts shall be dried to a moisture content not exceeding 19 percent after treatment.
  4. Where possible, precut material before treatment.
  5. Holes and cutoffs and handling and storage shall be in accordance with AWPA M-4.
  6. Ensure that ferrous metal fastenings and items in contact with wood treated with waterborne salts are hot dip galvanized (1.25 oz. coating) where required by ICC reports.
- F. Framing Connectors: Simpson Strong Tie Corp., or equal.

## **2.2 MOISTURE CONTENT**

- A. 19 percent maximum for two times thickness and less; 19 percent maximum for thickness greater than two times and less than four times; and 22 percent maximum for thickness greater than four times.

## **2.3 SIZES**

- A. Surfaced to "DRY" sizes. Sizes noted are nominal unless shown as net.

## **2.4 SURFACING**

- A. All wood materials exposed in the finished work shall have re-sawn surfaces of clean natural color unless noted or specified otherwise. Concealed framing lumber shall be S4S.

## **PART 3 EXECUTION**

### **3.1 ERECTION AND INSTALLATION**

- A. Framing:
1. Properly lay out framing with pieces closely fitted, accurately plumbed, leveled and aligned, and rigidly secured in place.
- B. Except as specifically shown on structural drawings, cutting of all wood, etc. is limited to those cuts permitted by CBC.
- C. Bridging and Blocking:
1. Provide two times blocking at intersections of finished surfaces for adequate bearing and at points where required to support fixtures, cabinets, hardware, and other equipment mounted on walls.

- D. Plywood (General): Unless more stringent requirements are indicated on the Drawings or required by code, application of plywood shall be in accordance with recommendations of the American Plywood Association.
- E. Connections and Fastenings:
  - 1. For bolted connections, provide washers under heads and nuts bearing on wood, and draw nuts tight. Retighten before closing in framing.
  - 2. Exercise care in nailing through exposed sheathing and siding and ensure that fasteners penetrate into framing members

**END OF SECTION 06 10 00**

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## **SECTION 06 16 00 - SHEATHING**

### **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. Wall sheathing.
  - 2. Underlayment.
  - 3. Sheathing joint and penetration treatment.
  - 4. Accessories necessary for a complete installation.
- B. Related Sections:
  - 1. Section 05 40 00 - Cold Formed Metal Framing.
  - 2. Section 07 26 27 - Fluid Applied Air Barrier.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- C. ASTM C209 - Standard Test Methods for Cellulosic Fiber Insulating Board; 2020.
- D. ASTM C834 - Standard Specification for Latex Sealants; 2017.
- E. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2020.
- F. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- G. ASTM D1037 - Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials; 2012 (Reapproved 2020).
- H. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010 (Reapproved 2017).
- I. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.
- J. ASTM D5516 - Standard Test Method for Evaluating the Flexural Properties of Fire-Retardant Treated Softwood Plywood Exposed to Elevated Temperatures; 2018.
- K. ASTM D6305 - Standard Practice for Calculating Bending Strength Design Adjustment Factors for Fire-Retardant-Treated Plywood Roof Sheathing; 2021.
- L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- M. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- N. ASTM F1667/F1667M - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples; 2021a.
- O. AWPA U1 - Use Category System: User Specification for Treated Wood; 2024.

#### **1.4 SUBMITTALS**

- A. Product Data:
  - 1. Technical data for each type of process and factory fabricated product. Indicate component materials and dimensions and include construction and application details:

- a. Include data for wood preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
- b. Include data for fire retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
- c. For fire retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5516.
- d. For products receiving a waterborne treatment, include statement that moisture content of treated materials reduced to levels specified before shipment to Project site.
- e. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

## **1.5 QUALITY ASSURANCE**

- A. Fire Test Response Characteristics:
  1. For assemblies with fire resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction:
    - a. Fire resistance ratings: Indicated by design designations from UL Fire Resistance Directory or GA-600 Fire Resistance Design Manual.
- B. Testing Agency Qualifications: For testing agency providing classification marking for fire retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

## **1.6 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 MATERIALS**

- A. Plywood: DOC PS 1.
- B. Oriented Strand Board: DOC PS 2.
- C. Thickness: As necessary to comply with requirements specified, but not less than thickness indicated.
- D. Factory mark panels to indicate compliance with applicable standard.

### **2.2 PRESERVATIVE TREATED PLYWOOD**

- A. Preservative Treatment by Pressure Process - AWWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground:
  1. Preservative chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

### **2.3 FIRE RETARDANT TREATED PLYWOOD**

- A. Where fire retardant treated materials are indicated, use materials complying with requirements acceptable to authorities having jurisdiction and with fire test response characteristics specified

determined by testing identical products per test method indicated by a qualified testing agency.

- B. Fire Retardant Treated Plywood by Pressure Process:
  - 1. Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test:
    - a. Use treatment that does not promote corrosion of metal fasteners.
    - b. Exterior type: Treated materials shall comply with requirements specified above for fire retardant treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
    - c. Design value adjustment factors: Treated lumber plywood shall be tested according to ASTM D5516 and design value adjustment factors shall be calculated according to ASTM D6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high temperature fire retardant treatment is indicated, span ratings for temperatures up to 170 degrees F (76 degrees C) shall be not less than span ratings specified.
  - C. Kiln dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
  - D. Identify fire retardant treated plywood with appropriate classification marking of qualified testing agency.
  - E. Application:
    - 1. Treat plywood indicated on Drawings and the following:
      - a. Roof and wall sheathing within 48 inches (1,220 mm) of fire walls.
      - b. Subflooring and underlayment for raised platforms.

## 2.4 WALL SHEATHING

- A. Glass Mat Gypsum Wall Sheathing - ASTM C1177/C1177M:
  - 1. Subject to compliance with requirements; provide products by one of the following:
    - a. CertainTeed Corporation: GlasRoc (basis of design).
    - b. Georgia Pacific: Dens-Glass.
    - c. National Gypsum Company: Gold Bond eXP.
    - d. United States Gypsum Co.: Securock.
  - 2. Type and Thickness: Regular, 1/2 inch (12.7 mm) thick.
  - 3. Size: Four feet by eight feet (1,220 mm by 2,440 mm) for vertical installation.

## 2.5 SUBFLOORING AND UNDERLAYMENT

- A. Plywood Combination Subfloor Underlayment: DOC PS 1, Exterior, Structural I, C-C Plugged Single Floor Panels:
  - 1. Span rating: Not less than 20 o.c.
  - 2. Nominal thickness: Not less than one inch (25 mm).
  - 3. Edge detail: Tongue and groove.
  - 4. Surface finish: Fully sanded face.
- B. Underlayment: Provide underlayment in nominal thickness not less than 1/4 inch (6.4 mm) over smooth subfloors and not less than 3/8 inch (9.5 mm) over board or uneven subfloors.
- C. Sound Deadening Board: Class C Fire Rated, Molded, Recycled Post-Consumer Paper, Cellulose Fiber Structural Panel:
  - 1. Density: 26 pcf to 28 pcf (416 = 448 kg/cu.m) tested in accordance with ASTM C209.
  - 2. Tensile strength when tested in accordance with ASTM C209:
    - a. Parallel: 450 to 700 psi (3,100 - 4,830 kPa).
    - b. Transverse: 750 to 1,000 psi (5.1171 - 6.894 kPa).
  - 3. Hardness (Janka Ball): 230 pounds (104 kg) tested in accordance with ASTM D1037.



4. Water absorption by volume, when tested in accordance with ASTM C209:
  - a. Two-hour immersion: Maximum seven percent (7%).
5. Expansion: 50 percent to 90 percent relative humidity, 0.25 percent in accordance with ASTM C209.
6. Noise reduction coefficient (NCR): 0.20.
7. Flame spread: Maximum 75 tested in accordance with ASTM E84 Class C.
8. Thickness: 3/4 inch (19 mm).

## **2.6 FASTENERS**

- A. Provide fasteners of size and type indicated that comply with requirements specified for material and manufacture. Provide fasteners with hot dip zinc coating complying with ASTM A153/A153M.
- B. Nails, Brads, and Staples: ASTM F1667/F1667M.
- C. Power Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening Gypsum Sheathing to Cold Formed Metal Framing:
  1. Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic polymer or corrosion protective coating having salt spray resistance of more than 800 hours according to ASTM B117:
    - a. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C1002.

## **2.7 SHEATHING JOINT AND PENETRATION TREATMENT MATERIALS**

- A. Sealant for Glass Mat Gypsum Sheathing:
  1. 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:
    - a. Sheathing tape: Self-adhering glass fiber tape, minimum two inches (50 mm) wide, ten by ten or ten by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass mat gypsum sheathing and with history of successful in-service use.

## **2.8 MISCELLANEOUS MATERIALS**

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- 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 (3) 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.
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall and roof sheathing installation with flashing and joint sealant installation so materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. 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. Fasten gypsum sheathing to cold formed metal framing with screws. Install boards with a 3/8 inch (9.5 mm) gap where non-load bearing construction abuts structural elements. Install boards with a 1/4 inch (6.4 mm) gap where they abut masonry or similar materials that 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:
  - 1. Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud:
    - a. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.
- D. Seal sheathing joints according to sheathing manufacturer's written instructions. Apply glass fiber sheathing tape to glass mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal penetrations and openings.

### **3.3 PATCHING**

- A. Refer to Section 07 27 26 - Fluid-Applied Air Barrier for criteria regarding repair of damaged sheathing in preparation for application of air barrier system.

**END OF SECTION 06 16 00**

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## **SECTION 06 20 00 - FINISH CARPENTRY**

### **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. Providing all finish carpentry items including, but not limited to:
    - a. Finish carpentry.
    - b. Millwork and cabinetry.
    - c. Plastic laminate.
    - d. Casework hardware.
    - e. Miscellaneous millwork.
  - 2. Installation of:
    - a. Finish hardware.
    - b. Plastic laminate faced wood doors.
- B. Related Sections:
  - 1. Section 06 10 00 - Rough Carpentry.
  - 2. Section 13 34 23.14 - Fabricated Classroom Buildings.

#### **1.3 REFERENCE STANDARDS**

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- C. BHMA A156.9 - Cabinet Hardware; 2020.

#### **1.4 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
  - 2. Manufacturer's preprinted product information for all hardware proposed on the Project.
  - 3. Manufacturer's preprinted maintenance instructions for the casework hardware.
- B. Shop Drawings:
  - 1. Indicate size, material, and finish.
  - 2. Show locations and installation procedures, including hardware, sinks, service fixtures, trim, and other pertinent data for each unit.
- C. Certification: Provide manufacturer's certification that casework has been fabricated and installed according to WI "Custom" Grade guidelines or better.
- D. Samples: Two (2) each, 6 inch by 6 inch by 3/4 inch sample of specified particleboard core with grade stamp for use as verification of installed product.
- E. Closeout:
  - 1. Record drawings: Indicate revisions to original Drawings and shop drawings.
  - 2. Manufacturer contact names, addresses, and phone numbers.
  - 3. Finish material schedule: Names and color numbers of laminates and stains.
  - 4. Keys: Provide additional master key for each room and additional locksets totaling one percent (1%) of total Project for attic stock.

#### **1.5 PERFORMANCE REQUIREMENTS**

- A. Unless otherwise indicated, perform work in accordance with WI "Architectural Woodwork Standards," Custom Grade, except where specification exceeds those standards the more stringent shall govern.

- B. Fabricate millwork and cabinetry in accordance with ANSI A161.1, NEMA LD3, and general static load testing performed and certified by an independent testing agency covering the following areas of product performance, with these minimum results:
  - 1. Base cabinet construction/racking test: 800 pounds.
  - 2. Cabinet front joint loading test: 425 pounds.
  - 3. Wall cabinet static load test: 2,000 pounds.
  - 4. Drawer front joint loading test: 600 pounds.
  - 5. Drawer construction/static load test: 750 pounds.
  - 6. Cabinet adjustable shelf support device/static load test: 300 pounds.
- C. Shelf Loading: Comply with loading/deflection standards of the Composite Panel Association.

## 1.6 QUALITY ASSURANCE

- A. Manufacturers and fabricators must be Woodwork Institute listed Accredited Millwork Companies, current roster.
- B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a licensee of WI's Certified Compliance Program.
- C. Installer Qualifications: Licensee of WI's Certified Compliance Program.
- D. Quality Standard:
  - 1. Unless otherwise indicated, comply with WI's "Manual of Millwork" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements:
    - a. Before delivery to jobsite, millwork supplier:
      - 1) Licensees of WI shall issue a certified compliance certificate indicating millwork products being furnished for this Project, and certifying that these products and their installation, will fully meet requirements of grade or grades specified.
      - 2) Non-licensees of WI shall provide evidence that they have arranged for inspection by WI inspector after completion of fabrication and installation. If conditions are found to be compliant, inspector will issue Compliance Certificate indicating millwork products being furnished for this Project and certifying that these products and their installation will fully meet requirements of grade or grades specified.
    - b. Each elevation of casework and each countertop shall bear certified compliance label.
    - c. Cabinet Design Series (CDS): CDS numbers on Drawings indicate typical designs.
- E. Certified Seismic Installation Program (CSIP):
  - 1. Before wood or metal stud walls are closed up, provide a written Woodwork Institute CSIP report confirming that acceptable backing is provided in all locations required for casework installation or identifying those locations where backing is missing or improperly located:
    - a. Backing shall consist of a minimum of either 3 x 6 flat Douglas Fir or 16 gauge 50 KSI sheet metal.
  - 2. On completion of installation, provide a Woodwork Institute CSIP Certificate identifying the work covered and certifying that installation meets the requirements of the WI CSIP attachment details and schedules.
  - 3. All fees charged by the Woodwork Institute for their CSIP are the responsibility of the millwork installer and shall be included in their bid.
- F. Pre-Installation Conference:
  - 1. Refer to Section 01 31 00 - Project Management and Coordination.

## 1.7 WARRANTY

- A. Warranty the work specified herein for five (5) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

- B. Defects shall include but not be limited to the following:
  - 1. Rough or difficult operation, or loose or missing parts.
  - 2. Delamination of surfaces.
  - 3. Noticeable deterioration of finish.
  - 4. Warped or misaligned surfaces or telegraphing of subsurface imperfections.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver completed laminate clad casework, countertops, and related products only after wet operations in building are completed. Store in ventilated place, protected from the weather, with relative humidity range of 20 to 50 percent.
- B. Protect finished surfaces from soiling and damage during handling and installation with a protective covering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

### 2.2 MILLWORK MATERIALS

- A. Plastic Laminate:
  - 1. Manufacturers:
    - a. Abet Laminati: [abetlaminati.com/#sle](http://abetlaminati.com/#sle).
    - b. Formica: [www.formica.com/#sle](http://www.formica.com/#sle).
    - c. Panolam: [panolam.com/hpl-high-pressure-laminate/#sle](http://panolam.com/hpl-high-pressure-laminate/#sle).
    - d. Wilsonart: [www.wilsonart.com/#sle](http://www.wilsonart.com/#sle).
  - 2. High-pressure decorative laminate complying with NEMA LD3, and the following requirements:
    - a. PL-1: Plastic Laminate Gray.
      - 1) Manufacturer: Formica.
      - 2) Color: 961-58 Fog.
      - 3) Finish: Matte.
      - 4) Location: As indicated on Drawings.
    - b. PL-2: Plastic Laminate \_\_\_\_\_.
      - 1) Manufacturer: Formica.
      - 2) Color: 8813-PA Tonal Paper.
      - 3) Finish: Paper.
      - 4) Location: As indicated on Drawings.
    - c. PL-3:
      - 1) Manufacturer: Formica.
      - 2) Color: As selected by the Architect from manufacturer's full line.
      - 3) Finish: As selected by the Architect from manufacturer's full line.
      - 4) Location: As indicated on Drawings.
    - d. If laminate has wood grain, direction of grain shall be vertical on door, end panels, fascia panels, and exposed backs; horizontal on drawer faces, aprons, and top rails.
  - 3. Laminate Grades:
    - a. Exposed doors, finished end panels, and other vertical surfaces: GP28 (0.028 inch thick nominal)
    - b. Horizontal surfaces other than top: GP28 (0.028 inch thick nominal)
    - c. Cabinet Liner: CL20 (0.020 inch nominal), white.

- d. Work surfaces and countertops: GP50 (0.050 inch thick nominal) with BK20 (0.20-inch thick) backer sheet.
- e. Backsplash: PH42 (0.042 inch nominal) with nominally balanced backer sheet.
- 4. Adhesive: PVA water resistant adhesive. Contact adhesives not permitted.
- 5. Pressure Fused Laminate:
  - a. NEMA LD3 VGL, and NEMA LD3 CLS, melamine resin impregnated, 120-gram PSM minimum, thermofused to core under pressure.
  - b. Color:
    - 1) Closed interiors, underside of wall cabinets: White.
    - 2) Exposed and semi-exposed open cabinets: Match exterior.
  - c. Provide balanced construction with same thermofused melamine. Unsurfaced coreboard or simple backers not allowed.
- B. Core Material:
  - 1. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
  - 2. Medium-density fiberboard: ANSI A208.2, Grade MD.
  - 3. Plywood: Shop sanded, exterior grade veneer cored, hardwood faced, any species, with no defects affecting strength or utility. Overlay plywood not permitted. Plywood allowed at countertops and toe-base only.
  - 4. Water resistant treated plywood shall have 24-hour thickness swell factor of five percent (5%) or less and 24 hour water absorption factor of ten percent (10%) or less; P.S. 51, Type II or better.
  - 5. Cabinet components shall be of the following minimum core thicknesses:
    - a. Cabinet Backs, Drawer Body, and Drawer Bottoms: 1/2 inch particleboard.
    - b. Door and Drawer Face, Base, Wall, and Tall Cabinet Tops and Bottoms, Cabinet Sides, Drawer Spreaders, Cabinet Back Rear Hangstrips, Structural Dividers, and Exposed Cabinet Backs: 3/4 inch particleboard.
    - c. Work Surfaces and Countertops: Minimum 1 inch particleboard or plywood. Use water resistant treated plywood core at counters with sinks.
    - d. Shelves: 3/4 inch particleboard core for 30 inches long or less, 1 inch thick particleboard core for more than 30 inches long; 14-inch deep, unless otherwise noted. Provide vertical dividers for shelves over 36 inches long.
    - e. Cabinet toe-base: 3/4 inch plywood. No particleboard within 3 inches of floor.
- C. Countertops:
  - 1. Refer to Section 12 36 00 - Countertops.
- D. Toe Spaces:
  - 1. Leave toe spaces unfinished for installation of resilient base, unless otherwise shown.
- E. End Panels and Filler Strips:
  - 1. Match adjacent case-piece.
- F. Edging:
  - 1. Provide the following in accordance with "Edging Locations:"
    - a. Plastic Laminate: Refer to Plastic Laminate in this Section.
  - 2. Edging Locations:
    - a. Cabinet body edge, including door/drawer front spacer rail:
      - 1) Plastic Laminate to match cabinet body face.
    - b. Forward edge of interior body components, interior dividers, shelf, and top edges of drawer body:
      - 1) Plastic Laminate to match cabinet body face.
    - c. Door/drawer-front edging:
      - 1) Plastic Laminate to match door/drawer face.
- G. Wood Door Framing:
  - 1. Basis of Design: Flametech manufactured by Navy Island, LLC.

2. Species: As selected by the Architect from manufacturer's full line.
3. Finish: As selected by the Architect from manufacturer's full line.

### 2.3 CABINET HARDWARE

- A. All hardware shall meet BHMA A156.9 and shall be subject to approval by the Architect. All keying shall match existing master key system and be approved by the School District:
1. Acceptable manufacturers:
    - a. Knappe & Vogt.
    - b. As specified herein, provide specified product, or Architect approved equal.
- B. Hinges:
1. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, self-closing.
    - a. Provide 170 degree minimum opening capabilities. For end doors perpendicular to walls, provide 90 degree type.
    - b. For doors 32 inches high or less, provide 2 pair of hinges, add 1/2 pair for every additional 20 inches.
    - c. Products: Subject to compliance with requirements, provide one of the following:
      - 1) No. 326.05 manufactured by Hafele North America Co.
      - 2) No. B71650 manufactured by Julius Blum, Inc.
      - 3) No. MD61-253-Z00 manufactured by Mepla-Alfit, Inc.
  2. One pair per door to 48 inches height. One and one-half pair over 48 inches in height. Hinge shall accommodate 13/16 thick laminated door and allow 270-degree swing.
  3. Finish: US26D.
- C. Pulls:
1. 4 Inch Wire:
    - a. Wire design, 4 inches long.
    - b. Finish: satin chrome, US26D finish.
- D. Sliding Door Hardware:
1. Frameless 1/4 inch glass sliding doors; double track rolling door assembly.
  2. Framed 13/16 inch thick stile and rail sliding doors; top mounted track with dual roller hangers. Vertical adjustment for accurate alignment.
- E. Drawer Slides:
1. Standard drawers: 3/4 extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 100-pound dynamic load rating at full extension.
  2. File drawers: Full extension, three-part progressive opening slide, precision steel ball bearing, minimum 100-pound dynamic load rating at full extension, zinc plated or epoxy coated at manufacturer's option.
  3. Provide body mounted molded rails for hanging file system for legal or letter size as indicated by manufacturer's model number. Cutting or machining of drawer body/face not permitted.
  4. Paper storage drawers: Full extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 150-pound dynamic load rating at full extension.
- F. Catches:
1. Provide opening resistance in compliance with the Americans with Disabilities Act:
    - a. Provide top-mounted magnetic catch for base and wall cabinet door.
    - b. Provide two (2) at each tall cabinet door. Catch housing shall be molded in White.
- G. Adjustable Shelf Supports:
1. Dual-pin design with anti-tip-up shelf restraints for both 3/4 inch and 1 inch shelves.
  2. Include keel to retard shelf slide-off, and slot for mechanical attachment of shelf to clip.
  3. Load rating shall be minimum 300 pounds each support without failure.
  4. Basis of Design: Products manufactured by Knappe and Vogt.



- a. Standard: Model 255 Steel.
- b. Supports: Model 256.
- H. Wardrobe Rod: 1-1/6 inch diameter plated steel rod, with captive sockets.
- I. Coat Hooks: Single and double prong, wall mount - satin aluminum.
- J. Locks: Five-disk tumbler cam-style with strike. Locks on cabinets in same room keyed alike. Provide two (2) keys per room where doors and drawers are scheduled to receive locks. Dull chrome finish. Lock core shall be removable with a control key, permitting Owner to change lock arrangements without tools.

## 2.4 SPECIALTY ITEMS

- A. Grommets:
  - 1. Approved Product/Manufacturer: Model No. EDP3 manufactured by Doug Mockett & Company, Inc. (basis of design), Manhattan Beach, CA; (800) 523-1269, or Architect approved equal.
  - 2. Size: 2-1/2 inches diameter with "Flip-Top"™ tab in cap.
  - 3. Colors: As selected by Architect from manufacturer's available colors.
  - 4. Number/location: Where electrical, telephone, and computer data wiring need to pass through tops whether shown or not.
- B. Keyboard Drawers (at all knee spaces):
  - 1. Approved product/manufacturer: No. SD-1 as manufactured by Knappe & Vogt; or Architect approved equal.
- C. Molded Personal Pencil Drawer: High-impact 100 Polystyrene with in-stop, out-stop, and self-closing features. Provide under top mounted 100-pound self-closing slides. Twelve (12) compartment drawer body, and slides, black. Provide where indicated on plans.
- D. Mailbox Label Holder: Brass, card size 1/2-inch by 2-3/16 inches. Provide one (1) at each opening.

## 2.5 MISCELLANEOUS

- A. Utility Shelving: WI "Economy" grade.
- B. Clothes Rod: 1-1/2 inch diameter smooth wooden dowel by length required, with end supports and fasteners of type recommended to suit application.
- C. Telephone/MDF/IDF Board: Provide minimum four foot by eight foot by 3/4 inch (4' x 8' x 3/4") thick plywood for telephone/data punch down blocks and video equipment in accordance with Section 06 10 00: Rough Carpentry. Paint in accordance with Section 09 90 00: Painting and Coating.
- D. Pegboard:
  - 1. Material: Tempered Hardboard.
  - 2. Thickness: 1/4 inch.
  - 3. Size: As indicated on Drawings.
  - 4. Accessories: Provide the following:

## 2.6 MILLWORK FABRICATION

- A. Use the WI Custom Grade woodwork classification unless noted elsewhere complying with referenced quality standard.
- B. Fabricate casework, countertops, and related products to dimensions, profiles, and details shown on Drawings. Fabricate casework square, plumb, and true.
- C. Detailed Requirements for Cabinet Construction:
  - 1. Toe-Base:
    - a. Continuous, ladder type platform with concealed fastening to cabinet bottom, level and secured to floor.

- b. Toe-base at exposed cabinet end panels shall be recessed 1/4 inch from face of finished end for flush installation of finished base material.
- c. No cabinet sides-to-floor will be allowed.
2. Cabinet Top and Bottom:
  - a. Solid sub-top shall be furnished for all base and tall cabinets.
  - b. At cabinets over 36 inches, bottoms and tops shall be mechanically joined by a fixed divider.
  - c. Assembly devices shall be concealed on bottom side of wall cabinets.
3. Cabinet Sides:
  - a. Doweled, and glued under pressure, or attached with fully concealed interlocking mechanical fasteners to sub-top and bottom.
  - b. Drill holes for adjustable shelves 1-1/4 inch on center.
4. Cabinet Backs:
  - a. Side bound, captured in grooves, recessed from cabinet rear, and securely fastened at top and bottom.
  - b. Hang rails shall be located at rear of cabinet back and fastened to cabinet sides. Provide minimum of two (2) at base, two (2) at wall, and three (3) at tall cabinets as instructed by casework manufacturer.
  - c. Provide removable back panels and closure panels for plumbing access at all sink cabinets, and where shown on Drawings.
5. Exposed end corner and face frame attachment:
  - a. Butt joint, glued and finish nailed; or attached with fully concealed interlocked mechanical fasteners.
6. Door and Drawer Fronts:
  - a. Drawer fronts and hinged doors shall overlay the cabinet body. Maintain a maximum 1/8 inch reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet.
  - b. Where indicated, provide stile and rail doors with full 1/4 inch plate glass, hinged or sliding. Exposed lite-opening edges shall be trimmed and glazed with extruded glazing bead.
  - c. Where indicated, frameless sliding glass doors shall be 1/4 inch thick plate glass with ground and polished edges. Fit with anodized aluminum shoes and nylon rollers.
- D. Drawers:
  1. Drawer fronts: Apply to separate drawer body component sub-front.
  2. Drawer sides: Doweled to receive front and back, glued under pressure, machine squared.
  3. Drawer bottom: Set into front and sides, 1/4 inch deep groove with minimum 3/8 inch standing shoulder, continuously glued. Reinforce drawer bottoms with 1/2 inch by 4 inch front-to-back intermediate underbody stiffeners, mechanically fastened. One (1) at 24 inches, two (2) at 36 inches, and over.
  4. Paper Storage Drawers: Fitted with full width hood at back.
  5. Hanging file drawers shall be fabricated to accept letter size hanging folders compatible with Pendaflex system.
- E. Vertical and Horizontal Dividers: As required by manufacturer for type and style of component.
- F. Door/Drawer Front Rail: As required by manufacturer for type and style of component, and hardware placement.
- G. Typical Desk or Counter Height at Knee Space Locations: 30 inches A.F.F.

### **PART 3 EXECUTION**

#### **3.1 JOB CONDITIONS**

- A. Environmental Requirements:
  1. Do not install casework until permanent HVAC systems are operating and temperature and humidity have been stabilized for at least one (1) week:

- a. Manufacturer/supplier shall advise Contractor of temperature and humidity requirements for architectural casework installation areas.
  - b. After installation, control temperature and humidity to maintain relative humidity between 25 and 55 percent.
- B. Conditions: Do not store or install casework in building until concrete, masonry, and drywall/plaster work is dry.

### **3.2 COORDINATION**

- A. Coordinate the work of this Section with plumbing work specified in Division 22. Coordinate sink opening construction with sinks specified in Division 22 or as indicated on Drawings.
- B. Coordinate location of blocking in walls for installation and support of wall cabinets.

### **3.3 MILLWORK INSTALLATION**

- A. Positioning: Place approximately level, plumb, and at right angles to adjacent work.
- B. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging the products and adjacent work.
- C. Anchorage: Attach securely so the products will perform to their maximum ability without damage from inadequate fastenings.
- D. Fasten tops to frames with concealed clips, screws, and glue.
- E. Install simulated wood trim in locations shown on Drawings and in accordance with manufacturer's instructions.

### **3.4 EXISTING DOOR LAMINATE RESURFACING**

- A. Resurfacing procedures shall be in accordance with the recommendations and instructions of the laminate and adhesive manufacturers.
- B. Acclimate laminate to the same environment as existing material at least 48 hours. Perform work in well-ventilated area, out of the way of construction dust and traffic to maintain clean adhesion.
- C. Clean the substrate with detergent or non-flammable solvent as instructed by laminate manufacturer to remove wax, grease, and polish deposits.
- D. Using a belt sander or sander instructed by manufacturer, sand entire surface to remove original finish. Remove sanding dust thoroughly.
- E. Coat the sanded surface and back of laminate with a uniform coating of contact adhesive. Allow to dry thoroughly prior to assembling. Assembling wet adhesive lines will trap solvent and may result in poor bonding. Follow the adhesive manufacturer's instructions.
- F. Index the laminate with the substrate. Make initial contact by smoothing with palms. Apply pressure using a "J" roller or rotary press. Allow to set as instructed by adhesive manufacturer to achieve full adhesion to maintain warranty. Trim with recommended tools.
- G. Apply laminate to door faces and exposed vertical edges. Apply edges before face. Paint top and bottom edges to color match facing.
- H. Coordinate hardware and vision lite cutouts with work of other Sections.

### **3.5 FINISH HARDWARE INSTALLATION**

- A. The supplier will mark each item of hardware for location. Protect the markings until each item is installed. If any item is delivered to the job not properly marked, return it to the supplier for marking before attempting to install it.
- B. Check markings on hardware for proper location. Install and make necessary adjustments for proper working order. Any hardware damaged by improper adjustment or careless abuse will be replaced by Contractor at his expense.
- C. Provide clean, properly sized, and accurately placed mortises and drilled holes for all mortise hardware such as locksets and for cylindrical locks where specified only.

- D. Fit all surface-applied hardware accurately.
- E. After hardware is installed, protect exposed surfaces by use of heavy paper and masking tape and maintain until job completion.
- F. Remove all finish hardware except that which is primed for painting before painter's finish is applied. Permanently replace and re-adjust for proper function after painter's finish has dried hard.
- G. Millwork Contractor shall be responsible for hardware on millwork.

**3.6 PLASTIC LAMINATE FACED WOOD DOOR INSTALLATION**

- A. Protect all doors during handling.
- B. Install doors in accordance with manufacturer's instructions.
- C. Install and adjust doors for smooth, quiet operation.
- D. Refer to Section 08 81 00 - Door Hardware where applicable.

**END OF SECTION 06 20 00**

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## **SECTION 06 83 16 - FIBERGLASS REINFORCED PANELING**

### **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. Glass fiber reinforced plastic paneling (FRP).
  - 2. Accessories necessary for a complete installation.
- B. Related Sections:
  - 1. Section 06 10 00 - Rough Carpentry.
  - 2. Section 07 92 00 - Joint Sealants.
  - 3. Section 09 21 16 - Gypsum Board Assemblies.

#### **1.3 REFERENCE STANDARDS**

- A. 9 CFR 416.2 - Regulatory Requirements Under the Federal Meat Inspection Act and the Poultry Products Inspection Act, Part 416-Sanitation; current edition.
- B. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2023, with Editorial Revision.
- C. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- D. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2022.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- F. FDA Food Code - Chapter 6 - Physical Facilities; Current Edition.
- G. FM 4880 - Examination Standard for Class 1 Fire Rating of Building Panels or Interior Finish Materials; 2022.
- H. ISO 846 - Plastics - Evaluation of the Action of Microorganisms; 2019.
- I. ISO 2812-1 - Paints and Varnishes -- Determination of Resistance to Liquids -- Part 1: Immersion in Liquids Other than Water; 2017.

#### **1.4 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Samples: Submit two samples 3 by 3 inches (75 by 75 mm) in size illustrating material and surface design of panels.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Refer to Section 01 60 00 - Product Requirements for additional requirements.
  - 2. Extra Panels: Quantity equal to \_\_\_ percent of total installed.

#### **1.5 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Building Code: Comply with applicable requirements of the Building Code for interior plastic materials and interior wall finishes.
  - 2. Surface Burning Characteristics:
    - a. Determined by testing identical products according to ASTM E84 by qualified testing agency. Identify products with appropriate markings of applicable testing agency:

- 1) Flame spread index: 25 or less.
- 2) Smoke developed index: 450 or less.

B. Source Limitations: Obtain FRP and trim accessories from single manufacturer.

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

A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
1. Fiberglass Reinforced Plastic Panels:
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

### **2.2 PANEL SYSTEMS**

- A. Wall:
1. Panel Size: 4 by 8 feet (1.2 by 2.4 m).
  2. Panel Thickness: 0.10 inch (2.5 mm).
  3. Surface Design: Embossed.
  4. Color: White.
  5. Attachment Method: Adhesive only, sealant joints, no trim.

### **2.3 MATERIALS**

- A. Panels:
1. Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
  2. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
  3. Class 1 fire rated when tested in accordance with FM 4880.
  4. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  5. Impact Strength: Greater than 6 ft lb force per inch (320 J per m), when tested in accordance with ASTM D256.
  6. Sanitation and Cleanability: Comply with 9 CFR 416.2.
  7. Surface Characteristics and Cleanability: Provide products that are smooth, durable, and easily cleanable, in compliance with FDA Food Code, Chapter 6 - Physical Facilities.
  8. Chemical Cleanability: Excellent chemical resistance to common cleaners and detergents when tested in accordance with ISO 2812-1.
  9. Biological Resistance: Rating of 0, when tested in accordance with ISO 846.
  10. Surface Protection: \_\_\_\_\_.
- B. Fasteners: Nylon rivets.
- C. Adhesive: Type recommended by panel manufacturer.
- D. Sealant: Type recommended by panel manufacturer; white.

## **PART 3 EXECUTION**

### **3.1 PROJECT CONDITIONS**

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

### **3.2 EXAMINATION**

- A. Verify existing conditions and substrate flatness before starting work.
- B. Verify that substrate conditions are ready to receive the work of this section.
- C. Verify that layout of hangers will not interfere with other work; make adjustments in layout as necessary.
- D. Do not begin ceiling installation until services above ceiling are complete except for final trim

### **3.3 PREPARATION**

- A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.
- B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels so that trimmed panels at corners are not less than 12 inches (300 mm) wide:
  - 1. Mark plumb lines on substrate at trim accessory panel joint locations for accurate installation.
  - 2. Locate trim accessories panel joints to allow clearance at panel edges according to manufacturer's written instructions.

### **3.4 INSTALLATION - WALLS**

- A. Install panels in accordance with manufacturer's instructions.
- B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.
- C. Pre-drill fastener holes in panels, 1/8 inch (3.2 mm) greater in diameter than fastener, spaced as indicated by panel manufacturer.
- D. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.
- E. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.
- F. Install panels with manufacturer's recommended gap for panel field and corner joints.
- G. Drive fasteners to provide snug fit, and do not over-tighten.
- H. Place trim on panel before fastening edges, as required.
- I. Fill channels in trim with sealant before attaching to panel.
- J. Install trim with adhesive and screws or nails, as required.
- K. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.
- L. Remove excess sealant after paneling is installed and prior to curing.

**END OF SECTION 06 83 16**



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## **SECTION 07 16 00 - BELOW GRADE WATERPROOFING**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Preparation of concrete surfaces to receive waterproofing membrane.
- B. Sealing of cracks and joints.
- C. Fluid applied waterproofing system, with prefabricated drainage composite or protection board at walls that fall below grade (auditorium, basement, elevator pit, etc.).
- D. Pre-applied waterproofing system, with joint sealing tape, and other accessories at below grade horizontal surfaces under the slab or elevator pit.

#### **1.2 RELATED SECTIONS**

- A. Section 03 30 00 - Cast-In-Place Concrete
- B. Section 07 92 00 - Building Sealants
- C. Division 23 - Mechanical: Mechanical penetrations, such as floor drains and piping, through waterproofing membrane.
- D. Division 26 - Electrical: Electrical penetrations, such as conduit, through waterproofing membrane.

#### **1.3 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
  - 2. Manufacturer's installation instructions.
- B. Certifications:
  - 1. Manufacturer's certification that applicator is approved by Manufacturer.
  - 2. Manufacturer's affidavit that materials used in Project contain no asbestos.
- C. Warranty: Submit a sample warranty identifying the terms and conditions stated in warranty.

#### **1.4 QUALITY ASSURANCE**

- A. Applicator Qualifications: Applicator shall be experienced in applying the same or similar materials and shall be specifically approved in writing by the membrane system Manufacturer.
- B. Regulatory Requirements: Comply with applicable codes, regulations, ordinances, and laws regarding use and application of products that contain volatile organic compounds (VOC).

### **PRE-INSTALLATION CONFERENCE**

- 1.5 A. Refer to Section 01 31 13 – Project Coordination

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials job site in original, factory-sealed, unopened containers bearing Manufacturer's name and label intact and legible with following information.
1. Name of material.
  2. Manufacturer's stock number and date of manufacture.
  3. Material safety data sheet (MSDS).
- B. Store and handle in strict compliance with Manufacturer's instructions, recommendations, and material safety data sheet (MSDS).
- C. Protect from damage from sunlight, weather, excessive temperatures, and construction operations.
- D. Remove damaged material from the site and dispose of in accordance with applicable regulations.
- E. Do not double-stack pallets of waterproofing on the job site. Provide cover on top and all sides.
- F. Store drainage composite and protection board flat and off the ground. Provide cover on top and all sides.
- G. Protect waterproofing materials from freezing. In cool temperatures, store the material for several hours at room temperature to facilitate mixing and application.
- H. Sequence deliveries of materials to avoid delays but minimize on-site storage.

**1.7 PROJECT CONDITIONS**

- A. Perform work only when existing and forecasted weather conditions are within the limits established by the Manufacturer of the materials and products used.
- B. Proceed with installation only when substrate construction and preparation work is complete and in condition to receive membrane waterproofing.
- C. Coordinate waterproofing work with other trades to ensure adequate illumination, ventilation, and dust-free environment during application and curing of membrane. The applicator shall have sole right of access to the specified areas for the time needed to complete the application and allow the membrane to cure adequately.
- D. Protect adjoining surfaces not to be coated against damage or soiling. Protect plants, vegetation and animals which might be affected by waterproofing operations.
- E. Warn personnel against breathing of vapors and contact of material with skin or eyes. Wear applicable protective clothing and respiratory protection gear.
- F. Keep products away from spark or flame. Do not allow the use of spark producing equipment during application and until all vapors have dissipated. Post "NO SMOKING" signs.

- G. Maintain work area in a neat and orderly condition, removing empty containers, rags, and rubbish daily from the site.

**1.8 WARRANTY**

- A. Warrant the work specified herein for ten (10) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.

**PART 2 - PRODUCTS**

**2.1 FLUID APPLIED WATERPROOFING SYSTEM - POST APPLIED**

- A. Specifications are based on named Manufacturer's products and systems listed below. Other Manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
  - 1. AVM Industries, Inc. Canoga Park, CA (AVM Aussie Membrane 500)
  - 2. Carlisle Coatings and Waterproofing Incorporated, Wylie, TX (Barricoat)
  - 3. GCP Applied Technologies, Cambridge, MA (Procor)
  - 4. W. R. Meadows, Inc., Hampshire, IL (Mel-Rol LM)
- B. Fluid Applied Waterproofing Membrane: Water-based rubber and / or bitumen liquid / fluid applied waterproofing membrane modified with high performance rubberized polymers and special additives for use in vertical seamless applications.

Waterproofing Membrane Physical Properties, minimum:

<b>Property</b>	<b>Test Method</b>	<b>Typical Value</b>
Cured / Dry Film Thickness	ASTM D3767	60 mils
Solids Content	---	62%
Low Temp Flexibility	ASTM C836	Pass
Elongation	ASTM D412	500%
Pliability	ASTM D1970	Unaffected
Resistance to Standing Water	ASTM D2939	Pass

- C. Accessory Products:
  - 1. Protection Coarse: Prefabricated drainage composite material designed to promote positive drainage while serving as a protection course. Provide product consisting of an impermeable polymeric sheet cusped under heat and pressure to form a high flow dimpled drainage core with a bonded layer of nonwoven filter fabric.
- D. Locations: Vertical below-grade structural concrete foundation walls opposite conditioned and habitable areas that fall below grade 0'-0" and where shown on drawings.

**2.2 SHEET APPLIED WATERPROOFING SYSTEM - POST APPLIED**

- A. Specifications are based on named Manufacturer's products and systems listed below. Other Manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
  - 1. Carlisle Coatings and Waterproofing Incorporated, Wylie, TX (MiraDRI 860/861)
  - 2. W. R. Meadows, Inc., Hampshire, IL (Mel-Rol)
- B. Sheet Applied Waterproofing Membrane: Self-adhering sheet membrane consisting of rubberized asphalt laminated to a polyethylene film.

Waterproofing Membrane Physical Properties, minimum:

<u>Property</u>	<u>Test Method</u>	<u>Typical Value</u>
Thickness	ASTM D3767	60 mils
Low Temp Flexibility	ASTM D1970	Pass
Elongation	ASTM D412	350%
Puncture Resistance	ASTM E154	50 lbf
Hydrostatic Head	ASTM D5385	230 ft

- C. Accessory Products:
  - 1. Primer: Manufacturer's recommended spray or roller applied water-based adhesive.
  - 2. Detail Sealant: Manufacturer's recommended sealant material for use at penetrations, cut edges, top edge terminations, transitions, etc. and adhesion for the protection course.
  - 3. Detail Strip: Manufacturer's recommended waterproofing membrane material.
  - 4. Protection Coarse: Prefabricated drainage composite material designed to promote positive drainage while serving as a protection course. Provide product consisting of an impermeable polymeric sheet cusped under heat and pressure to form a high flow dimpled drainage core with a bonded layer of nonwoven filter fabric.
  - 5. Termination Bar: High strength, pre-formed, multi-purpose plastic strip with holes 6" o.c.
- D. Locations: Vertical and horizontal below-grade structural concrete foundation walls opposite conditioned and habitable areas that fall below grade 0'-0" and where shown on drawings.

**2.3 SHEET APPLIED WATERPROOFING SYSTEM - PRE-APPLIED**

- A. Specifications are based on named Manufacturer's products and systems listed below. Other Manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
  - 1. AVM Industries, Inc. Canoga Park, CA (AVM Aussie Skin 550G)
  - 2. GCP Applied Technologies, Cambridge, MA (Preprufe 200)
- B. Sheet Waterproofing Membrane: Composite sheet comprising a heavy duty, puncture resistant, HDPE film, an aggressive pressure sensitive adhesive and a weather resistant protective coating. Membrane provides a continuous seal that resists water ingress and migration between the membrane and the structure.
- C. Accessory Products:

1. Pressure Sensitive Tape: Two-sided, reinforced, pressure sensitive tape constructed with an extremely aggressive adhesive. Material to form a continuous and integral seal to the structure (GCP Prefrufe CJ Tape).
  2. Detail Sealant: Manufacturer's approved sealant intended for use sealing around penetrations.
- D. Locations: Vertical below-grade structural concrete foundation walls opposite conditioned and habitable areas as well as horizontal surfaces below the slab that fall below grade 0'-0" and where shown on drawings.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Before waterproofing work is started all surfaces to be waterproofed shall be thoroughly examined for all deficiencies. Should deficiencies exist, the Architect shall be notified in writing and corrections made.

#### **3.2 SURFACE PREPARATION**

- A. Surfaces to which waterproofing is to be applied shall be thoroughly clean, dry, and free from all surfaces contaminates or cleaning residue that may harmfully affect the adhesion of the membrane.
- B. Repair all cracks in accordance with Manufacturer's instructions.

#### **3.3 APPLICATION**

- A. Priming: Shall be in accordance with membrane Manufacturer's instructions.
- B. Apply waterproofing in accordance with membrane Manufacturer's instructions.
- C. Liquid membrane waterproofing on vertical walls shall positively overlap turned up sheet membrane waterproofing from under slab as instructed by the Manufacturer.
- D. Where shown or required, install specified perimeter drainage system as the first course of drainage composite immediately after membrane has cured on vertical surfaces. Install Manufacturer's recommended drainage composite or protection board / protection course on remainder.

**END OF SECTION 07 16 00**

## **SECTION 07 21 00 - THERMAL 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: Requirements including but not limited to:
  - 1. Glass mineral fiber blanket.
  - 2. Accessories necessary for a complete installation.
- B. Related Sections:
  - 1. Section 05 40 00 - Cold Formed Metal Framing: Exterior framing.
  - 2. Section 06 10 00 - Rough Carpentry.
  - 3. Section 07 27 26 - Fluid-Applied Membrane Air Barriers: Vapor retarders.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- C. ASTM C764 - Standard Specification for Mineral Fiber Loose-Fill Thermal Insulation; 2019.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- E. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- F. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024.
- G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

#### **1.4 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Technical data and installation instructions for each type of insulation product specified.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions.

#### **1.5 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Fire Performance Characteristics: Identify products with appropriate markings of applicable testing and inspecting organization
    - a. Surface Burning Characteristics: Per ASTM E84.
      - 1) Flame Spread Index: Maximum 25.
      - 2) Smoke Developed Index: Maximum 450.
    - b. Fire Resistance Ratings: Per ASTM E119.
    - c. Combustion Characteristics: Non-combustable per ASTM E136.
  - 2. Underwriter's Laboratories UL 723 Tests for Surface Burning Characteristics of Building Materials.
- B. Single Source Responsibility for Insulation Products: Obtain each type of building insulation from single source with resources to provide products of consistent quality in appearance and

physical properties without delaying progress of work.

1. Mark insulation boards and packages with manufacturer's name and product designation. Unmarked boards and packages will be rejected.

C. Environmental Requirements:

1. Manufacture extruded polystyrene with HCFC or other CFC free blowing agents.
2. Insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or polybrominated diphenyl ether fire retardants.
3. Wherever possible, provide boards from manufacturers who recycle insulation materials.

## 1.6 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:
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.

## 1.7 PROJECT CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.
- B. Sequence work to ensure fireproofing and firestop materials are in place before beginning work.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
1. CertainTeed Corporation: [www.certainteed.com/building-insulation](http://www.certainteed.com/building-insulation).
  2. Johns Manville; a Berkshire Hathaway company
  3. Knauf Insulation: [www.knaufinsulation.com](http://www.knaufinsulation.com).
  4. Owens Corning: [www.owenscorning.com/en-us/insulation/commercial](http://www.owenscorning.com/en-us/insulation/commercial).
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

### 2.2 GLASS MINERAL FIBER INSULATION

- A. Glass Mineral Fiber Batt, Unfaced: ASTM C665, Type I (unfaced); with maximum flame spread and smoke developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.
1. Subject to compliance with the requirements of this Section, provide one of the following:
    - a. CertaPro manufactured by CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. EcoBatt with ECOSE manufactured by Knauf Insulation.
    - d. PINK Next Gen Fiberglas manufactured by Owens Corning.

### 2.3 INSULATION FASTENERS

- A. Adhesively Attached, Spindle Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
1. Plate: Perforated, galvanized carbon steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.



2. Spindle: Copper coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- B. Adhesively Attached, Angle Shaped, Spindle Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
  1. Angle: Formed from 0.030 inch (0.762 mm) thick, perforated, galvanized carbon steel sheet with each leg 2 inches (50 mm) square.
  2. Spindle: Copper coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- C. Insulation Retaining Washers: Self-locking washers formed from 0.016 inch (0.41 mm) thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
  1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
    - a. Crawl spaces.
    - b. Ceiling plenums.
    - c. Attic spaces.
- D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

## **2.4 ACCESSORIES**

- A. Insulation for Miscellaneous Voids:
  1. Glass Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame spread and smoke developed indexes of 5, per ASTM E84.
- B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

## **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**

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Board and Batt Insulation: Install insulation that is undamaged, dry, and unsoiled and has not been exposed to ice, rain, or snow at any time.
  1. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Do not seal joints in board insulation. Remove projections that interfere with placement.
  2. 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.
- C. Framed Construction, Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
  1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
  2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  3. Maintain 3 inch (76 mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
6. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
  - a. Glass Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
  - b. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

### **3.3 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 07 21 00**

## **SECTION 07 27 26 - FLUID APPLIED AIR BARRIER SYSTEM**

### **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 SECTION INCLUDES**

- A. Fluid-applied air barrier membrane in exterior wall assemblies.
- B. Materials to bridge and seal the following air leakage pathways and gaps:
  - 1. Connections of the walls to the roof air barrier.
  - 2. Connections of the walls to the foundation air barrier.
  - 3. Seismic and expansion joints.
  - 4. Openings and penetrations of window frames, storefront, curtain wall and mechanical, electrical and plumbing systems.
  - 5. Barrier precast concrete and other envelope systems.
  - 6. Door frames.
  - 7. Piping, conduit, duct and similar penetrations.
  - 8. Masonry ties, screws, bolts and similar penetrations.
  - 9. All other air leakage pathways in the building envelope.
- C. Related Work in other Sections includes but is not limited to the following:
  - 1. Section 01 45 00 – Quality Control
  - 2. Section 01 50 00 – Temporary Facilities and Controls
  - 3. Section 03 30 00 – Cast-In-Place Concrete
  - 4. Section 04 20 00 – Unit Masonry
  - 5. Section 07 41 13 – Prefinished Metal Roofing
  - 6. Section 07 54 23 – Fully Adhered Thermoplastic Membrane Roofing System
  - 7. Section 07 65 00 – Flexible Flashing
  - 8. Section 07 90 00 – Joint Sealants
  - 9. Section 09 21 16 – Gypsum Wallboard Systems (Exterior Sheathing)

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Material Performance: Provide air barrier materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.004 cfm / ft<sup>2</sup> @ 1.57 psf), when tested in accordance with ASTM E2178 (unmodified).
- B. Provide materials with a water vapor permeance of 10.0 US perms or greater, determined in accordance with ASTM E96 Water method (Procedure B).
- C. Assembly Performance: Provide a continuous air barrier in the form of an assembly that has an air leakage not to exceed 0.04 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.04 cfm/ft<sup>2</sup> @ 1.57 psf) when tested in accordance with ASTM E2357. The assembly shall accommodate movements of building materials by providing expansion and control joints as required. Expansion / control joints, changes in substrate and perimeter conditions shall have appropriate accessory materials at such locations.

1. The air barrier assembly shall be capable of withstanding combined design wind, fan and stack pressures, both positive and negative on the envelope without damage or displacement, and shall transfer the load to the structure.
  2. Fluid applied air barriers shall not displace adjacent materials in the air barrier assembly under full load.
  3. The air barrier assembly shall be joined in an airtight and flexible manner to the air barrier materials of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations, creep, and anticipated seismic movement.
- D. Connections to Adjacent Materials: Provide connections to prevent air leakage at the following locations:
1. Foundation and walls, including penetrations, ties and anchors.
  2. Walls, windows, curtain walls, storefronts, louvers or doors.
  3. Different wall assemblies, and fixed openings within those assemblies.
  4. Wall and roof connections.
  5. Floors over unconditioned space.
  6. Walls, floor and roof across construction, control and expansion joints.
  7. Walls, floors and roof to utility, pipe and duct penetrations.
  8. Seismic and expansion joints.
  9. All other potential air leakage pathways in the building envelope.

#### **1.4 PRE-INSTALLATION CONFERENCE**

- A. Refer to Section 01 31 13 – Project Coordination

#### **1.5 SUBMITTALS**

- A. Submittals: Submit in accordance with Division 1 requirements.
- B. Installer Qualifications: Submit evidence of current Contractor accreditation and Installer certification under the Air Barrier Association of America's (ABAA). Submit accreditation number of the Contractor and certification number(s) of the ABAA Certified Installer(s).
- C. Product Data: Submit material Manufacturer's Product Data, material Manufacturer's instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, Technical Data, and tested physical and performance properties.
1. Submit letter from primary air barrier material Manufacturer indicating approval of materials that are proposed to be used that are not currently listed in the accessories section of this specification for that Manufacturer's material.
  2. Include statement from the primary air barrier material Manufacturer that the materials used in their air barrier assembly which will be used to adhere to the underlying substrate are chemically compatible to the substrate material.
- D. Samples: Submit clearly labeled samples, three (3) inch by four (4) inch minimum size of each material specified.
- E. Field Test Results of Mock-Up: Submit test results of air leakage test and water leakage test of mock-up in accordance with specified standards, including retesting if initial results are not satisfactory.

- F. Compatibility: Submit letter from primary material Manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use.

## 1.6 QUALITY ASSURANCE

- A. Air Barrier Installer Qualifications: Air barrier Subcontractor(s) shall be accredited at the time of bidding and during the complete installation period by the Air Barrier Association of America (ABAA).
  - 1. Fluid-applied membrane air barrier Installer(s) shall be certified in accordance with the requirements outlined by ABAA. Installers shall have their photo identification air barrier certification cards in their possession and available on the project site, for inspection upon request.
- B. Manufacturer: Obtain primary ABAA Evaluated Materials from a single ABAA Evaluated Manufacturer regularly engaged in manufacturing specified fluid-applied membranes. Obtain secondary materials from a source acceptable to the primary materials Manufacturer.
- C. Accredited Laboratory Testing for Materials: Laboratory accredited by International Accreditation Service Inc. (IAS), American Association for Laboratory Accreditation (A2LA), or the Standards Council of Canada (SCC).
- D. VOC Regulations: Provide products which comply with applicable regulations controlling the use of volatile organic compounds.
- E. Preconstruction Meeting: Convene a minimum of two weeks prior to commencing Work of this Section. Agenda shall include, at a minimum, construction and testing of mock-up, sequence of construction, coordination with substrate preparation, air barrier materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction and chemical/fire safety plans. Attendance is required by the Fluid Applied Air Barrier System Manufacturer's field representative, representatives of related trades including covering materials, substrate materials and adjacent materials.
- F. Mock-Ups: Build mock-up representative of primary air barrier assemblies and glazing assemblies including backup wall and typical penetrations as acceptable to the Architect. Mock-up shall be dimensioned no less than eight (8) feet long by eight (8) feet high and include the air barrier materials and air barrier accessories proposed for use in the exterior wall assembly. The mock-ups shall remain visible and intact for the duration of the fluid applied air barrier system work scopes. Mock-ups shall be suitable for field testing.
- G. Mock-Up Tests for Air and Water Infiltration: The General Contractor shall provide testing of the window and door opening(s) in the mock-up for air and water infiltration. The testing shall be in accordance with AAMA 501.2 (hand wand field testing). If deficiencies are found, the air barrier Contractor shall reconstruct mock-up at their cost for retesting until satisfactory results are obtained. Deficiencies include air leakage beyond values specified, uncontrolled water leakage, unsatisfactory workmanship.
- H. Air Barrier Assembly Testing: Verify air barrier assembly testing by the material Manufacturer by visiting the ABAA website to ensure an ASTM E2357 test has been completed and to obtain results. Visit the ABAA website for the reported air barrier assembly leakage rate and illustrations or CAD details which includes the methods in which the assembly test mock-ups shall be assembled.

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

- A. Deliver materials to Project site in original packages with seals unbroken, labeled with material Manufacturer's name, product, date of manufacture, and directions for storage.
- B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by material Manufacturer. Protect stored materials from direct sunlight and other sources of ultra-violet light.
- C. Handle materials in accordance with Manufacturer's recommendations.

## **1.8 PROJECT CONDITIONS**

- A. Temperature: Install fluid-applied air barrier material within range of ambient and substrate temperatures recommended by material Manufacturer. Do not apply air barrier to a damp or wet substrate.
- B. Field Conditions: Do not install air barrier in snow, rain, fog, or mist. Do not install air barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the Manufacturer.
- C. Sequencing: Do not install air barrier material before the roof assembly has been sufficiently installed to prevent a buildup of water in the interior of the building.
- D. Compatibility: Do not allow air barrier materials to come in contact with chemically incompatible materials.
- E. Ultra-violet exposure: Do not expose air barrier materials to sunlight longer than as recommended by the material Manufacturer.

## **1.9 WARRANTY**

- A. Material Warranty: Provide Manufacturer's standard product warranty, for a minimum 20 years from date of Substantial Completion.
- B. Subcontractor (approved by ABAA and Manufacturer) Installation Warranty: Provide a five (5) year installation warranty from date of Substantial Completion, including all accessories and materials of the air barrier assembly, against failures including loss of air tight seal, loss of watertight seal, loss of attachment, loss of adhesion and failure to cure properly.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Fluid Applied Membrane Air Barrier: Use regular, high temperature or low-temperature formulation depending on site conditions, within temperature ranges specified by Manufacturer. Subject to compliance with requirements, provide one of the following:

1. Carlisle Coatings and Waterproofing: Fire-Resist Barritech VP at 60 mils thick (wet). [www.carlisle-ccw.com](http://www.carlisle-ccw.com):
  - a. AIR BARRIER MATERIAL PROPERTIES:
    - 1) Air permeance for this material has been tested and reported as being 0.0002 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0002 cfm/ft<sup>2</sup> @ 1.57 psf), at 65 mils (wet), when tested in accordance with ASTM E2178 (unmodified).
    - 2) Water vapor permeance for this material has been tested and reported as being 817 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (817 ng/(Pa·s·m<sup>2</sup>) / 14.295 US perms) at 60 mils (wet) [40 mils (dry)] when tested in accordance with ASTM E96 (water method – unmodified).
  - b. AIR BARRIER ACCESSORY MATERIALS:
    - 1) Detail Flashing: Fire-Resist 705 FR.
    - 2) Counter-flashing for Metal Wall Flashings: Fire-Resist 705 FR.
    - 3) Water-Based Primer for Detail Flashing: CCW-702 WB.
    - 4) Solvent-Based Primer for Detail Flashing: CCW-702 or CCW-702 LV.
    - 5) Solvent-Based Aerosol Primer for Detail Flashing: CAV-GRIP.
    - 6) Reinforcing Fabric: DCH Reinforcing Fabric.
    - 7) Glass Mat: LiquiFiber-W.
    - 8) Termination Mastic: SURE-SEAL Lap Sealant.
    - 9) Fill Compound: CCW-201 or CCW-703 V.
2. Dow Corning: DefendAir 200 at 15 mils thick (dry). [www.buildabetterbarrier.com](http://www.buildabetterbarrier.com):
  - a. AIR BARRIER MATERIAL PROPERTIES:
    - 1) Air permeance for this material has been tested and reported as being 0.0010 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0010 cfm/ft<sup>2</sup> @ 1.57 psf), [0.0049 liters per square meter per second under a pressure differential of 75 Pa (0.0049 L/(s·m<sup>2</sup>) @ 75 Pa)] at 15 mils (dry), when tested in accordance with ASTM E2178 (unmodified).
    - 2) Water vapor permeance for this material has been tested and reported as being 1387.7 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1387.7 ng/(Pa·s·m<sup>2</sup>) [24.26 US perms] at 15 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
  - b. AIR BARRIER ACCESSORY MATERIALS:
    - 1) Solvent-Based Primer: Dow Corning® DefendAir Primer
    - 2) Sealants: Dow Corning® 791 Silicone Weatherseal Sealant, Dow Corning® 756 SMS Silicone Sealant, Dow Corning® 795 Silicone Building Sealant, Dow Corning® 758 Silicone Weather Barrier Sealant
    - 3) Transition Membrane for details and terminations: Dow Corning® 778, Dow Corning® Silicone Transition Strip
    - 4) Flashing at Transition Membrane: Dow Corning® Silicone Transition Strip
    - 5) Counterflashing for Through-Wall Flashings: Dow Corning® Silicone Transition Strip

- 6) Through-Wall Flashings or Shelf Angle Flashings: Dow Corning® 778 below the flexible through wall flashing system.
  - 7) Substrate Joint Treatment: Dow Corning® 791 Silicone Weatherseal Sealant
3. Grace Construction Products: Perm-A-Barrier VP, 90 mils thick (wet), 45 mils thick (dry). [www.na.graceconstruction.com](http://www.na.graceconstruction.com):
- a. AIR BARRIER MATERIAL PROPERTIES:
    - 1) Air permeance for this material has been tested and reported as being 0.0004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0004 cfm/ft<sup>2</sup> @ 1.57 psf), at 69 mils (wet), when tested in accordance with ASTM E2178 (unmodified).  
Water vapor permeance for this material has been tested and reported as being 741.6 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (741.6 ng/(Pa·s·m<sup>2</sup>) / 12.9 US perms) at 40 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
  - b. AIR BARRIER ACCESSORY MATERIALS:
    - 1) Membrane for details and Terminations: Bituthene Liquid Membrane.
    - 2) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Perm-A-Barrier WB Primer or Perm-A-Barrier Primer Plus.
    - 3) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: Bituthene Primer B-2 and Bituthene Primer B2 LVC or Bituthene Primer B2.
    - 4) Through-Wall Flashings or Shelf Angle Flashings: Perm-A-Barrier Wall Flashing below the flexible through wall flashing system.
    - 5) Sealants, Mastics, Adhesives and Tapes: As recommended by Grace Construction Products.
    - 6) Transition Membrane: Perm-A-Barrier Detail Membrane, Perm-A-Barrier Aluminum Flashing and Perm-A-Barrier Wall Flashing.
    - 7) Penetrations and Termination Sealant: Bituthene Liquid Membrane and as recommended by Grace Construction Products.
    - 8) Window Flashing and Detail Membrane: Perm-A-Barrier Detail Membrane, Perm-A-Barrier Aluminum Flashing and Perm-A-Barrier Wall Flashing.
    - 9) Joint Sealant: Refer to Technical Letter 1 for details on compatible waterproofing sealants.
4. Sika Corporation: Sikagard 530 Liquid Applied Vapor Permeable Air Barrier at 30 mils (dry). [www.sika.com](http://www.sika.com):
- a. AIR BARRIER MATERIAL PROPERTIES:
    - 1) Air permeance for this material has been tested and reported as being < 0.0001 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (< 0.0001 cfm/ft<sup>2</sup> @ 1.57 psf), at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
    - 2) Water vapor permeance for this material has been tested and reported as being 661 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (661 ng/(Pa·s·m<sup>2</sup>) / 11.5



US perms) at 22 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

- 1) Water-Based Primer: Sikagard 530.
- 2) Solvent-Based Primer: Sikagard 510.
- 3) Termination Mastic: Sikaflex 11FC.
- 4) Sealants: Sikaflex 11FC.
- 5) Transition Membrane for details and terminations: SikaMultiSeal 515.
- 6) Reinforcing/Joint Tape: SikaMultiSeal 515.
- 7) Counterflashing for Through-Wall Flashings: SikaMultiSeal Plus with Flexible Flashing.
- 8) Through-Wall Flashings or Shelf Angle Flashings: SikaMultiSeal Plus below the flexible through wall flashing system.
- 9) Substrate Joint Treatment: Sikaflex 11FC.

5. Soproma: Sopraseal LM 202 VP at 10 mils (wet) [www.soprema.us](http://www.soprema.us)

a. AIR BARRIER MATERIAL PROPERTIES:

- 1) Air permeance for this material has been tested and reported as being 0.00004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00004 cfm/ft<sup>2</sup> @ 1.57 psf), [0.0002 liters per square meter per second under a pressure differential of 75 Pa (0.0002 L/(s·m<sup>2</sup>) @ 75 Pa)] at 10 mils (wet) when tested in accordance with ASTM E 2178 (unmodified).
- 2) Water vapor permeance for this material has been tested and reported as being 1004 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1004 ng/(Pa·s·m<sup>2</sup>) [17.6 US perms] at 10 mils (wet) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

- 1) Water Based Primer: Soprema Elastocol Stick H20 Primer
- 2) Solvent-Based Primer: Soprema Sopraseal Stick primer
- 3) Sealants: Soprema Sopraseal sealant
- 4) Transition Membrane for details and terminations: Soprema Sopraseal Stick 1100T or Soprema Soprsolin HD
- 5) Substrate Joint Treatment: Soprema Sopraseal Mesh

6. W.R. Meadows, Inc.: Air-Shield LMP, at 60 mils (wet), 30 mils (dry). [www.wrmeadows.com](http://www.wrmeadows.com):

a. AIR BARRIER MATERIAL PROPERTIES:

- 1) Air permeance for this material has been tested and reported as being 0.000096 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.000096 cfm/ft<sup>2</sup> @ 1.57 psf), [0.00048 liters per square meter per second under a pressure differential of 75 Pa (0.00048 L/(s·m<sup>2</sup>) @ 75 Pa)] at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).

- 2) Water vapor permeance for this material has been tested and reported as being 598 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (598 ng/(Pa·s·m<sup>2</sup>) [10.47 US perms] at 30 mils (dry) when tested in accordance with ASTM E 96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

- 1) Water-Based Primer: None required for Air Shield LMP.
- 2) Solvent-Based Primer: None required for Air Shield LMP.
- 3) Solvent-Based Aerosol Primer: None required for Air Shield LMP.
- 4) Termination Mastic: Pointing Mastic or BEM.
- 5) Transition Membrane for details and terminations: Air Shield.
- 6) Reinforcing / Joint Tape: Reinforcing Fabric HCR.
- 7) Flashing at Transition Membrane: Air Shield Thru-Wall Flashing.
- 8) Counter-flashing for Through-Wall Flashings: Air Shield Thru-Wall Flashing.
- 9) Through-Wall Flashings or Shelf Angle Flashings: Air Shield Thru-Wall Flashing below the flexible through wall flashing system.
- 10) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: Mel-Prime VOC.
- 11) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Mel-Prime WB.
- 12) Substrate Joint Treatment: Air Shield Joint Filler.

## 2.2 AUXILIARY MATERIALS

- A. Transition Membrane Between Air and Vapor Barrier Membrane and Roofing and Other Adjacent Materials: Comply with both air barrier Manufacturer's recommendations and roofing material Manufacturer's recommendations.
- B. Provide primers, glass fabric scrim tape, mastic, and other materials not specifically described, but required for a complete and proper installation as instructed by the air barrier system Manufacturer or required to provide a continuous the air barrier assembly.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. The ABAA Certified Air Barrier Contractor shall examine substrates, areas, and conditions under which the air barrier assembly will be installed, with ABAA Certified Installer present, for compliance with requirements.
  1. Confirm site access logistics and scheduling requirements, including but not limited to use of scaffolding, lifts and staging.
  2. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
  3. Ensure that the following conditions are met:
    - a. Surfaces are sound, dry, even, and excess mortar and / or other contaminants.
    - b. Inspect and confirm substrates to be smooth and without large voids or sharp protrusions. Inform General Contractor if substrates are not acceptable and need to be repaired by the substrate Subcontractor.
    - c. Inspect and confirm masonry joints to be reasonably flush and completely filled, and ensure all excess mortar accumulated on masonry ties has been removed. Inform

General Contractor if masonry joints are not acceptable and need to be repaired by the masonry Subcontractor.

- d. Masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.
4. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263 and take suitable measures until substrate passes moisture test.
5. Verify sealants are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.
6. Notify Architect in writing of anticipated problems using air and vapor barrier over substrate prior to proceeding.

### **3.2 SURFACE PREPARATION**

- A. Clean, prepare, and treat substrate according to material Manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.
  1. Ensure that penetrating work by other trades is in place and complete.
  2. Prepare surfaces by brushing, scrubbing, scraping, grinding or compressed air to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion of the fluid-applied membrane.
  3. Wipe down metal surfaces to remove release agents or other non-compatible coatings using clean sponges or with a material chemically compatible with the primary air material.
- B. Prime substrate for installation of sheet membrane transition strips as recommended by material Manufacturer and as follows:
  1. Prime masonry, concrete substrates with conditioning primers.
  2. Prime glass-fiber surfaced gypsum sheathing an adequate number of coats to achieve required bond, with adequate drying time between coats.
  3. Prime wood, metal, and painted substrates with primer.
  4. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier at protrusions.
- C. Prime substrate for installation of fluid-applied air barrier if recommended by material Manufacturer based on project conditions.
- D. Protection from spray-applied materials as recommended by material Manufacturer and as follows:
  1. Mask and cover adjacent areas to protect from over-spray.
  2. Ensure any required foam stop or back up materials are in place to prevent over-spray and achieve complete seal.

### **3.3 INSTALLATION**

- A. Fluid Applied Membrane Air Barrier: Install air barrier accessories and fluid-applied membrane air barrier material to provide continuity throughout the building envelope in a shingle fashion. Install materials in accordance with material Manufacturer's instructions , but no less then 40 mils. Dry film thickness, and the following (unless Manufacturer recommends other procedures in writing based on project conditions or particular requirements of their recommended materials):
  1. Install veneer anchors as per air barrier Manufacturer installation sequencing.

2. Apply treatment to exterior gypsum joints and screw heads as per air barrier material Manufacturer.
3. Apply primer for transition material at the rate instructed by the air barrier material Manufacturer for 1 inch beyond terminating edge of transition membrane. Allow primer to set / cure completely before transition strip application.
4. Position subsequent sheets of transition material so that membrane overlaps the membrane sheet below by a minimum of 2 inches, unless greater overlap is recommended by the material Manufacturer. Ensure transition membrane is securely sealed onto substrate with roller.
5. Overlap horizontally adjacent pieces of transition material a minimum of 2 inches, unless greater overlap is recommended by the material Manufacturer. Roll all areas of transition strip including seams with roller.
6. Seal around all penetrations with termination mastic / sealant, membrane counterflashing or other procedure in accordance with material Manufacturer's instructions, ensuring chemical compatibility amongst adjoining materials.
7. Connect air barrier in exterior wall assembly continuously to the air barrier of the roof, to concrete below-grade structures, to windows, curtain wall, storefront, louvers, exterior doors, other intersection conditions and transitions from wet cavity to dry cavity and seal penetrations using accessory materials in accordance with the material Manufacturer's instructions.
8. Provide transition material at changes in substrate plane (with bead of sealant / mastic, membrane counter-flashing or other material recommended by material Manufacturer) under membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
9. Provide mechanically fastened non-corrosive metal sheet or other Manufacturer approved transition material to span gaps greater than 1 inch in substrate plane and to make a smooth transition from one plane to the other. Transition membrane shall be installed continuously from air barrier material onto sheet metal maintaining 2 inch overlap on both edges.
10. Lap transition material over top edge of through-wall flashing and head-flashing.
11. Provide backup for the membrane to accommodate anticipated movement or use other Manufacturer approved transition material at deflection and control joints.
12. Provide transition material to joint assemblies at expansion and seismic joints.
13. Provide backup for the fluid applied air barrier to accommodate anticipated movement at deflection and control joints as recommended by material Manufacturer.
14. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and / or as otherwise recommended by the material Manufacturer.
15. Seal top edge of the self-adhered membrane to substrate with termination mastic at end of each working day.
16. Inspect installation prior to enclosing assembly and repair punctures, damaged areas and inadequately lapped seams with a patch of membrane lapped as recommended by material Manufacturer.
17. Install primer for fluid-applied air barrier if instructed by material Manufacturer.
18. Install fluid-applied membrane using equipment and methods recommended by Manufacturer to achieve a dry film thickness as required by the material Manufacturer.
19. Do not allow materials to come in contact with chemically incompatible materials.
20. Do not expose membrane to sunlight / ultraviolet light longer than as recommended by the Manufacturer.
21. Turn flashing membrane into window opening at sill, jambs and heads. Terminate just before interior sealant bead.

### **3.4 FIELD QUALITY CONTROL**

- A. Owner's Inspection and Testing: Cooperate with Owner's testing agency as applicable. Allow access to work areas and staging. Notify Owner's testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted.
- B. Manufacturer's Field Representative Review: Contractor is not to commence any work other than staging until contact and meeting with the Manufacturer's Field Representative on site. The Manufacturer's Field Representative is to visit the jobsite a minimum of four (4) times to review work processes and / or work completed prior to work commencement, at 10% completion, at 50% completion and prior to the work being covered by finish materials.

### **3.5 PROTECTING AND CLEANING**

- A. Protect air barrier materials from damage during installation and the remainder of the construction period, according to material Manufacturer's written instructions.
  - 1. Coordinate with installation of materials which cover the air barrier assemblies, to ensure exposure period does not exceed that recommended by the air barrier Manufacturer.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by Manufacturer of affected construction and acceptable to the primary material Manufacturer.

**END OF SECTION 07 27 26**

## **SECTION 07 41 13 - PREFINISHED METAL ROOFING**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Furnish all labor, materials, tools, equipment and services for all preformed roofing as indicated.
- B. Coordinate with work of other trades.
- C. It is the intent of this Section that the Work shall:
  - 1. conform to all applicable building code requirements and of authorities having jurisdiction;
  - 2. include, but not limited to:
    - a. Preformed, prefinished metal roof panels
    - b. Flashings
    - c. Gutters, Downspouts and Splash Blocks
    - d. All supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure, weathertight, and complete installation.
  - 3. be performed by a single source contractor.

#### **1.2 RELATED WORK**

- A. Division 5 Sections as required; generally: structural steel, steel joists, and miscellaneous metals.
- B. Section 06 10 00 - Rough Carpentry: Plywood roof deck.
- C. Section 07 62 00 – Roof Related Sheet Metal
- D. Divisions 22, 23 and 26: All Sections of Work relating to or affecting the roofing system, including mechanical, plumbing and electrical items penetrating roofing system.

#### **1.3 REFERENCES**

- A. American Institute of Steel Construction (AISC)
  - 1. Manual of Steel Construction
- B. American Iron and Steel Institute (AISI)
  - 1. Cold Formed Steel Design Manual
- C. ASTM International (ASTM)
  - 1. A792, Specifications for Steel Sheet, Aluminum-Zinc Alloy-Coated (Galvanized) by the Hot-Dip Process, General Requirements (“Galvalume”)
  - 2. E1514, Standard Specification for Structural Standing Seam Steel Roof Panel Systems
  - 3. E1592, Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference

4. E1680, Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems
  5. E1646, Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference
- D. Factory Mutual System (FM)
1. I-90 wind uplift
- E. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
1. Architectural Sheet Metal Manual
- F. Underwriters' Laboratories (UL)
1. Tests for Uplift Resistance of Roof Assemblies
- G. Uniform Building Code (UBC)

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
1. Manufacturer must have a minimum of three (3) years experience manufacturing roof panels of the type specified for this Project. Panels specified in this Section shall be produced in a factory environment (not job site) with fixed-based roll forming equipment to assure the highest level of quality control. A letter certifying compliance should accompany the product material submittal.
- B. Installer's Qualifications:
1. Installer of the system shall be an approved installer, certified and authorized by the manufacturer as trained and qualified to install the manufacturer's product. Provide a letter of certification from manufacturer that installer has a minimum of three (3) year of metal roof panel installation experience preceding the date upon which work is to commence.

#### 1.5 SYSTEM PERFORMANCE REQUIREMENTS

- A. Performance Testing:
1. Metal roof system must be tested in accordance with UL Test Method 580, Tests for Uplift Resistance of Roof Assemblies.
  2. Metal roof system must be installed to resist the roof design pressures calculated in accordance with UBC or authorities having jurisdiction. Determine panel bending and clip-to-clip strength by testing in accordance with ASTM E1592. Capacity for gauge, span or loading other than those tested may be determined by interpolating test results.
  3. Metal roof system must meet the air infiltration requirements of ASTM E1680 when tested with a 6.24 PSF pressure differential with resulting air infiltration of 0.0071 cfm/sq. ft.
  4. Metal roof system must meet the water penetration requirements of ASTM E1646 when tested with a 12.00 PSF pressure differential with no uncontrollable water leakage when five (5) gallons per hour of water is sprayed per square foot of roof area.

## 1.6 SUBMITTALS – Provide one (1) submittal for this section

- A. Product Data:
  - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
  - 2. Manufacturer's installation instructions.
- B. Shop Drawings: Include layouts of panels, details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashing, closures and special details. Distinguish between factory and field assembly work.
- C. Calculations:
  - 1. Engineering calculations defining cladding loads on all roof areas based on specified building codes, allowable clip loads and required number of fasteners to secure the panel clips to the designated substructure.
  - 2. Uplift loads on clip fasteners with full recognition of prying forces and eccentric clip loading. Calculate holding strength of fasteners in accordance with submitted test data provided by fastener manufacturer based on length of embedment and properties of materials.
- D. Samples:
  - 1. Color charts or samples from the manufacturer's standard line of Kynar 500 or Hylar 5000 finishes for Architect's selection.
  - 2. One (1) foot long sample of coated panel, including clips and fasteners.
- E. Certifications:
  - 1. Letter of certification from manufacturer that installer is in compliance and meets specified requirements.
  - 2. Letter of certification from manufacturer that panels have been produced in a factory environment (not job site roll formed) with fixed-base roll forming equipment.
  - 3. Certified test results by a recognized testing laboratory or manufacturer's laboratory (witnessed by a professional engineer) in accordance with specified performance test methods for each panel system.
  - 4. Manufacturer's affidavit that materials used in Project contain no asbestos.
- F. Testing Reports: Showing metal panels have been tested in accordance with specified performance testing requirements.
- G. Warranty: Manufacturer's warranty as specified.

## 1.7 INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Coordination.

## 1.8 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver metal roof system to job site properly packaged to provide protection against transportation damage.
- B. Handling: Exercise extreme care in unloading, storing and erecting metal roof system to prevent bending, warping, twisting and surface damage.



- C. Storage:
1. Store all materials and accessories above ground on well skidded platforms.
  2. Store under waterproof covering.
  3. Provide proper ventilation of metal roof system to prevent condensation build-up between each panel or trim/flashing component.

## 1.9 WARRANTY

- A. Warrant the work specified herein against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials or workmanship. Warranty shall be a "Weather tightness" Warranty. Field Reports are required throughout Project and are to be supplied by a Manufacturer's Approved Technical Inspector. Manufacturer's personnel which are not Quality Control Technicians are not acceptable for inspection.
1. Roof Panels and Finish:
    - a. Durability of the roof panels due to rupture, structural failure or perforation shall be warranted for a period of 20 years by the Manufacturer.
    - b. The exterior color finish for painted roof panels shall be warranted by the Manufacturer for 20 years against chalking, blistering, peeling, cracking, flaking, checking and chipping.
  2. Weathertightness:
    - a. The entire roof system including all roof panels, flashings, curbs, interior gutters, etc. shall be warranted by the manufacturer against leaks for a period of 20 years.
    - b. The warranty shall be issued to the Owner by the Manufacturer at time of entire Project Substantial Completion.
    - c. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation.
    - d. The roof system shall include roof insulation, flashing, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system by the manufacturer, including materials and labor, shall be done at no cost to the Owner for duration of warranty period.
  3. Roofing Contractor: Jointly with any subcontractors employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the building will be and remain waterproof for a five (5) year warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Contractor, and subcontractors, to make good the requirements of the warranty. The warranty will be held jointly with the Bonding Company for the first two (2) years and the manufacturer for the remaining three (3) years.

## PART 2 - PRODUCTS

### 2.1 APPROVED MANUFACTURERS

- A. Specifications are based on SuperLok® (double lock seam) architectural structural standing seam metal roof system manufactured by MBCI, Houston, TX; (281) 445-8555. Manufacturers listed who produce products equivalent to those specified are approved for use on the Project. Other manufacturers must have a minimum of ten (10) years experience manufacturing equivalent products to those specified and comply with requirements of Division 1 regarding substitutions to be considered.
  - 1. AEP-Span, Dallas, TX; (214) 827-1740
  - 2. Fabral, Grapevine, TX; (800) 477-9066
  - 3. MBCI, Houston, TX; (281) 445-8555
  - 4. Pac Clad , Tyler TX 1-800-441-8661
  - 5. McELROY METAL Bossier City, LA 800-950-6531
  - 6. UNA-CLAD Anoka Minnesota 800-426-7737
- B. Roof panels with lap type side joints or those requiring battens or other non-integral sealing means or exposed structural fasteners will not be acceptable.
- C. Roof panels shall be roll formed in the Manufacturer's plant to control quality. On-site roll formed panels fabricated with UL approved equipment will be acceptable.
- D. Roof panels shall have plant-installed sealant for quality control.

## 2.2 MATERIALS

- A. Metal Roof Panels:
  - 1. Panel Profile: Two (2) inch high x 3/4 inch wide rib x 16 inch wide, striated panel.
  - 2. Metal Roof System: Vertical leg, concealed fastener, standing seam, utilizing male and female rib configurations, with factory applied hot-melt mastic in female rib, continuously locked together by an electrically powered mechanical seaming device during installation.
  - 3. Gauge: Minimum 24 gauge (UL 90 rated)
  - 4. Substrate: Galvalume Plus® steel sheet, minimum yield of 50,000 PSI.
  - 5. Clips: Two (2) piece floating clip, 18 gauge base, 24 gauge top, with factory applied mastic ( UL-90 rated - Underwriters Laboratories), with two (2) fasteners to structural. Comply with FM I-90 requirements.
  - 6. Texture: Embossed with striations (minimizes oil canning effect).
  - 7. Finish: Full strength Kynar 500 or Hylar 5000 Fluoropolymer coating, applied by the manufacturer on a continuous coil coating line, with a top side dry film thickness of 0.70 to 0.90 mil over 0.25 to 0.35 mil prime coat, to provide a total dry film thickness of 0.95 to 1.25 mil. Bottom side shall be coated with primer with a dry film thickness of 0.25 mil. Finish shall conform to tests for adhesion, flexibility, and longevity as specified by the Kynar 500 or Hylar 5000 finish supplier. Color shall be selected by Architect from manufacturer's full range of non-metallic colors. (20 year warranty)

## 2.3 MISCELLANEOUS MATERIALS

- A. Fasteners: All self-tapping/self-drilling fasteners, bolts, nuts, self-locking rivets and other suitable fasteners shall be designed to withstand specified design loads.
  - 1. Use long life fasteners for all exposed fastener applications.
  - 2. Provide fasteners with a factory applied coating in a color to match metal roof system application.
  - 3. Provide neoprene washers under heads of exposed fasteners.

4. Locate and space all exposed fasteners in a true vertical and horizontal alignment. Use proper torque settings to obtain controlled uniform compression for a positive seal without rupturing the neoprene washer.
- B. Accessories:
1. General: Provide all components required in accordance with the metal roof system manufacturer's approved shop drawings for a complete metal roof system to include panels, panel clips, trim/flashing, fascias, ridge, closures, sealants, fillers, and other required items.
  2. Plywood Deck: 5/8 inch thick exterior grade plywood as specified in Section 06100, Rough Carpentry, unless indicated otherwise on drawings.
  3. Insulation Board: Thickness as indicated on drawings. Closed cell glass reinforced polyisocyanurate insulation board complying with ASTM C1289, Type I, Class 2 and FS HH-I-1972/1, Class 2.
  4. Felt: #30 unperforated asphalt saturated felt.
  5. Prefabricated Roof Curbs and Equipment Supports, Roof Jacks, and Rooftop Walkways: Shall be product of manufacturer approved by the metal roof system manufacturer and as specified below.
  6. Closures: All outside closures shall be fabricated from "Galvalume" sheet steel of the same gauge, finish and color as the panels.
  7. Tape Seal: Shall be a pressure sensitive, 100 percent solids, polyisobutylene compound sealing tape with a release paper backing. Provide permanently elastic, non-sagging, non-toxic, non-staining tape seal approved by the metal roof system manufacturer.
  8. Joint Sealant: Shall be a one-part elastomeric polyurethane sealant approved by the metal roof system manufacturer.
  9. Splash Blocks: Shall be as specified in Section 07 62 00, Sheet Metal Flashing, Gutters, Downspouts and Trim.

## 2.4 FABRICATION

- A. Material shall be in-line tension leveled prior to roll forming panel profile.
- B. Roll form panels in continuous lengths, full length of detailed runs.
- C. Standard panel length shall be 45 feet, unless approved by the metal roof system manufacturer.
- D. Fabricate trim/flashing and accessories to detailed profiles.
- E. Fabricate trim/flashing from same material as panel.

## PART 3 - EXECUTION

### 3.1 SURFACE CONDITIONS

- A. Inspect installed work of other trades and verify that such work is complete to a point where this work may continue.
- B. Verify that installation may be made in accordance with approved shop drawings and manufacturer's instructions. This specifically includes verifying the secondary structurals and/or decking are installed to meet UL and building code requirements. Coordinate with

metal roof system manufacturer to insure that reduced clip spacings at eave, rake, ridge and corner areas are accommodated.

- C. Discrepancies:
  - 1. Bring discrepancies to the attention of the Architect.
  - 2. Do not proceed with installation until discrepancies have been resolved.

### **3.2 INSTALLATION OF METAL ROOFING OVER PLYWOOD DECK**

- A. Install plywood deck to meet FMRC Class I-90 wind uplift requirements.
- B. Install two (2) layers of felt laid dry; minimum 12 inch end laps, two (2) inch salvage laps; with joints of second layer staggered to joints of first layer; starting at eave over plywood in conformance with approved shop drawings and manufacturer's instructions.
- C. Mechanically attach roof insulation to plywood deck using manufacturer's recommended fasteners at spacing required to meet FMRC Class I-90 wind uplift requirements. Do not install more insulation than can be roofed the same day. Tape seal all joints.
- D. Remove protective strippable plastic film covering from metal roof panels, trim, and related items when and in conformance manufacturer's instructions.
- E. Install metal roof system so that it is weathertight, without waves, warps, buckles, fastening stresses or distortion, allowing for expansion and contraction. Isolate dissimilar metal contact with proper taping and/or coatings.
- F. Install metal roof panels, trim, and related items in accordance with approved samples with approved shop drawings and manufacturer's instructions.
- G. Provide concealed anchors at all panel attachment locations.
- H. Install panels plumb, level and straight with seams and ribs parallel, conforming to design as indicated.
- I. Install roof jacks in accordance with approved shop drawings and manufacturer's instructions.
- J. Install roof curbs in accordance with approved shop drawings and manufacturer's instructions. Anchor curbs securely in place with provisions for thermal and structural movement.
- K. Install gutters and downspouts in accordance with approved samples with approved shop drawings and manufacturer's instructions.
- L. Install downspouts plumb and level, attached to columns or wall with straps located at top and bottom of downspout and maximum ten (10) feet on center.
- M. Install splash block under discharge port of downspouts.
- N. Install gutter screen over installed gutter. Secure screen to spacer with self-tapping screw.

- O. Provide expansion joints on ends of gutters spaced maximum 50 feet on center. Install snap-on cover over expansion joint.
- P. Entire roof assembly shall meet FMRC Class I-90 wind uplift requirements.

### **3.3 CLEANING AND PROTECTION**

- A. Remove scraps and debris and leave work area clean.
- B. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes. Paint areas where finish is damaged on prefinished metal by painting with a compatible paint in color to match undamaged finish.
- C. Clean other work damaged or soiled by Work of this Section.
- D. Protect finished work from damage.

### **3.4 INSPECTION**

- A. Architect and Contractor reserve the right to inspect the work during application. Upon completion of the work, if inspection discloses that roofing is not according to specifications or has been damaged, Contractor agrees to furnish additional materials necessary to make repairs and place work in an acceptable condition at no additional expense to Owner.

**END OF SECTION 07 41 13**

## **SECTION 07 51 10 BUILT-UP BITUMINOUS ROOFING REPAIR**

### **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 Built-Up Roofing Repair or placement around HVAC Equipment Replaced:
  - 1. Built-up roofing membrane, conventional application for Patch and Repair.
  - 2. Insulation, tapered (Patch and Repair).
  - 3. Base flashings (Patch and Repair).
  - 4. Roofing cant strips, accessories, roofing vents, and walkways.
- B. Related Sections:
  - 1. Section 01 33 00: Submittal Procedures.
  - 2. Section 01 73 29: Cutting and Patching (Project Modernization Only).
  - 3. Section 06 10 00: Rough Carpentry.
  - 4. Section 07 62 00: Sheet Metal Flashing and Trim.
  - 5. Section 07 72 00: Roof Accessories.
  - 6. Division 23 HVAC
- C. Reference Standards:
  - 1. ASTM International:
    - a. ASTM C177 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
    - b. ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
    - c. ASTM D4586 Standard Specification for Asphalt Roof Cement, Asbestos-Free.
    - d. ASTM D5643 Standard Specification for Coal Tar Roof Cement, Asbestos Free.
    - e. ASTM E96/E96M Standard Test Methods for Water Vapor Transmission of Materials.
  - 2. National Roofing Contractors Association:
    - a. NRCA The NRCA Roofing and Waterproofing Manual.
  - 3. Local Air Quality Management District:
    - a. AQMD Rules for: Air Toxics Control Measures.
  - 4. Underwriters Laboratories Inc.:
    - a. UL Fire Resistive Directory.
    - b. UL Roofing Materials and Systems Directory (RMSD).

#### **1.3 SUBMITTALS**

- A. Product Data: Provide data indicating membrane and bitumen materials, base flashing materials, insulation, and surfacing.
- B. Certifications:
  - 1. Submit the following certifications indicating:
    - a. Built-up bituminous roofing manufacturer's qualifications specified in this Section.
    - b. Built-up bituminous roofing installer's qualifications specified in this Section.
    - c. Materials to be used in manufacturer's systems compliance with standards designated. Include certificates of compliance for surface aggregate and materials

delivered in hot-bulk equipment.

- C. Samples: Only as requested.
- D. Installer's Compliance:
  - 1. Submit a written statement from Contractor's installer stating that:
    - a. Contract Documents have been reviewed with the primary roofing material manufacturer's representative.
    - b. Installer intends to comply with the Contract Documents.
    - c. Roofing details do not conflict with manufacturer's product/system warranty.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

#### 1.4 QUALITY ASSURANCE

- A. Design Criteria:
  - 1. Meet requirements of CBC Chapter 15.
  - 2. Meet requirements of Class A roof per CBC Table 1505.1a.
  - 3. Comply with recommendation of NRCA, including any condition not indicated on the Drawings or noted here-in.
  - 4. Prevent water or moisture from penetrating any area of roofing application.
  - 5. Flashings shall not depend solely upon mastic or sealant for primary waterproof protection. Best Practice will be observed in accordance with SMACNA.
  - 6. Meet requirements of manufacturer's specifications that are consistent with specified built-up bituminous roofing systems and construction conditions
  - 7. Provide built-up roofing system and component materials that have been tested for application and slopes indicated and that are listed by UL for Class external fire exposure.
  - 8. Insulation, securement materials, and method of installation shall meet requirements of Factory Mutual Class 1.
- B. Provide products that are free from asbestos.
- C. Built-Up Bituminous Roofing Manufacturer: Obtain primary roofing from a single manufacturer. Provide secondary materials as recommended by manufacturer of primary materials.
- D. Built-Up Bituminous Roofing Installer's Qualifications:
  - 1. Installer shall be licensed or otherwise certified by manufacturer of accepted roofing system to do work requiring warranty, including materials and workmanship.
  - 2. Installer shall have applied accepted roofing system on two (2) or more projects that have been completed for at least ten (10) years. Information on completed systems shall include date of installation, General Contractor, Owner, contact, and other related information that will facilitate verifications of qualifications.
  - 3. Installer's field supervision: Maintain a full-time supervisor/foreman on jobsite during all phases of bituminous sheet roofing work; at any time roofing work is in progress, proper supervision of workers shall be maintained. A copy of the specification shall be in the possession of the supervisor/foremen and on the roof at all times.

#### 1.5 WARRANTY

- A. Provide (2) year labor warranty to cover failure to prevent penetration of water.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Labels: Clearly label materials except gravel with material name, production date or product code, and inspection agency approvals where required.
- B. Deliver, store, and handle packaged materials in manufacturer's original containers with seals unbroken and labels intact until time of use.
- C. Unload materials carefully and store off ground, deck, or surface where material could become wet or damp, at temperatures maintained above 50 degrees and below 75 degrees Fahrenheit. Protect from elements. Do not dump onto ground.
- D. Keep all moisture sensitive materials dry at all times while being transported, stored, and installed.
- E. Store materials on raised pallets. Do not double stack pallets:
  - 1. Cover top and all sides of moisture sensitive materials and allow for adequate ventilation.
  - 2. Utilize covers made from breathable materials.
- F. Handle materials in a manner to prevent damage. Store rolls in an upright position:
  - 1. Discard rolls that have been flattened or damaged.
  - 2. Remove damaged materials from the site and replace with new materials.
- G. Avoid concentrated loading of building structure with materials. When storing pallets on the roof, locate over columns.
- H. Do not store materials or debris on newly installed roof surfaces.
- I. Store liquid materials such as adhesives, thinners, and cleaners in areas away from sparks, open flames, and excessive heat:
  - 1. No smoking is to be allowed in the area where solvent, adhesives, thinners, or welding agents are being used.
  - 2. Exercise caution at all times when working with solvent-type materials and comply with the limitations as described by the solvent manufacturer.
  - 3. Obtain specific approval of Owner's representative prior to storage of flammable materials on Project site.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Sheet and Bitumen Materials:
  - 1. GAF Materials Corporation (bases of design).
  - 2. Johns Manville Roofing Systems Group.
  - 3. Or approved equal.
- B. Roof Insulation:
  - 1. GAF Materials Corporation.
  - 2. Johns Manville Roofing Systems Group.
  - 3. Or approved equal.

### **2.2 BUILT-UP BITUMINOUS ROOFING SYSTEMS**

- A. General Requirements:
  - 1. Materials for built-up roofing systems (BURS) are composed of alternating layers of



- asphalt ply sheets (built-up bituminous roofing system), except roof insulation board and protection board, shall be products of, or recommended by, a single manufacturer.
2. Materials quantities stipulated for systems are generalized for BURS; manufacturer may vary to those listed below. Such variations are to be included in product listings and shop drawing review.
  3. Feather Back existing roof material minimum of three feet from intended exposed area. Layer replacement new roofing to these specifications and Drawing Details.
  4. Layering built-up roofing may include (refer to Drawing details):
    - a. Self-adhered products.
    - b. Cold applied.
    - c. Hot mopped.
- B. Typical 4-Ply BURS over metal deck:
1. Description:
    - a. 1/4-inch pressed fiber protection board.
    - a. Roof insulation board: Over fiber board over metal roof deck attached with roofing screws and washer per manufacturer's specifications.
    - b. Perforated venting base sheet.
    - c. First layer: 6-ply asphaltic roofing material.
    - d. Second layer: 6-ply asphaltic roofing material.
    - e. Third layer: 6-ply asphaltic roofing material.
    - f. Top flood coat and gravel.

## 2.3 COMPONENTS

- A. Roof Insulation Boards:
1. Description:
    - a. Closed cell polyisocyanurate core bonded to universal fiberglass reinforced facers.
    - b. Meet physical requirements of ASTM C1289, Type II, Class 1, Grade 2.
    - c. Thermal resistance and thickness as indicated on drawings/details for roofing systems.
    - d. Provide tapered insulation were noted or required to provide the indicated slope.
  2. Product:
    - a. Johns Manville Roofing Systems Group's Energy 3, or Approved equal.
- B. Felts, Fabrics, and Dry Sheet:
1. Asphalt base sheet: ASTM D2626.
  2. Fiberglass base sheet: ASTM D4601. GAF Materials Corp's; GAFGLAS #75 Base Sheet, or equal.
  3. Fiberglass roofing felt: ASTM D2178. GAF Materials Corp's GAFGLAS FlexPly 6", or equal.
  4. Mineral surface cap sheet: ASTM D3909. GAF Materials Corp's GAFGLAS Mineral Surfaced Cap Sheet, or equal.
- C. Asphalt Primer:
1. ASTM D41.
  2. Topcoat membrane: Surface applied over concrete.
- D. Bitumen:
1. Asphalt: ASTM D312, type as recommended by built-up bituminous roofing manufacturer for region, climate, and slope of roof.
  2. Bituminous plastic cement: ASTM D4586, Type II, cut back asphalt type.
- E. Composition Flashing Systems: All composition flashing systems are to be modified bitumen by same manufacturer as roofing system or built-up bituminous roofing manufacturer's

standard.

- F. Fabric Reinforcement: Bituminous woven glass fabric meeting requirements of ASTM D1668.
- G. Cants: Fiberboard, minimum three-inch (3") vertical leg, four inches (4") wherever possible, 45-degree slope.
- H. Surfacing Aggregate: Clean, hard, durable river aggregate conforming to ASTM D1863, gradation size No. 7, and as recommended by built-up bituminous roofing system manufacturer.
- I. Fasteners:
  - 1. Mechanical fasteners for insulation: Meet insulation manufacturer's requirements.
  - 2. Concrete: Twin legged fastener, electro zinc plated, fastener to provide positive attachment and resistance to specified wind up-lift forces. Minimum depth per manufactures recommendations (1.8 inches long with 2.7-inch diameter plate).
  - 3. Base sheet to wood nailers: One-inch (1") square head nails in length as required to fully penetrate into substrate.
- J. Traffic Surfacing:
  - 1. Description: 3/4-inch thick panels manufactured from asphalt, reinforcing fibers, and mineral granules, thoroughly ground and molded under heat, and compressed between tops and bottoms of inert fiberglass membranes with skid-resistant mineral granules applied to top surface; color as selected from manufacturer's standard range. Refer to Drawings for location and layout.
  - 2. Placement is over newly Patched Roofing and Existing Roofing. Do NOT impede water drainage around HVAC Units or Roof Drains.
- K. Other Accessories: As recommends by built-up bituminous roofing manufacturer.

## **PART 3 EXECUTION**

### **3.1 SITE CONDITIONS**

- A. Environmental Requirements:
  - 1. Proceed with roofing work when existing and forecasted weather conditions will permit work to be performed in accordance with manufacturers' recommendations and warranty requirements.
  - 2. Do not apply roofing membrane during unsuitable weather.
  - 3. Do not apply built-up bituminous roofing when ambient temperature is below 40 degrees Fahrenheit or above 95 degrees Fahrenheit.
  - 4. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring; apply built-up bituminous roofing in dry weather.

### **3.2 EXAMINATION**

- A. Examine areas to receive built-up bituminous roofing and verify that:
  - 1. Surfaces and site conditions are ready to receive work.
  - 2. Deck is supported and secure.
  - 3. Deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped, and suitable for installation of roof system.
  - 4. Voids in substrate have been patched flush with surrounding surfaces.
  - 5. Nailing strips, blocking, reglets, other embedded items, and items to penetrate surfaces

- 6. Low spots or areas where ponding water may occur have been adequately corrected.
  - 7. Roof openings, curbs, and penetrations through roof are solidly set and cant strips are in place.
  - 8. New flashings and other related items have been installed or fabricated and are onsite ready for installation when roofing work commences.
  - 9. Conditions are otherwise satisfactory for application.
- B. Assure that related work of other trades has been completed, and that the sequence of the flashing work may proceed in accordance with good flashing practice and the intent of the Specifications.
- C. Notify District's representative immediately in writing of any discrepancy between field conditions and the ability to achieve the intent of these Specifications, and do not proceed with the work until adequate correction has been made.
- D. Do not start work until unsatisfactory conditions have been corrected. Start of work shall signify acceptance of, and responsibility for, condition of receiving surface.

### 3.3 PREPARATION

- A. Protection:
- 1. Protect surrounding work from damage by roofing materials or operations; especially protect paving and building walls adjacent to hoists and kettles.
  - 2. Prevent bitumen, aggregate, and debris from entering and clogging roof drains and rainwater conductors.
  - 3. Protect existing fresh air intakes, doors, and windows as to prevent entry of asphalt fumes. Due to the nature of the work coordinate with District for application during school times.
  - 4. Be responsible for costs of repair or restoration of other work damaged by materials or operations of built-up bituminous roofing
- B. Clean roof and flashing areas thoroughly of loose materials and foreign matter to provide sound, dry, and level decks for positive attachment of roof system materials.

### 3.4 GENERAL APPLICATION REQUIREMENTS

- A. Apply built-up bituminous roofing and related work in accordance with materials manufacturer's specifications for systems accepted for this Project, match existing in-place components and/or meeting requirements of CBC Chapter 15, except where other requirements are indicated or specified (Chapter 15 for roofing and 1511 reroofing).
- B. Make attachments to metal work and accessories integral with waterproofing in accordance with accepted built-up bituminous roofing manufacturer's recommendations.
- C. Bitumen:
- 1. Do not exceed temperature limitation recommend by roofing materials manufacturer for heating bitumen:
    - a. Bitumen shall be applied at its equiviscous temperature (EVT) for the method of application being used, plus or minus 25 degrees Fahrenheit.
    - b. Do not exceed the flash point.
    - c. Do not exceed the finishing blowing temperature.
  - 2. Provide clearly visible thermometer on each kettle or delivery truck used to heat bitumen.
  - 3. Remove overheated bitumen from site immediately.

4. Do not apply hot bitumen under conditions that would cause foaming.
- D. Lay multiple-ply courses of felt and hot bitumen in shingle plies, and comply with recommendations of roofing material manufacturer:
    1. Lap felts with direction of drainage.
    2. Start installation of plies at lowest point of roof with plies perpendicular to slope of roof deck.
    3. Except where spot mopping sheets, lay felt plies in bitumen while still hot and tacky and broom thoroughly for full felt width to eliminate trapped air or gases.
    4. Lay out roof areas accurately for proper lap and sequence of plies.
    5. Lay out plies accurately and broom each into hot, tacky bitumen.
    6. Ensure felts are free from fishmouths, buckles, blisters, and other faulty workmanship.
    7. Built-up bituminous roofing displaying voids will be rejected.
    8. Do not use wet, once wet, or damaged rolls.
  - E. Provide cant strips where indicated, where required, and wherever feasible to prevent 90-degree bending of membrane system. Turn all membranes up on cant strip where they abut against vertical surface.
  - F. Provide membrane base flashings at cant strips and other sloping and vertical surfaces, at roof edges, and at major penetrations through roof deck. Nail or provide other forms of mechanical anchorage of membrane flashing to vertical surfaces as recommended by roofing material manufacturer.
  - G. Valley and Ridge Lines: Reinforce with one additional ply layer, centered on-line, set on top of the top membrane ply in full 25 pound per 100 square foot mopping of hot asphalt.
  - H. Provide any other roofing accessories necessary to conform to built-up roofing manufacturer's requirements.

### 3.5 ROOF INSULATION

- A. Install where required by built-up bituminous roofing systems.
- B. Verify proper thickness, locations, and attachment of insulation stops.
- C. On Metal Decks:
  1. Install roof insulation boards with edges parallel to flutes of metal decking and bearing on deck surface.
  2. Install first layer of roof insulation boards on metal decks with mechanical fasteners.
  3. Install second layer of roof insulation boards in broken joint construction, so that each layer breaks joints to a minimum of six inches (6") both ways with preceding layer.
- D. Set roof insulation boards solidly into place using hot steep asphalt and/or fasten mechanically per manufacturer's directions; press firmly into place.
- E. In addition, the first four-foot (4') width around the perimeter of the roof and all openings shall be mechanically secured. Unless otherwise indicated by Detail.
- F. Lay boards with edges in moderate contact without forcing.
- G. Cut roof insulation boards to fit neatly around vertical surfaces and deck projections.

- H. Joint Tape: Tape joints in top layer of insulation according to manufacturer's instructions. Apply joint tape to joints between wood blocking or insulation stops and insulation boards.
- I. Do not leave installed roof insulation boards exposed to weather.
- J. Meet requirements of materials manufacturers.
- K. Tapered Insulation at Crickets:
  - 1. Apply multi-layers of tapered insulation in pattern to achieve positive slope of 1/8 inch per foot. Slope to drains.
  - 2. Stagger the joints of each layer from the preceding course by 1/2 of the board's dimension. Set boards into 30 pounds of asphalt. Bring boards into moderate uniform contact at sides and ends while asphalt is hot and fluid. Install top layer with joints continuous in both directions.
- L. Cant Strips:
  - 1. Install at intersection of vertical surfaces and where otherwise required.
  - 2. Install into hot asphalt to top of insulation.
  - 3. Mechanically fasten into nailers with square head roofing nails at 12 inches on center, minimum three (3) nails per piece. Use nails with sufficient length to achieve minimum 1-1/2-inch penetration into nailers.
  - 4. Miter corners for tight fit.
- M. Tapered Edging: Install wherever necessary to achieve smooth transitions for the roof membrane. Do not allow transitions greater than 1/4 inch.
- N. Water Cut-Offs: Provide at exposed edges of roof insulation boards at end of day's work and whenever rain is imminent. Extend cut-offs six inches (6") on roof deck, carry up and over roof insulation boards, and extend six inches (6") on top of built-up roofing. Remove before continuing installation of roof insulation boards.

### 3.6 BUILT-UP BITUMINOUS ROOFING INSTALLATION

- A. Complete application of built-up bituminous roofing daily up to line of termination at end of day's work. Daily aggregate surfacing is not necessary.
- B. Apply fiberglass roofing felts in a solid, continuous asphalt moping:
  - 1. Lay plies straight and flat.
  - 2. Apply all ply sheets so they are properly shingled to flow of water.
  - 3. Provide enough overlap so that every cross section will have required number of plies.
  - 4. Stagger all end laps at least 12 inches.
  - 5. Install one (1) extra ply sheet, 36 inches wide, at all waterways.
- C. Ensure full and continuous seal and contact between asphalt and ply sheets or base sheet, including ends, edges, and laps by applying asphalt uniformly and by brooming fully before asphalt cools:
  - 1. Use minimum 34-inch wide brooms or squeegees.
  - 2. Do not walk on membrane until asphalt cools down.
  - 3. Keep equipment off hot membrane.
- D. Do not allow sheets to contact other sheets even at roof edges or over cants and tapered edge strips:

1. Cut out fishmouths or side laps not completely sealed with asphalt, and patch with ply sheet set in hot asphalt.
  2. Remove and replace all sheets that are fully and continuously bonded or that have inadequate mopping along end or edge laps.
- E. At Roof Edges and Openings: Provide bleed sheets (felt envelopes) to prevent bitumen drippage.
- F. Roof Sumps and Drains:
1. Temporarily plug drains to prevent asphalt drippage; remove at end of each work day.
  2. Install tapered insulation to form a minimum 24-inch by 24-inch sump area.
  3. Bring roofing felt plies down over insulation and extend into roof drain flashing ring.
  4. Over felts in sump, apply modified bitumen flashing to extend minimum four inches (4") out of sump onto main roof deck and into roof drain flashing ring.
  5. Verify installation of gravel stops at outer edge of sump.
  6. Coordinate to embed gravel stop in plastic cement over flashing with flange stripped in with flashing.
  7. Embed aggregate surfacing in plastic cement on top of flange and stripping for six inches (6") from raised lip of gravel stop.
- G. Turn all membranes up on cant strip where they but against vertical surface.
- H. Provide membrane base flashings at cant strips and other sloping and vertical surfaces, at roof edges, and at major penetrations through roof deck. Nail or provide other forms of mechanical anchorage of membrane flashing to vertical surfaces as recommended by roofing material manufacturer.
- I. Composition Flashing:
1. Install in accordance with manufacturer's recommendations and requirements specified.
  2. Provide at termination of roofing on curbs, vertical surfaces, and where indicated or required for complete watertight installation.
  3. Verify proper locations of nailers at top of flashing.
  4. Prime vertical and horizontal substrate surfaces to be flashed with asphaltic products with asphalt primer and allow to dry before applying flashing.
  5. Strip Flashing:
    - a. Coordinate to provide a complete watertight and weatherproof roofing system:
      - 1) Prime all flanges (both sides) with asphalt primer and allow to dry.
      - 2) Set flanges in 1/8-inch thick continuous bed of plastic roofing cement.
      - 3) Fasten flange as detailed.
      - 4) Apply two (2) strip flashing sheets into 1/8-inch thick continuous bed of flashing cement extending four inches (4") and six inches (6") respectively onto completed roof membrane.
  6. Base Flashing:
    - a. Apply over cants and run up parapet walls where indicated on the Drawings (maximum 24 inches above roof line).
      - 1) Apply base sheet and modified bitumen built-up base flashing system consisting of a minimum of a base sheet, a ply sheet, and polymer modified top sheet.
      - 2) Mechanically fasten base sheet at 12 inches on center in rows eight inches (8") apart.
      - 3) Apply ply sheet over base sheet in a continuous 1/8-inch thick layer of flashing cement.
      - 4) Apply modified bitumen base flashing over ply sheet in a continuous 1/8-inch thick layer of flashing cement.

- 5) Fasten top edge at six inches (6") on center.
- 6) Do not seal top edge of base flashing.

J. Sheet Metal:

1. Supervise installation of sheet metal items integral with built-up bituminous roofing and ensure conformity with built-up bituminous roofing manufacturer's recommendations.
2. Metal flashings that are an integral part of roofing shall be installed simultaneously with roofing application.
3. Fill bottom half pitch pockets at window washing system davits with non-shrink grout and top half with elastomeric pitch pocket filler. Crown top for slope to drain.

### 3.7 SURFACING

- A. Do not install surfacing until the inspection of the membrane has been performed and "punch list" repairs have been completed.
- B. Aggregate:
1. Aggregate surfacing to fully cover all membranes and strip flashing surfaces.
  2. Coat roof surface with uniform and continuous layer of asphalt at minimum rate of 60 pounds per square foot unless otherwise indicated.
  3. Apply aggregate into hot asphalt, uniformly at a minimum rate of 400 pounds per square foot. Ensure complete coverage and minimum 50 percent embedment.

### 3.8 TRAFFIC SURFACING INSTALLATION

- A. Sweep areas to receive traffic surfacing clean of dust, sand, and gravel prior to installation.
- B. Apply mineral surfaced cap sheet surfacing over completed roof membrane at areas indicated on Drawings:
1. Cut mineral surfaced cap sheet into 18-foot lengths and allow to relax one (1) hour.
  2. Set in continuous mopping of 25 pounds per square foot of hot asphalt.
  3. Install one (1) ply of mineral surfaced cap sheet extending one foot (1') beyond sides of panels.
  4. Lap ends six inches (6") and laps sides 12 inches. Stagger end joints.
  5. Apply mineral surfaced cap sheet after strip flashing has been applied, but prior to base flashing application.
- C. Install traffic surfacing panels over mineral surfaced cap sheet with plastic roofing cement in accordance with manufacturer's recommendations. Space panels six inches (6") apart, unless indicated otherwise, to permit unrestricted flow of roof water. Lay out panels so that end pieces are not less than 1/2 full length.
- D. Install aggregate over mineral cap sheet and up to edge of panels.

### 3.9 FIELD QUALITY CONTROL

- A. Refer to Project Notes for Quality Requirements.
- B. Require site attendance of roofing and insulation material manufacturers daily during installation of the work.

### 3.10 CLEANING

- A. Remove bituminous markings from adjacent finished surfaces.

- B. Repair or replace defaced or disfigured finishes caused by work of this Section.
- C. In areas where finished surfaces are soiled by bitumen or other source of soiling caused by work of this Section, consult manufacturer of surfaces for cleaning advice and conform to their instructions.
- D. At completion of the work of this Section, remove all excess materials, cartons, wrappings, and tools and implements from the site.

### **3.11 PROTECTION**

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials. Provide special protection or avoid heavy traffic on completed work when ambient temperature is above 80 degrees Fahrenheit.

**END OF SECTION 07 51 10**



## **1SECTION 07 52 19 - MODIFIED BITUMEN "COOL ROOF" MEMBRANE ROOFING SYSTEM**

### **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 SECTION INCLUDES**

- A. Providing coordination for the entire roofing assembly, including, but not limited to:
1. Tapered edge strips, cant strips, and wood nailers. (Refer to this Section and Section 06 10 00)
  2. Modified bitumen membrane roofing.
  3. Flashings, including sheet metal perimeter edge (fascia) (Refer this Section and Section 07 62 00).
  4. Work incidental to, the complete and proper installation of a watertight modified bitumen membrane roofing system as shown on the drawings or specified herein, and in accordance with all applicable requirements of the Contract Documents.
- B. It is the intent of this Section that the Work shall:
1. provide a watertight facility.
  2. conform to all applicable building code requirements and of authorities having jurisdiction.
  3. include Section 07 62 00, Roof Related Sheet Metal as part of the Work of this Section; and be performed to obtain a single responsibility total system warranty.
- C. Work and materials hereinafter specified shall be best of kind described and, unless specified otherwise, shall be new and of best quality. All roofing materials utilized in performance of each type of work shall be the products of one (1) manufacturer or supplier.

#### **1.3 RELATED WORK**

- A. All Sections of Work relating to the roofing system, including mechanical, plumbing, and electrical items penetrating the roof system.

#### **1.4 REFERENCES**

- A. American Society for Testing and Materials (ASTM)
1. C920, Standard Specification for Elastomeric Joint Sealants
  2. D41, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
  3. D312, Standard Specification for Asphalt Used in Roofing
  4. D2178, Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing
  5. D4479, Standard Specification for Asphalt Roof Coatings - Asbestos-Free
  6. D4586, Standard Specification for Asphalt Roof Cement, Asbestos-Free
  7. D4601, Standard Specification for Asphalt-Coated Glass Fiber Sheet Used in Roofing
  8. D5147, Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material

9. D6163, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements
- B. ASCE-7 Wind uplifts requirements for geographical area.
- C. Federal Specifications (FS)
  1. SS-R-620B
  2. TT-S-00230C
- D. National Roofing Contractors Association (NRCA)
  1. Roofing and Waterproofing Manual
- E. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
  1. Architectural Sheet Metal Manual
- F. International Building Code
- G. Underwriters' Laboratories (UL)
  1. Fire Hazards Classifications
- H. Texas State Board of Insurance

## 1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's printed instructions, schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, fastener pattern layout, and accessories to be used in the Work.
- B. Certifications:
  1. Manufacturer's written certification that installer is approved and licensed to install specified roofing system. **(Submit a copy with Proposal Form).**
  2. Manufacturer's affidavit that materials used in Project contain no asbestos.
  3. Installer shall submit resume and project experience list for proposed system for Project Manager and job site superintendent.
  4. Installer shall submit written certification that there are no undocumented workers being employed by them or by any subcontractor on this project and that all workers on this project are covered by workmen's compensation.
  5. Installer shall submit list of all subcontractors with evidence of subcontractor's insurance coverage in compliance with contract requirements.
  6. Manufacturer's written certification of approval / acceptance of these specifications and details.
  7. Warranty: Submit letter from manufacturer signed by agent authorized to do so, stating acceptance of warranty as specified and detailed.
- C. Referenced Standards: Two (2) copies of each referenced standard and retain approved copies at site.
- D. Shop Drawings: Furnish from copies of the manufacturer's literature or from copies of NRCA "Roofing and Waterproofing Manual," fourth edition.
  1. Furnish for approval any proposed details which differ from those included with this proposal package. All proposed details shall first be approved in writing by roofing manufacturers prior to submitting to Architect for approval.
  2. Furnish detail project sequencing, staging, material loading, manpower plans, and project construction schedule for approval.

- E. Samples:
  - 1. Submit sample copy of job specific warranty that is to be issued upon project completion.
  - 2. Submit mock-up of all fabricated sheet metal items.
  - 3. Submit 12-inch x 12-inch sample of all types of roof membranes to be installed.
- F. Temperature Charts: Bitumen heating devices 24-hour temperature charts.
- G. Test Reports: Bitumen manufacturer's test reports relative to the following for each batch of bitumen furnished:
  - 1. Softening Point: ASTM D312.
  - 2. Flashpoint: ASTM D92.
  - 3. Acceptable Bitumen Temperature: As recommended by the bitumen manufacturer and EVT label on containers.
  - 4. Thermometers: Two (2) handheld, "8F" thermometers complying with ASTM E1 to Architect for his checking kettle temperature.
- H. Upon Substantial Completion of Work, submit the following to Architect for his submission to Owner:
  - 1. Manufacturer's Warranty: Manufacturer's written warranty as specified.
  - 2. Maintenance Procedures: Three (3) copies of manufacturer's printed instructions for Owner's use regarding care and maintenance of roof.

## 1.6 PROJECT CONDITIONS

- A. Weather Condition Limitations: Proceed with roofing work when existing and forecasted weather conditions permit work to be performed in accordance with manufacturer's recommendations and warranty requirements. Roofing application with moisture present will not be accepted. Do not attempt construction of the roofing system when the reported or calculated dew point are within three (3) degrees of each other.
- B. Do not allow waste products, petroleum, grease, oil solvents, mineral oil, and other contaminants to come into contact with the roofing system before or during installation. Advise Owner if there is a possibility of his facility emitting such contaminants in the future.

## 1.7 INSPECTIONS / TESTS

- A. The Architect's and Manufacturer's representative shall at all times have access to the job site and work areas. The contractor will provide proper and safe facilities for such access and inspection.
  - 1. Architect Inspections: The Architect will be providing periodic inspections throughout the duration of the project. Architect's Representative shall be required to inspect after completion of each major phase of construction for approval.
  - 2. Manufacturer Inspections:
    - a. An inspection shall be made by a representative of the material manufacturer at appropriate intervals during performance of Work to ensure that said project is installed in accordance with the manufacturer's specifications and illustrated details. Written reports by the manufacturer shall be turned over to the Architect, on each Monday following the prior week.
    - b. The authorized material manufacturer's field representative shall be responsible for:

- 1) Keeping the Architect's representative informed after periodic inspections as to the progress and quality of the work observed.
  - 2) Calling to the attention of the contractor those matters observed which are considered to be in violation of the contract requirements.
  - 3) Reporting to the Architect's representative, in writing, any failure or refusal of the contractor to correct unacceptable practices called to his attention.
  - 4) Confirming, after completion of the work and based on his observation and test, that he has observed no application procedures in conflict with these specifications.
- B. Any failure by the Architect's or Manufacturer's Representative to detect, pinpoint, or object to any defect or noncompliance of these specifications of work in progress or completed work shall not relieve the contractor, or reduce, or in any way limit, his responsibility of full performance of work required of him under these specifications.
- C. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM standard procedures.
1. Owner will select testing laboratory and will pay for Work required by testing laboratory.
  2. Re-tests for work which fail initial tests or inspections shall be paid by contractor.
  3. Noncompliance with contractor requirements will result in the Architect/Owner to assign full time quality control and will be subject to reimbursement by the construction manager/contractor.

## 1.8 QUALITY ASSURANCE

- A. Applicator:
1. Applicator shall have approval by manufacturer of accepted roofing system for application and issuance of specified warranty for a minimum of three (3) years. Proof of license agreement dated at least three years prior to date of bid opening.
  2. Applicator shall be an experienced single firm specializing in the type of roofing and sheet metal work specified, with a minimum of five (5) years of previous successful experience on projects similar in size and scope.
  3. No subcontracting of sheet metal fabrication or installation will be accepted. Contractor must have a sheet metal shop on the company premises.
  4. Applicators shall have a competent Superintendent, who is not actually performing roofing work, on site at all time while work is in progress, with full authority to act on behalf of the Contractor as his agent.
  5. All workers shall be covered by Workmen's Compensation insurance (verify upon request) and thoroughly experienced in the particular class of work upon which employed. Use of undocumented workers will not be tolerated - No Exceptions.
  6. Contractor shall ensure that base fastener pull out resistance tests on existing decks were performed and approved by Architect and coordinated with Roofing Consultant prior to starting roofing application.
  7. Roofing contractor must have reached the highest level of qualifications from the manufacture they are providing material for (i.e., Master Select contractor).
- B. Regulatory Requirements:
1. Classification by Underwriters' Laboratories, Inc. as a Class A roof covering.
  2. Roofing system shall be installed in accordance with ASCE-7 wind uplift requirements for geographical location exposure B, 110 MPH 3-second gust wind speed zone and an importance factor of 1.15 based on IBC building code

requirements. Wind-resistance loads listed below have a safety factor of 2.0 incorporated into the calculation.

- a. Zone 1 Field -58.1 psf or as otherwise indicated by Structural.
  - b. Zone 2 Perimeter -97.4 psf or as otherwise indicated by Structural.
  - c. Zone 3 Corner -146.5 psf or as otherwise indicated by Structural.
3. Follow Texas State Board of Insurance Windstorm Regulations.
  4. Follow local, state, and federal regulations of safety standards and codes. Refer to applicable building code or International Building Code for roofing system installation requirements and limitations.
- C. Texas State Board of Insurance Windstorm Regulations: Owner will provide inspector to meet all requirements. Contractors to coordinate all applicable roof inspections with Owners Inspector.
- D. Laboratory Testing and Samples:
1. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM procedures.
  2. Owner will select testing laboratory and will pay for Work required by testing laboratory. Contractor shall assume all costs for extraction and patch of all samples.
  3. Re-tests for work which fail initial tests or contractor shall pay inspections.
  4. Contractor shall correct all deficiencies in accordance with manufacturers recommended procedures at no cost to Owner.
- E. Installation:
1. Unless otherwise indicated, the materials to be used in this specification are those specified and denote the type, quality, performance, etc. required. All proposals shall be based upon the use of the specified material.
  2. Install materials in accordance with the manufacturer's current published application procedures and the general recommendations of the National Roofing Contractors Association.
  3. It will be the contractor's responsibility to obtain and/or verify any necessary dimensions by visiting the job site, and the contractor shall be responsible for the correctness of it. Any drawings supplied are for reference only.
  4. Contractor shall plan and conduct the operations of the work so that each section started on one day is complete, details installed and thoroughly protected and in watertight condition before the close of work for that day.
  5. Materials will be securely fastened in place in a watertight, neat, and workmanlike manner. All workers shall be thoroughly experienced in the particular class of work upon which employed. Work shall be performed in accordance with these specifications and shall meet the approval in the field of the Architect.
  6. All waste materials, rubbish, etc., shall be removed from the Owner's premises as accumulated. Rubbish shall be carefully handled to reduce the spread of dust and shall be deposited at an approved disposal site. At completion, all work areas shall be left broom clean, and all contractors' equipment and materials removed from the site.

## 1.9 PERFORMANCE REQUIREMENTS

- A. Texas State Board of Insurance Windstorm Regulations: Owner will provide inspector to meet all requirements. Contractors to coordinate all applicable roof inspections with Owners Inspector.
- B. Fire Resistance: Meet Underwriter's Laboratory Class "A" fire rating.

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- C. Contractor shall ensure that base fastener pull out resistance tests on structural roof deck are performed and approved by Architect and coordinated with Roofing Consultant prior to starting roofing application.

#### **1.10 PRE-INSTALLATION CONFERENCE**

- A. Meet with Owner, Architect, inspecting agency representative, roof installer, roofing system manufacturer representative, deck installer, plumber, electrician and other trades work impacts Air Barrier, Water Proofing, and roofing.
- B. Review methods and procedures related to installation.
- C. Review schedule and material availability.
- D. Review roof plan and details pertaining to work.
- E. Review temporary protection of roof system during and after installation.
- F. Review material storage requirements.

#### **1.11 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in manufacturer's original unopened packaging with all tags and labels intact and legible. Carton and can labels shall indicate appropriate warnings, storage conditions, lot numbers, and usage instructions. Handle and store materials and equipment in such a manner as to avoid damage. Coordinate material storage with school Principal.
- B. Manufacturer's packaging and/or roll plastic is not acceptable for exterior storage. Tarpaulin with grommets shall be minimum acceptable for exterior coverings. All materials stored as above shall be minimum of four (4) inches off the substrate, and the tarpaulin tied off with rope.
- C. Products liable to degrade as a result of being frozen shall be maintained above 40 degrees F in heated storage.
- D. Moisture sensitive products shall be maintained in dry storage areas or properly covered. Roofing insulation and felts must always be covered or stored in a dry area when not being used.
- E. The proper storage of materials is the sole responsibility of the contractor. Materials damaged in shipping or storage shall not be used. Wet or damaged roofing materials shall be discarded, removed from job site, and replaced with new materials prior to application.
- F. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

#### **1.12 PRECAUTIONS**

- A. Some of the indicated materials are extremely flammable and/or toxic. Use precautions indicated on can and carton labels.
- B. Due caution should be exercised so as not to alter the structural integrity of the deck. When cutting through any deck, care should be taken so as not to damage the deck or any part of the deck, such as post tension cables, etc.

- C. If torches are used, Contractor shall maintain a three (3) hour fire watch after completion of torching of each day's work. Provide a 20 lb. fire extinguisher near torch at all times. Use a thermal infrared thermometer to monitor all roof areas.
- D. The contractor is to verify the location of all interior ducts, electrical lines, piping, conduit, and/or similar obstructions. The contractor is to perform all work in such a manner as to avoid contact with the above-mentioned items.

### 1.13 WARRANTY

- A. Roofing Manufacturer: Warrant the roofing and associated Work for 20 years from date of Substantial Completion as follows:
  - 1. The warranty shall be a NDL "No Dollar Limit" / no penal sum type, with total replacement cost.
  - 2. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation, with NO exclusion for ponding water.
  - 3. The roof system shall include roof insulation, flashing, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
- B. Roofing Contractor: Jointly with any subcontractors employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the building will be and remain waterproof for a five (5) year warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Contractor, and subcontractors, to make good the requirements of the warranty. The warranty will be held jointly with the Bonding Company for the first two (2) years and the manufacturer for the remaining three (3) years.
- C. Make arrangements with the materials manufacturer to provide required inspections for issuance of warranty. Final warranty shall be submitted to Owner at time of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Unless noted otherwise, specifications are based on products of named manufacturers but should not preclude the Contractor from using other manufacturers who produce products that meet or exceed the specifications. Manufacturers whose products meet or exceed the specifications, who have manufactured and installed roof materials and systems of the type specified for a minimum of ten (10) years, and who maintains a single source responsibility for the total roofing system, as described herein, may apply for approval as a substitution in accordance with Division 1 requirements regarding substitutions.
  - 1. All materials shall be manufactured, specified, or accepted in writing by membrane manufacturer issuing the warranty. Proposed materials shall ensure full system warranty from said manufacturer. Installer shall be an applicator licensed by the manufacturer.
  - 2. Samples of all materials used on the project, which are not supplied by the membrane manufacturer, shall be submitted to the membrane manufacturer for written approval prior to starting work.
  - 3. All materials used on the project shall be asbestos free.

- A. All materials shall be manufactured, specified, or accepted in writing by membrane manufacturer issuing the warranty. Proposed materials shall ensure full system warranty from said manufacturer.
- B. Samples of all materials used on the project, which are not supplied by the membrane manufacturer, shall be submitted to the membrane manufacturer for written approval prior to starting work.
- C. All materials used on the project shall be asbestos free.

## 2.2 APPROVED PRODUCTS / MANUFACTURERS

- A. Basis of Design Product: Subject to compliance with requirements, provide Johns Manville, Roof Assembly in accordance with FM ROOFNAV# 376570-373762-0 and FM ROOFNAV# 374829-373726-0 where required by wind pressures or comparable product by one of the following.
- B. Approved Manufactures:
  - 1. Siplast, Inc.
  - 2. Garland Company, Inc.
  - 3. Tremco Incorporated
  - 4. Johns Manville

## 2.3 ROOF MEMBRANE ASSEMBLY

- A. Hot Asphalt Applied Modified Bitumen Base Ply: ASTM D 6163, Grade S, Type 1, SBS Modified asphalt sheet, reinforced with glass fibers, SBS-modified asphalt-impregnated and coated sheet, with glass-fiber- reinforcing mat, dusted with fine mineral surfacing on both sides.
  - 1. Basis of Design Product: Subject to compliance with requirements, provide Johns Manville Dynabase or comparable product.
    - a. Weight: 45 lb./100 sq. ft. minimum
    - b. Thickness: 80 mil. Minimum
- B. Hot Asphalt Applied Modified Bitumen Finish Ply: ASTM D 6163, Grade G, Type 1, SBS Modified asphalt sheet (reinforced with glass fibers), granule surfaced, suitable for application method specified.
  - 1. Basis of Design Product: Subject to compliance with requirements, provide Johns Manville Dynalastic 180 FR CR G, fire retardant, fiber glass reinforced SBS reflective mineral surfaced cool cap sheet or comparable product.
    - a. Surfacing: White synthetic chips
    - b. Three-year aged solar reflectance: 0.55 minimum
    - c. Three-year aged Thermal Emittance: 0.75 minimum
    - d. Thickness: 130 mil. minimum

## 2.4 FLASHING MEMBRANE ASSEMBLY

- A. Hot Asphalt Applied Modified Bitumen Base Flashing: ASTM D 6164/D 6164/M, Grade G, Type 1, or Type 2, SBS Modified asphalt sheet, reinforced with polyester fabric, granule surfaced, suitable for application method specified.



1. Basis of Design Product: Subject to compliance with requirements, provide Johns Manville Dynalastic FR CR G, fire retardant, polyester reinforced SBS reflective mineral surfaced, cool flashing sheet or comparable product.
  - a. Weight: 45 lb./100 sq. ft. minimum
  - b. Thickness: 80 mil. minimum

## 2.5 ROUGH CARPENTRY

- A. All nailers, cants and wooden curbs shall be No. 2 or better treated lumber selected to meet design details and field dimensions and requirements of Section 06 10 00, Rough Carpentry. MCQ and MCA only.

## 2.6 ROOFING SHEET METAL

- A. Refer to Section 07 62 00, Roof Related Sheet Metal.

## 2.7 ROOF INSULATION

- A. Roofing Insulation:
  1. All insulation shall be approved in writing by the membrane manufacturer as to thickness, type, and manufacturer. All insulation must be approved for the specific application with UL and FM Global approval.
  2. Polyisocyanurate Roof Insulation: Shall comply with ASTM C1289 Type II Class 2, Grade 2 with inorganic coated glass facer on both sides, with a 20-psi minimum compressive strength. Thickness shall be a minimum total of 4.4" (or size specified on drawings) and divided in two staggered layers. Basis of specification shall be ENRGY 3 CGF as manufactured by Johns Manville.
    - a. Acceptable substitute manufacturers include Atlas Roofing and Hunter Panels.
  3. Cover Board: Glass-Faced Gypsum Roof Board equal to UL rated Type X "DensDeck Prime Roof Board w/ Eonic Technology" as manufactured by Georgia-Pacific. Stock board sizes shall be 48" x 96" x 1/2" or as indicated on drawings for roof assembly. Provide as required by manufacturer recommendation for project roof system(s). Approved substitute, SECUROCK by USG.
  4. Substrate Board: Where required for fire rating or as indicated, 5/8-inch-thick Gypsum Board, tapered-edged, conforming to ASTM C36, Type X. Sizes shall be 4 feet-0 inches wide by longest practical length to minimize joints.
  5. Polyisocyanurate Tapered Roof Insulation: Shall comply with ASTM C1289 Type II Class 2, Grade 2 with inorganic coated glass facer on both sides, with a 20-psi minimum compressive strength. Provide factory cut 48" x 48" stock board. Slope and thickness to vary as required to achieve a minimum 1/4" per foot finished slope unless noted otherwise on the Drawings (cricketed areas between roof drains / scuppers are to achieve a minimum 1/2" per foot slope). Provide 1/2" cover board similar to that specified above tapered polyisocyanurate board insulation. Basis of specification shall be ENRGY 3 CGF as manufactured by Johns Manville.
    - a. Acceptable substitute manufacturers include Atlas Roofing and Hunter Panels.

6. Tapered “Fesco” Edge Strip: 0” to 1½” tapered (or as required for field conditions), 18” wide x 48” long. Install at all expansion joints, curbs, projections, crickets, saddles, and base flashings. Basis of specification shall be as manufactured by Johns Manville or approved substitute.

## 2.8 ROOFING ACCESSORIES

- A. Roofing Adhesives:
  1. Mopping Asphalt: Asphalt that has been certified for full compliance with the requirements for Low Fume Type IV asphalt listed in Table I, ASTM D312. Each container or bulk shipping ticket shall indicate the Equiviscous temperature EVT, the finished blowing temperature, FBT, and the flash point, FP.
    - a. Approved Product: Trumbull Low Fume asphalt or as required by membrane.
  2. Cold Adhesive (if applicable): An asphalt-based adhesive formulated especially for adhering polymer modified asphalt roofing membranes and base plies. Adhere shall be UL & FM listed and approved.
    - a. Soprema Product: FMA
    - b. Siplast Product: PA-311 Adhesive
    - c. Firestone Product: MB Cold Adhesive
    - d. JM Product: MBR Cold Application Adhesive
- B. Bituminous Cutback Materials:
  1. Primer: A high flash, quick drying, asphalt solvent blend which meets or exceeds ASTM D41 requirements.
  2. Plastic Cement: An asphalt cutback mastic, reinforced with non-asbestos fibers, used as a base for setting metal flanges and conforming to ASTM D4586 Type II requirements.
  3. Flashing Cement: A heavy-bodied all-weather trowel grade mastic, used as a base for laying-up cold process flashing membrane where fast setting adhesives are required.
- C. Sealants: A single component, high performance, elastomeric sealant conforming to ASTM D232 or ASTM C920 requirements. Acceptable types are as follows:
  1. Sonolastic NP 1 manufactured by Sonneborn Building Products; Minneapolis, MN (612) 835-3434
- D. Ceramic Granules: No. 11 Grade Specification Ceramic granules of color scheme matching the granule surfacing of the finish ply.
- E. Walkpads / Protection Pads: Provide cut sections of granule surfaced polyester reinforced modified bitumen sheet, such as “Dyna Tred Plus.”
  1. Walk pads shall have contrasting granule color from surfacing.
  2. Provide walk pads shall be installed at point of roof access, at service points of all roof mounted equipment requiring periodic maintenance.
  3. Protection pads shall have rounded corners and extend minimum four (4) inches beyond edge of overlying element.
  4. Provide new protection pads under all pipe supports, at HVAC and mechanical access points, in front of all roof top doors and openings.
- F. Fasteners:
  1. Shall be Factory Mutual approved and as recommended by the manufacturer for the specific application.

2. Fastener for Brick: Shall be 1/4-inch x 2 inches, stainless steel nail, one piece unit, flat head, as manufactured by Rawl Zamac Nailin, or approved equal.
  3. Fastener for Wood and Insulation (over steel decks): Shall be a minimum #14 Factory Mutual approved fastener, fluorocarbon coated, with CR-10 coating. A minimum 0.200-inch diameter shank and 0.250-inch diameter thread. To be used with Factory Mutual approved, round pressure plates or bar, and having a fluorocarbon CR-10 coating, when subjected to 30 Kesternich cycles (DIN 50018) shows less than ten percent (10%) red rust which surpasses Factory Mutual Approval Standard 4470 as manufactured by Olympic Manufacturing Group, Inc., or pre-approved equal. Stainless Steel 304 when used with ACQ treated lumber.
  4. Nails: Stainless Steel ring shank, size as required to suite application, minimum 11 gauge with 3/8-inch diameter head.
  5. Iron-Lok Toggle: Shall be a toggle bolt with minimum 0.215-inch diameter shank and minimum 20 threads per inch, with a 2-1/2 inch wingspan, with wing activated adhesive and pressure plate, as manufactured by Olympic Manufacturing Group, Inc.
- G. Liquid Flashings: One-Part Liquid Flashing is a one-component polyurethane / bitumen resin that provides a liquid flashing solution for asphaltic roofing systems. Utilize fabric in three-part system at all penetrations.

## 2.9 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Other materials shall be as shown, specified, or required and be of the best grade for the proposed use as recommended by the manufacturer.
1. Expansion Joint: As detailed on drawings and outlined in NRCA and SMACNA manuals.
  2. Low Level expansion joints, as noted on the drawings, to be fabricated similar to Situra Inc. "Red Line" Low level expansion joint details. Install as per manufactures recommendations.
    - a) Approved Substitute Soprema's "Sopra Joint." Install as per manufactures recommendations.
  3. Sealant Backer Rod: Provide compressible rod stack of polyethylene foam, polyurethane foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable, non-absorptive material as recommended by sealant manufacturer for back-up of and compatibility with sealant. Where used with hot-applied sealant, provide heat-resistant type which will not be deteriorated by sealant application temperature as indicated.
  4. Pipe Hangers and Supports: Provide and install all necessary supports for gas lines, conduit, chilled water lines, duct work, condensate lines, etc. Refer to Section 07721, Roof Accessories.
  5. Cant Strips: Shall be wood fiber where used for non-structural purposes. Shall be treated solid wood where used for structural purposes meeting NRCA, Factory Mutual and Underwriters Laboratory guidelines. If solid wood cant is used where insulation exists, cant is to be toe nailed into treated solid wood nailer the same height as insulation.
  6. Termination Bar:
    - a. Material: Extruded aluminum bar with lip profile.
    - b. Size: 0.090 inch thick by 3/4 inch wide with 3/16-inch lip width and a 45-degree lip angle, factory punched 1/4-inch x 3/8-inch oval holes spaced six (6) inches on center.
    - c. Approved Product/Manufacturer: "LIPTB 06" manufactured by Olympic Manufacturing Group, Inc., or approved equal.

## **PART 3 - EXECUTION**

### **3.1 SITE CONDITIONS**

- A. Environmental Requirements:
  - 1. Apply roofing in dry weather.
  - 2. Do not apply roofing when ambient temperature is below 45 degrees F.
  - 3. Refer to manufacturers' recommendations.

### **3.2 ROOFING AND FLASHING - GENERAL**

- A. Membrane Application: Install roofing in accordance with roofing system manufacturer's current published instructions and the following requirements. Application of roofing membrane components shall immediately follow installation of insulation as a continuous operation.
- B. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this Project. Make necessary preparations, utilize recommended application techniques, apply the specified materials, and exercise care in ensuring that the finished application is acceptable to the Owner.
- C. Application of materials shall be in strict accordance with the manufacturer's recommendations except where more stringent requirements are shown or specified. In the instance of a conflict between these specifications and those of the manufacturer, the more stringent specifications shall take precedence.
- D. General Installation:
  - 1. Protect adjacent areas with tarpaulin or other durable materials.
  - 2. Contractor shall prevent overspray and be responsible for parking lot areas and/or adjoining areas not part of this contract.
  - 3. Contractor shall be responsible for sealing, as required, all openings that may allow bitumen migration or drippage, i.e., pitch dams, envelopes, and filler strips.
  - 4. Prepare surfaces according to manufacturer's or applicator's published instructions. All metal that is to receive bitumen, or come in contact with bitumen or adhesive, shall be first primed with appropriate primer. All Kynar 500 or Hylar 5000 finished metal shall be buff sanded on the surface which is to be primed prior to the application.
  - 5. Use cleaning materials or primers necessary to render an acceptable surface/substrate.
  - 6. All surfaces/substrates shall be clean and dry prior to application of materials. Roof deck substrates shall be inspected for moisture in accordance with the manufacturer's recommendations. Architect's representative shall witness inspection. Roofing installed before inspection by Architect's representative shall be removed to allow inspection.
  - 7. Prior to application of felts and membrane, all foreign matter, gravel, etc., shall be removed from the substrate. Gravel or debris between the substrate and plies is not acceptable.
  - 8. Ambient temperature shall be 45 degrees F and rising.
  - 9. Bitumen kettles or tankers shall have a visible thermometer and thermostatic control to provide positive monitoring of the bitumen temperature when it is heated in accordance with manufacturer's instructions. Kettle shall be kept a minimum of 20 feet away from building, placed so that fumes, odors, and smoke, do not enter building through windows, doors, fresh air vents or similar entrances; are not

- directed towards freshly painted or anodized surfaces, glass, or other glazing materials. Do not place kettle under trees or near vegetation. The assigned kettle man shall remain in close attendance, within 25 feet of ground level, while burners are lit. Kettle lids are to remain closed except for loading. Level of bitumen shall be kept within eight (8) inches from top of kettle. All kettles are to have afterburners installed to reduce fume emissions.
10. Asphalt Bitumen Heating: Heat and apply bitumen in accordance with Equi viscous temperature method ("EVT Method") as recommended by the manufacturer. Discard bitumen that has been held at temperature, exceeding finished blowing temperature (FBT) for a period exceeding three hours. Do NOT heat bitumen to a temperature higher than 25 degrees F (14 degrees C) below flash point.
  11. Asphalt Temperatures: If the EVT information is not provided, the following asphalt temperature shall be observed. Maximum heating temperature shall be 525 degrees F. Minimum application temperature shall be 400 degrees F.
  12. Asphalt Moppings: Ensure that all moppings do not exceed a maximum of 25 pounds per square. Mopping shall be total in coverage, leaving no breaks or voids.
  13. Membrane Adhesive Application: Apply cold adhesive in a smooth, even, continuous layer without breaks or voids at the rate of 1-1/2 gallons per square per ply. (The porosity of substrates may require a heavier application to ensure full adhesion.)
  14. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.
  15. Circulate bituminous materials, do not allow bituminous materials to stand in luggers for long periods. Use insulated hot transport lines and luggers.
  16. Keep kettle lid closed except when adding bitumen.
  17. Wrinkles, buckles, kinks, and fishmouths are not acceptable when laying felt and membrane.
  18. Dry voids of felt on felt are not acceptable.
  19. Primed cant strips shall be installed at the intersection of the deck and the vertical surfaces.
  20. All flashings shall be mechanically top-fastened with a termination bar a minimum of six (6) inches on center at the top leading edge and be a minimum of eight (8) inches in height above the finished membrane height.
  21. On slopes greater than one (1) inch in 12 inches, refer to NRCA and/or manufacturer's guidelines for backnailing procedures and follow the more stringent guidelines for all specified materials.
  22. Correct all errors in application the same workday they occur, including voids, fishmouths, dry laps or spots, wrinkles, ridges, blisters, bare spots, improper application, physical damage, and all work not meeting specifications.
  23. Follow manufacturer's recommendation for application of cold adhesive due to slope requirements.

### 3.3 NAILERS

- A. Wooden nailers shall be installed at perimeter edges or drip edges on outside perimeter of building in accordance with FM Global 1-49 securement requirements. All deck penetrations (soil stacks, mechanical curbs, etc.) shall receive wooden nailers stacked minimum 3/4 inch above designed deck thickness.
- B. All Construction: Nailers shall be the same height as the finished height of the insulation layer. Nailers shall be anchored to resist a pull-out force of 175 pounds per foot. Fasteners shall be no less than two (2) per nailer and be spaced at three (3) feet on center maximum

or as required by FM Global 1-49 requirements. Provide nailers at all penetrations. Install / Raise all curbs, etc. a minimum of ten (10) inches above roof deck.

### **3.4 SUBSTRATE PREPARATION**

- A. Substrate Surface: Prepare substrate surfaces to insure proper and adequate installation, in strict accordance with the Contract Documents and approved Shop Drawings, or manufacturer's requirements.
- B. Fill all gaps and voids between substrate components that are wider than 1/4 inch. Fill all gaps with same materials as the substrate.
- C. The membrane manufacturer shall specify types of substrates that are suitable for use with the bonding adhesive.
- D. Protection of Adjacent Areas or Surfaces: Protect adjacent areas or surfaces from damage as a result of the Work of this section. Remove sharp projections.
- E. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- F. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of the roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

### **3.5 APPLICATION OF INSULATION**

- A. General:
  - 1. Manufacturer's Instructions: In regard to attachment, the manufacturer's instructions or specifications shall determine the suitability for an application.
  - 2. Precautions: The surface of the insulation must not be ruptured or damaged prior to installation of the roof membrane. Replace damaged boards.
  - 3. Thermal insulation boards shall be laid on the substrate in parallel rows with end joints staggered and butted as close as possible. All joints shall be tight and at the roof perimeter and roof penetrations, insulation shall be cut neatly and fitted to reduce openings to a minimum. All openings 1/4 inch or larger shall be filled with insulation.
  - 4. Insulation shall be tapered or feathered at drains and scuppers to provide proper drainage (if applicable).
  - 5. No more insulation shall be installed than can be covered by the completed roof system by the end of the day or the onset of inclement weather.
  - 6. Tapered insulation and crickets, when specified, shall be placed in accordance with the drawings and/or as required NRCA standards.
- B. (Steel decks); Specified first layer of rigid insulation shall be mechanically fastened to the steel deck meeting ASCE-7 wind uplift requirements as dictated by wind zone applicable to location of project. Fasteners and fastening patterns shall be determined by building height, location, and geographical area of the United States. It is the contractor's responsibility to consult current publications, literature, and bulletins of current codes and the manufacturer that are in effect at the time of this project.

- C. For subsequent layer or layers of insulation or specified recovery board, the top surface of the underlying layer of insulation shall be coated with hot asphalt using a minimum of twenty-five pounds (25#) per one hundred (100) square feet of surface, and subsequent layers of insulation shall be applied using offset joints, so that all individual insulation layers joints are offset a minimum of six inches (6") both ways with the preceding layer, and immediately walked in place.

### 3.6 ROOF MEMBRANE INSTALLATION

- A. Membrane Application: Install roofing in accordance with roofing system manufacturer's current published instructions and the following requirements. Application of roofing membrane components shall immediately follow application of insulation as a continuous operation.
- B. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this Project. Make necessary preparations, utilize recommended application techniques, apply the specified materials (i.e., granules, metallic powder, etc.) and exercise care in ensuring that the finished application is acceptable to the Owner.
- C. Adhesive Application: Apply cold adhesive with a spray equipment or squeegee in a smooth even, continuous layer without breaks or voids at the rate of 1 ½ to 2 gallons per square per ply. (The porosity of substrates may require a heavier application to ensure full adhesion. Refer to manufacturer's requirements).
- D. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.
- E. Roofing Application: Apply all layers of roofing free of wrinkles, creases or fishmouths. Exert sufficient pressure on the roll during application to ensure prevention of air pockets. Lap seams between the base ply layer and the finish ply layer shall not coincide. Stagger the courses to ensure this.
  - 1. Apply all layers of roofing so that water flows over or along lap seams, but never against laps.
  - 2. Attach the base ply to the insulation with cold adhesive, torch, or hot asphalt. Each sheet shall have minimum three (3) inch side laps and six (6) inch end laps. Each sheet shall be applied directly behind the adhesive applicator. Stagger end laps a minimum of three (3) feet.
  - 3. Fully bond the finish ply to the base ply with cold adhesive, torch, or hot asphalt. Each sheet shall have a minimum of three (3) inch side and six (6) end laps. Each sheet shall be applied directly behind the adhesive applicator. Stagger end laps of the finish ply a minimum of three (3) feet. Stagger side laps of the finish ply a minimum of 12 inches from side laps in the underlying base ply. Stagger end laps of the finish ply a minimum of three (3) feet from end laps in the underlying base ply.
  - 4. Maximum sheet lengths and special fastening of the specified roof membrane system may be required at various slope increments where the roof deck slope exceeds 1/2 inch per foot. The manufacturer shall provide acceptable sheet lengths and the required fastening schedule for all roofing sheet applications to applicable roof slopes.
  - 5. Lap Treatment: A 20-pound roller shall be used on all side and end laps, following immediately behind application, apply uniform pressure across lap area to achieve a continuous visible bleed out.

- F. Granule Embedment: Broadcast mineral granules over all bitumen overruns on the finish ply surface, while the bitumen is still hot, to ensure a monolithic color and adhesion.

### 3.7 ROOF FLASHING MEMBRANE INSTALLATION

- A. Flashing - General:
1. Flashings shall be installed using the manufacturer's flashing membrane, with length of run not to exceed manufacturer's recommendations.
  2. Wooden nailers or curbs shall be installed at all edges and openings in the roof, mechanically fastened to the deck. The nailers should be of exterior grade womanized timber, and of the same thickness as any insulation to be used on the roof.
  3. Cant strips shall be installed at the intersection of the deck and/or all vertical surfaces. Prime all cants.
  4. The roofing field membrane shall extend up over and to the top of cant strips at all vertical intersections or out to the roof's edge.
  5. All substrates receiving flashing membrane shall be clean and primed with asphalt primer, prior to application.
  6. All flashings shall be mechanically fastened with a termination bar a maximum of six (6) inches on center, be a minimum of eight (8) inches above finished roof height (seal top with three (3) coursing), extend a minimum of nine (9) inches onto the field of horizontal roof membrane, and not exceed ten (10) linear feet of run in length.
  7. Install flashing membrane in accordance with drawings and / or material manufacturer's guarantee requirements, whichever is the most stringent.
  8. Exert sufficient pressure on the flashing membrane to ensure the prevention of air pockets. This can be accomplished by using a damp, kitchen type sponge mop or a damp, heavy duty cotton nap paint roller.
  9. Prime all end laps of the flashing membrane with a uniform coating of the specified asphalt primer and allow to thoroughly dry prior to overlapping of adjoining sheets.
  10. Probe laps using a clean, heated roofing trowel and heat fuse dry laps of the flashing membrane to ensure a complete seal.
- B. Flashing Application - Masonry Surfaces: Flash masonry parapet walls and curbs using the reinforcing sheet and the metal foil flashing membrane. After the base ply has been applied to the top of the cant, fully adhere the reinforcing sheet, utilizing minimum three (3) inch side laps and extend a minimum of three (3) inches onto the base ply surface and three (3) inches up the parapet wall above the cant. After the final roofing ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or by application of asphalt primer; allowing primer to dry thoroughly. Torch applies the metal foil-faced flashing into place using three (3) foot widths (cut off the end of roll) always lapping the factory selvage edge. Stagger the laps of the metal foil flashing layer from lap seams in the reinforcing layer. Extend the flashing sheet a minimum of four (4) inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall/roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on nine (9) inch centers. (See manufacturer's schematic for visual interpretation).
- C. Flashing Application - Wood Surfaces: Flash wood or plywood parapet walls and curbs using the reinforcing sheet and metal foil flashing membrane. The reinforcing sheet shall have minimum three (3) inch side laps and extend a minimum of three (3) inches onto the



base ply surface and to the top of the parapet wall, curb, etc. Nail the reinforcing sheet through the field of the sheet to the vertical wood surface on 12-inch centers from the top of the cant to top of wall curb, etc. Fully adhere the remainder of flashing reinforcing sheet that extends over the cant and roof level. After the finish ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or application of asphalt primer; allowing primer to dry thoroughly. Torch applies the metal foil-faced flashing into place using three (3) foot widths (cut off the end of roll) always lapping the factory selvage edge. Extend the flashing sheet a minimum of four (4) inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall/roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on nine (9) inch centers. (See manufacturer's schematic for visual interpretation).

D. Projection Flashings:

1. Plumbing Vents: Soil vent stack pipes shall receive lead flashings installed in accordance with practices set forth in the NRCA Roofing Manual. The lead shall be carried up and over the top of the stack and crimped down into the pipe to form a watertight seal. Projections shall be flashed as recommended by the roof membrane manufacturer. Strip-in flange with specified stripping ply and cap with finish ply. Provide flashing membrane target.
2. Square Projections: Strip in all flanges on square projections with specified stripping ply and cap with finish ply. Provide flashing membrane target. Provide tapered edge strips around base. Cricket up-side slope.
3. Prime all flanges prior to setting in a bed of mastic. Install to manufacturer's specifications. Provide tapered edge strips around base as required. Cricket up-side slope.
4. Round Projections: Strip in all flanges on round projections with specified stripping ply and cap with finish ply. Provide flashing membrane target.
5. Prime all metal prior to setting in mastic. Install to manufacturer's specifications.

E. Wall and Curb Flashings:

1. The flashing substrate shall be free of all dirt and loose material.
2.  $\frac{3}{4}$ " plywood is to be used at all parapets that receive wall flashings.
3. The underlayment ply or plies shall be brought to the top of the cant strip and adhered.
4. Starting on the roof at least six (6) inches from the roof side edge of the cant strip, adhere two (2) plies of flashing extending over the cant and up the vertical a minimum of eight (8) inches. Each lap of the ply sheet shall be a minimum of three (3) inches.
5. Starting two (2) inches past the flashing plies, install one (1) ply of SBS flashing membrane in hot asphalt. Laps shall not coincide with previously installed plies. The top of the SBS flashing shall be one (1) inch past the previously installed plies above the cant strip.
6. Fasten the top edge of the flashings on six (6) inch centers using approved termination bar and fasteners.
7. An NRCA-approved metal counterflashing shall extend down over the flashing a minimum of four (4) inches.
8. Cricket the up-side slope at all curb projections.

F. Perimeter Edge Flashing: Refer to Section 07 62 00.

- G. Bleed out of flashing membrane: Broadcast bulk aluminum powder over all bitumen overruns on the flashing membrane surface while the bitumen is still hot to ensure a monolithic surface color. With approval of manufacturer, a premium glossy aluminum paint may be used.

### **3.8 OVERNIGHT SEAL / WATER CUT-OFF**

- A. Over Night Seal: Shall be performed according to accepted roofing practice as outlined in the NRCA Roofing Manual.
- B. Water Cut-Off: At the end of day's work or when precipitation is imminent, construct a water cut-off at all open edges. Cut-offs can be built using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs must be completely removed prior to resumption of roofing.

### **3.9 ROOF SYSTEM INTERFACE WITH RELATED COMPONENTS**

- A. The following is a list of descriptions for correct installation of components integrated into the roof membrane assembly. In all cases, unless otherwise approved, incorporate flanged components into the system between the applications of the base ply and finish ply. The flange must be primed with a uniform coating of approved ASTM D41 asphalt primer and allowed to dry thoroughly; all flanges must be set in approved mastic.
- B. Sealant: Caulk all exposed finish ply edges at gravel stops, waste stacks, pitch pans, vent stacks, etc., with a smooth continuous bead of approved sealant.
- C. Sheet Metal: Refer to Section 07 62 00, ROOF RELATED SHEET METAL.

### **3.10 FIELD QUALITY CONTROL AND INSPECTIONS**

- A. Roof cuts shall be performed and repaired at contractor's expense. Cuts shall be made in the areas as indicated by the Architect's representative. Send required roof cuts to roof membrane manufacturer for laboratory examination. Roof cuts required by the Architect's representative shall be furnished to the Architect's representative for testing.
- B. Remove not more than one (1) 12-inch x 12 inch cut per 5,000 square feet of roof area or fraction thereof.
- C. Field audit will follow criteria outlined in current roof membrane manufacturer's Reference Manual.
- D. Repair sampled areas with "feathered in" patch consisting of same number of plies as in the roof specification.
- E. Correct deficiencies in roof as prescribed in current roof membrane manufacturer's Reference Manual and as approved by Architect's Representative.

### **3.11 CLEANING AND PROTECTION**

- A. Contractor shall keep the job clean and free from all loose materials and foreign matter. Contractor shall take necessary precautions to keep outside walls clean and shall allow no roofing materials to remain on the outside walls.

- B. Leave all areas around job site free of trash, debris, roofing materials, equipment, and related items after completion of job.
- C. All bituminous or roofing related materials shall be removed from ladders, stairs, railings, and similar parts of the building.
- D. Remove bitumen stains from walls, walkways, and driveways.

**END OF SECTION**

## **SECTION 07 62 00 - ROOF RELATED SHEET METAL**

### **PART I – 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 SECTION INCLUDES**

- A. It is the intent of this Section that the Work shall:
  - 1. conform to all applicable building code requirements and of authorities having jurisdiction;
  - 2. include all shop and field formed sheet metal work shown on drawings, specified or required, including, but not limited to:
    - a. Roof penetration sleeves and hood and umbrella counterflashing
    - b. Metal counterflashing
    - c. Expansion joint
    - d. Roof drains
    - e. Scuppers
    - f. Metal perimeter edge
    - g. Gutters, Downspouts, Splash Blocks and Splash Pans
    - h. One-way roof moisture relief vents
    - i. Metal gravity vents
    - j. Metal heat exhaust vents
    - k. Sanitary vent pipes
    - l. Pipe box
    - m. Copings, trim and miscellaneous sheet metal accessories.
  - 3. be part of the Work of the Roofing System; and
  - 4. be performed by a single source contractor.

#### **1.3 RELATED WORK**

- A. Section 07 51 09 – Built-up Roofing Repair
- B. Section 07 52 19 – Modified Bitumen Cool Roof Membrane Roofing System
- C. Section 07 72 00 – Roof Accessories
- D. All Sections of Work relating to or affecting the roofing system, including mechanical, plumbing and electrical items.

#### **1.4 REFERENCES**

- A. ASTM International (ASTM)
  - 1. A525, Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
  - 2. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
  - 3. B32, Standard Specification for Solder Metal

- 4. C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- B. ASCE 7
- C. Federal Specifications (FS)
  - 1. QQ-L-201 for lead
- D. FM Global
  - 1. FM Global Property Loss Prevention Data Sheets: 1-49, Perimeter Flashing
- E. National Association of Architectural Metal Manufacturers (NAAMM)
- F. National Roofing Contractors Association (NRCA)
  - 1. Roofing and Waterproofing Manual
- G. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
  - 1. Architectural Sheet Metal Manual
- H. ANSI / SPRI ES-1

## 1.5 SUBMITTALS

- A. Product Data:
  - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
  - 2. Manufacturer's installation instructions.
- B. Shop Drawings: Indicating sizes, configurations, details of attachment to related and adjacent work, materials, and finishes.
- C. Samples:
  - 1) Full range of finish colors for Architect's selection.
  - 2) 12-inch-long sample of each specified item with approved finish.
  - 3) Provide full size mockup of all shop-built assemblies.
  - 4) Documentation of Wind uplift requirements for Roof Edge for specific project location
    - a. Wind Calculator available online

## 1.6 QUALITY ASSURANCE

- A. Single Source Responsibility: Fabricator and installer of roof-related flashing, installer of prefabricated edge metal and accessories shall be the same as the membrane roof installer.
- B. Comply with governing codes and regulations of authorities having jurisdiction.
- C. ANSI / SPRI ES-1: Install sheet metal edge flashings and copings to comply with requirements of ANSI / SPRI ES-1 / FM 1-49 for minimum of up to 120 MPH wind speed zone and wind resistance loads.

## 1.7 INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13, Project Coordination.

## 1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver, handle and store materials in accordance with manufacturer's instructions.
- B. Handle and store materials and equipment in such a manner as to avoid damage.
- C. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

## 1.9 WARRANTIES

- A. Manufacturer's Product Warranty:
  - 1) Manufacturer's standard 30-year Kynar 500 or Hylar 5000 Finish warranty signed by the manufacturer, with guarantee covering any failure of the fluoropolymer finish during the warranty period.
  - 2) Failure is defined to include, but not be limited to:
    - a. Deterioration of finish, such as fading, discoloring, peeling, cracking, corroding, etc.
  - 3) Wind Warranty:
    - a. Non-Coastal: up to 160 MPH Blow Off Resistance, 20 Year
  - 4) Correction may include repair or replacement of failed product as outlined in Warranty Documents
  - 5) Finish warranty and wind warranty shall be delivered by Roofing Contractor to Owner at the conclusion of project as part of project closeout documents.
- B. Roofing Contractor's Warranty:
  - 1. Contractor shall warrant the installation and related work to be free from defects in workmanship and materials, and that the metal flashings will be and remain watertight and secure, for a period of five (5) years from date of Substantial Completion.
  - 2. Defects shall include, but not be limited to:
    - a. Leaking water on the exterior of the building, causing staining or discoloration of wall / exterior surface.
    - b. Leaking water or bitumen within building or construction.
    - c. Becoming loose from substrate / blocking.
    - d. Loose or missing parts.
    - e. Finish failure as defined above.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis of Design: Metal Era, Inc.; 1600 Airport Rd.; Waukesha, WI 53188; Toll Free Tel: 800-558-2162; Tel: 262-549-6900; Fax: 800-373-9156; Email: [request info \(info@metalera.com\)](mailto:info@metalera.com);

Web: [www.metalera.com](http://www.metalera.com)

- B. Substitutions: Before proposal date upon roof consultant approval.
- C. Requests for substitutions will be considered in accordance with provisions of Section 012513.
- D. Manufacturers named within specification are approved for use on the Project providing:
  - 1. their products meet or exceed the specifications;
  - 2. company has a minimum of five (5) years' experience manufacturing products of the type specified;
  - 3. products have been tested in conjunction with roofing membrane system as an assembly and as such has obtained the same approval and rating as the roofing membrane system; and
  - 4. products are approved for use by the roofing membrane manufacturer.

## 2.2 SHEET METAL MATERIALS

- A. General Requirements: Roofing sheet metal system shall have been tested in conjunction with roofing membrane system as an assembly and have the same approval and rating as the roofing membrane system.
- B. Prefinished Galvanized Sheet Steel:
  - 1. Commercial quality ASTM A527 G-90 hot-dip galvanized coating designation.
  - 2. Thickness: Except as otherwise indicated, minimum 24 gauge. SMACNA recommendations shall govern.
  - 3. Finish: Kynar 500 or Hylar 5000 in color as selected by Architect from manufacturer's full range of standard, premium and metallic colors.
- C. Membrane Clad Sheet Steel:
  - 1. Commercial quality ASTM A527 with G-90 hot-dip galvanized coating designation.
  - 2. Thickness: Except as otherwise indicated, minimum 24 gauge. SMACNA recommendations shall govern.
  - 3. Finish: PVC coating as per Membrane Manufacturer's requirements.
- D. Sheet Lead:
  - 1. Comply with FS QQ-L-201, Grade B
    - a. Four (4) pound minimum for use at roof drains and soil stacks.
- E. Stainless Steel: ASTM A167, Type 302 / 304 Soft Temper, No. 2D finish. Minimum thickness 24 gauge, except as otherwise noted.

## 2.3 FASTENERS

- A. Same metal as flashing / sheet metal or other non-corrosive metal or as noted below.
- B. Exposed fasteners shall be self-sealing and gasketed (ZAC type) for weathertight installation.
- C. Match finish of exposed heads with material being fastened.
- D. Mechanical Fasteners:
  - 1. Nails: Ring shank, minimum 1-1/2 inches in length with 1/2 inch diameter head.

2. Washers: Steel washers with bonded rubber sealing gasket.
  3. Screws: Self-tapping sheet metal type of stainless steel or compatible with material being fastened, with hooded integral EPDM washers (ZAC type).
  4. Rivets: Stainless steel and cadmium plated material, closed end type of sizes recommended by sheet metal manufacturer to suit application.
- E. Clips:
1. Cleat: Minimum 22-gauge, G-90 galvanized, stainless steel, or aluminum. Match material of coping / fascia and provide one (1) gauge heavier.

## 2.4 RELATED MATERIALS

- A. Solder: ASTM B32, alloy grade 58, 50 percent tin, 50 percent lead.
- B. Flux:
1. Phosphoric acid type, manufacturer's standard.
    - a. For Use with Steel or Copper: Rosin flux
    - b. For Use with Stainless Steel: Acid-chloride type flux, except use rosin flux over tinned surfaces.
- C. Underlayment:
1. At expansion joints: to be used as bellow; 48 mil minimum, non-reinforced, homogeneous, waterproof, impermeable elastomeric sheeting manufactured by Nervastral, Inc. or Lexsuco.
  2. At wood blockings: Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film. Provide compatible substrate primer as instructed by manufacturer and coordinate with specification 07 65 00.
- D. Adhesives: Type recommended by flashing sheet manufacturer seaming and adhesive application of flashing sheet to ensure adhesion and watertightness.
- E. Metal Accessories: Sheet metal clips, straps, anchoring devices, clamps and similar accessories required for the complete installation of work, matching or compatible with material being installed, non-corrosive, size and gauge recommended by installer to suit application and performance.
- F. Sealant:
1. Type A:
    - a. Type: One-part, non-sag, moisture-curing polyurethane sealant.
    - b. Approved Products / Manufacturers: "Chem-Calk 900" manufactured by Bostik Construction Products Division, "Vulkem 921" manufactured by Mameco International, Inc., "Dynatrol I" manufactured by Pecora Corporation, "MasterSeal NP 1" manufactured by BASF, or approved equal.
  2. Type B:
    - a. Type: One-part, neutral-curing, medium-modulus silicone sealant for sealing metal to metal surfaces, i.e. metal edge, cover plates, etc.
    - b. Approved Products / Manufacturers: "Chem-Calk 1200" manufactured by Bostik Construction Products Division, "795 Silicone Building Sealant" manufactured by Dow Corning Corporation, "895 Silicone" manufactured



by Pecora Corporation, "Omniseal" manufactured by Sonneborn Building Products, "Spectrem 2" manufactured by Tremco Incorporated, or approved equal.

- G. Termination Bar:
  - 1. Material: Stainless steel or extruded aluminum bar with lipped profile.
  - 2. Size: 1/8 inch thick by one (1) inch wide with factory punched 1/4-inch x 3/8 inch oval holes spaced six (6) inches on center.
  - 3. Approved Product / Manufacturer: "TB 125" manufactured by TruFast Corp., or approved equal.
- H. Pipe Hangers and Supports: Refer to Section 07 72 00, Roof Accessories.
- I. Splash Blocks: Concrete type, of size and profiles indicated; minimum 3,000 psi compressive strength at 28 days, with minimum five (5) percent air entrainment. Use at locations where roof drainage discharges on ground.
- J. Splash Pans: 22-gauge stainless steel, of size and profiles indicated. Use at locations where roof drainage discharges over adjoining, lower roof level(s).

## 2.5 FABRICATION

- A. Except as otherwise indicated, fabricate work in accordance with SMACNA Architectural Sheet Metal Manual and other recognized industry practices and reviewed shop drawings. Form all flashings, receivers and counter flashings in accordance with standards set forth in the NRCA roofing manual and SMACNA.
- B. Comply with manufacturer's installation instructions and recommendations.
- C. Shop fabricate Thru-wall, counter flashings, expansion joint metal and wind clips to greatest extent possible.
- D. Fabricate items to size and dimensions as indicated on the drawings. Limit single-piece lengths to twelve (12) feet for prefabricated pieces and ten (10) feet for shop fabricated pieces.
- E. Face of any fabricated vertical metal fascia or coping shall not exceed 8" without stiffener band or bird's beak. If stiffener band or bird's beak cannot be fabricated, contractor to use multiple pieces of metal to achieve overall distance without going over the 8" maximum per piece.
- F. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work sufficient to permanently prevent leakage, damage, or deterioration of the work.
- G. Integrate flashing in a manner consistent with membrane waterproofing detailing. Form work to fit substrates.
- H. Make angle bends and folds for interlocking metal with full regard for expansion and contraction to avoid buckling or fullness in metal after installation.

- I. Fabricated items will have straight lines, sharp angles, smooth curves, and true levels. Avoid tool marks, buckling, and oil canning.
- J. Fold back edges on concealed side of exposed edge to form hem.
- K. Unless noted otherwise, lap joints minimum three (3) inch. Lap joints to have sealant installed as per details, to maintain watertight condition, inside and outside corners and elevation changes to be riveted and soldered.
- L. Seams:
  - 1. Wherever possible, fabricate non-moving seams in sheet metal with flat-lock seams and end joints.
  - 2. Pre-finished Galvanized Steel: Seal pre-finished metal seams with rivets and silicone sealant.
  - 3. Metal Other than Aluminum: Tin edges to be seamed, form seams, and solder.
- M. On Kynar 500 or Hylar 5000 pre-finished metal, surface sand metal flanges prior to applying any primers. Prime all metal in contact with bituminous material.
- N. Back paint concealed metal surfaces with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals.
- O. Expansion Provisions: Where lapped or bayonet type expansion provisions in work cannot be used or would not be sufficiently waterproof or weatherproof, form expansion joints of intermeshing hooked flanges, not less than one (1) inch deep filled with mastic sealant concealed within joints.

## 2.6 FABRICATED ITEMS

- A. Metal Flashings:
  - 1. Through Wall Receiver Tray: Minimum 24-gauge stainless steel formed in maximum ten (10) foot lengths, through wall receivers shall not extend past the face of the exterior veneer more than  $\frac{3}{4}$ ".
  - 2. Counter flashings: Minimum 24-gauge prefinished steel, formed in maximum ten (10) foot lengths.
- B. Wind Clips: Minimum 24-gauge stainless steel (or match material of counterflashing), one (1) inch wide by length to engage counterflashing a minimum of 1/2 inch. To be installed at all wall flashings and at curb flashing lengths longer than 5 feet.
- C. Roof Penetrations:
  - 1. Umbrella Counterflashing: Two-piece construction of minimum 22 gauge stainless steel, fabricated in accordance with drawings or project requirements.
  - 2. Flashing Pans:
    - a. 24-gauge stainless steel.
    - b. Fabricate to provide installed minimum clear inside perimeter dimension of two (2) inches on each side of penetrating element.
    - c. Fabricate pans to at least six (6) inches above the finished roof membrane and with 1/4-inch hem at top edge and with four (4) inch flanges. Round all corners of flange.

- d. Fabricate metal bonnets for all pans, NO EXCEPTIONS. Fabricate bonnets with metal compatible with metal to which bonnet is to be attached. On beams and other steel, weld in place bonnets fabricated from 1/4-inch steel plate. Draw band bonnets fabricated from 22-gauge stainless steel may be used on circular projections.
- D. Metal Edge / Fascia:
1. Perma-Tite System 200 Fascia for thermoplastic roof systems: Decorative metal fascia with continuous formed rail.
    - 1) Construction:
      - a) Fascia metal gauge  
24-gauge galvanized steel.
      - b) Finish:  
Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of standard, premium and metallic colors.
      - c) Formed Rail: Shall be continuous 20-gauge galvanized steel at 12'-0" standard lengths with pre-punched slotted holes and 6" stainless steel springs at 4'-0" on center.
    - 2) Thermoplastic Version
      - a) Model:
        - 1) FA-80 (8.25" Face)
      - b) Performance:
        - 1) 20-year, 160 mph Wind Warranty.
        - 2) Tested per ANSI / SPRI ES-1 / FM 4435 Standard to a design pressure of 200 psf to comply with the International Building Code.
        - 3) FM tested to a minimum FM 1-180 rating
  2. Edge Systems One "One Drip Edge" for Thermoplastic Roof Systems: Features a continuous cleat with pre-slotted fastening holes.
    - 1) Metal:
      - a) 24-gauge galvanized steel.
    - 2) Finish:
      - a) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of standard, premium and metallic colors.
    - 3) Fascia: Standard 12'-0" lengths with matching concealed joint splice plates. 1/4" face height.
    - 4) Splice Plates and 22 gauge galvanized continuous cleats with slotted holes are included.
    - 5) Performance:
      - a) 20 Year, 160 mph Wind Warranty.
      - b) Tested per ANSI / SPRI ES-1 / FM4435 Standard to a design pressure of 276 lbs./ft<sup>2</sup> to comply with the International Building Code.
      - c) Factory Mutual approved I-285 for wind up lift protection.
- E. Metal Coping
1. Perma-Tite Coping

- 1) Construction:
  - a) Metal:
    - 1) 24-gauge galvanized steel.
  - 2) Finish: Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of standard, premium and metallic colors.
  - 3) Coping Cap: Length of 12'-0", widths to 24" manufactured to job requirements. True radii may be built to template.
  - 4) Coping Vertical Face and Back Leg: 2 1/4" to 12 1/2" manufactured to job requirements.
  - 5) Concealed Splice Plates: 8" wide. Finish to match finish of coping cap with factory applied dual non-curing sealant strips.
  - 6) Anchor / Support Cleat: 20-gauge pre-punched galvanized cleat with stainless steel spring mechanically locked to cleat normally 12" wide at 4'-0" on center. Mechanically fastened as indicated and detailed.
  - 7) Fasteners: 1 1/2" stainless steel with driver.
  - 8) Performance:
    - a) 20 Year, 160 mph Wind Warranty
    - b) Tested per ANSI / SPRI ES-1 / FM4435 Standard to comply with the International Building Code.
    - c) Factory Mutual 1-90 approved for wind up lift protection.
    - d) Miami-Dade Approved (No. 13-0419.03 12/11/18) to comply with the "High Velocity Hurricane Zone of the Florida Building Code".
- F. Continuous Cleats (where applicable): Continuous strips, same material and profile, minimum one gauge heavier of item which cleats attach.
- G. Vent Hoods, Sleeves, Penetration Flashings, and Accessories: Minimum 24-gauge stainless steel, or as shown or directed otherwise.
- H. Angle Termination Bar: Aluminum pressure bar 1/8-inch x one (1) inch.
- I. Vent Pipe Flashing: Unreinforced, pre-molded thermoplastic membrane pipe boot to suit flashing condition and pipe size. Provide stainless steel pipe clamp and sealant between pipe boot and clamp. Provide sheet metal umbrella flashing with sealant and pipe clamp above top of membrane pipe boot clamp and seal.
- J. Gutters / Downspouts / Collector Heads: Seal-Tite Industrial Gutter System by manufacturer.
  1. Minimum 24-gauge prefinished galvanized steel, formed in maximum twelve (12) foot lengths.
  2. Verify gutter and downspout meets rainfall data as outlined in SMACNA.
  3. Seal-Tite Industrial Gutter, including 2" Wide Gutter Straps 24" o.c., Wind Straps 6'-0" o.c., 1/8" Stainless Steel Pop Rivets, and #10 x 2" Stainless Steel Fasteners to be manufactured and supplied to suit profile and dimension of gutter and downspout by manufacturer.
  4. Supply Drip Edge at gutter.
  5. 24-gauge galvanized steel with membrane manufacturer's coating.
  6. For Single Ply roofing systems: Drip Edge with Factory Applied Flashing (PVC).
  7. End Caps, Downspout Outlets, Gutter and Downspout Straps, Support Brackets and joint fasteners to be manufactured to suit profile and dimension of gutter and downspout.
  8. Install all anchoring devices as outlined in manufacturer literature.

9. Expansion Joints: Style 1 per manufacturer, locate every 50 linear feet.
10. Gutter Straps and Supports: Minimum 3 per 12'-0" length, .100-inch-thick downspout straps: Strap type, like metal, match color.
11. Downspouts: Minimum 24-gauge prefinished galvanized steel (match color).
12. Downspout straps: Strap type, like metal, match color.
13. Gutter Screen: .050" Aluminum with 1/4" dia. perforations
14. Collect Heads: Minimum 24-gauge prefinished galvanized steel (match color). As outlined in SMACNA; Refer to Figure 1-25F and Figure 1-28 with alternate Section A-A.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify substrates are smooth and clean to extent required to perform sheet metal work.
- B. Verify roof openings, curbs, pipes, sleeves, ducts or vents through roof are solidly set in place.
- C. Verify that reglets, nailers, cants, and blocking to receive sheet metal are in place and free of concrete and soil.
- D. Do not start work until conditions are satisfactory.

#### **3.2 PREPARATION**

- A. Field measure site conditions prior to fabrication work.
- B. Install starter and edge strips and cleats before starting installation.

#### **3.3 INSTALLATION**

- A. Install sheet metal with lines, arises, and angles sharp and true, and plane surfaces free from objectionable wave, warp, or buckle. Exposed edges of sheet metal shall be folded back to form 1/4-inch hem on concealed side from view. Finished work shall be free from water retention and leakage under all weather conditions. Prefabricated corners or transitions are required at changes in direction, elevation, or plane and at intersections. Locate field joints not less than 12 inches, nor more than three (3) feet from actual corner. Laps shall be one (1) inch, riveted and soldered at following locations:
  1. Prefabricated corners;
  2. transitions;
  3. changes in direction, elevation, and plane; and
  4. at intersections.
- B. Anchor units of work securely in place to prevent damage or distortion from wind or buckling. Provide for thermal expansion of metal units; conceal fasteners wherever possible; and set units true to line and level as indicated. Install work with laps, joints, and seams which are permanently watertight and weatherproof.
- C. Install fabricated sheet metal items in accordance with manufacturer's installation instructions and recommendations and with SMACNA Architectural Sheet Metal Manual.

1. Ensure approved fasteners are used throughout the project.
  2. Ensure fasteners are installed in manufacturer pre-punched holes on rails, extrusions, clips, and cleats.
  3. Ensure sufficient amount of water block is applied where appropriate to prevent leaking under rails/extrusions. **Contractor is responsible for cleaning stained brick and remedying for total length of workmanship warranty if water block is not installed appropriately.**
- D. Separations: Provide for separation of metal from dissimilar metal or corrosive substrates by coating concealed surfaces with zinc chromate, bituminous coating, or other permanent separation at locations of contact as recommended by manufacturer or fabricator. Do not use materials which are incompatible with roofing system.
- E. Cleat: At exposed edges of perimeter edge, fascias, cap flashings, and where required, attach cleat with appropriate fasteners supplied by roof edge manufacturer. Install cleat so fascia extends a minimum of 1 inch below top of exterior wall finish.
- F. Counterflashing:
1. Do not use surface mount counterflashing except as noted in drawings.
  2. Set in through wall with receiver and spring lock counterflashing, as detailed in drawings and to NRCA roofing manual, SMACNA standards.
  3. Coordinate installation of through-wall flashing with the masonry contractor.
  4. Seal through-wall in conjunction with masonry wall waterproofing.
  5. Install wind clips 30 inches o.c. at all counterflashing over five (5) feet in length.
- G. Sanitary Vent Stacks: Thermoplastic Roof System
1. Prepare substrate and fit pre-molded pipe boot.
  2. Heat weld pipe boot flange to prepared thermoplastic field membrane.
  3. Apply sealant as recommended by membrane manufacturer to inside of the top edge of the pipe boot. Install stainless steel pipe clamp ensuring no wrinkles or folds in the pipe boot membrane. Apply second bead of sealant at the top of the pipe boot.
  4. Install sheet metal umbrella flashing, pipe clamp and sealant above top of pipe boot.
- H. Gutters / Downspouts:
1. Install gutters prior to edge metal and otherwise as detailed.
  2. Install downspouts plumb and level, attached to columns or wall with straps located at top and bottom of downspout and maximum ten (3) feet on center (note: 3 per 12' lengths supplied by manufacturer).
  3. Install splash pad or block under discharge port of downspouts (if non exist). Install splash pan over a protection (walkway) pad for downspouts located at roof level.

### 3.4 CLEANING AND PROTECTION

- A. Remove flux and residual acid immediately by neutralizing with baking soda and washing with clean water. Leave work clean of stains.
- B. Remove scraps and debris and leave work area clean.

- C. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes. Paint areas where finish is damaged on pre-finished metal by painting with a compatible paint in color to match undamaged finish.
- D. Prime soldered area of phosphatized metal after cleaning to prevent rusting.
- E. Paint metal flashings that have been soiled with bitumen with aluminized paint.
- F. Clean other work damaged or soiled by Work of this Section.
- G. Protect finished work from damage.

**END OF SECTION 07 62 00**

## **SECTION 07 65 00 - FLEXIBLE FLASHING**

### **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 SECTION INCLUDES**

- A. Provide flexible flashing where shown on drawings or required.

#### **1.3 RELATED SECTIONS**

- A. Section 03 30 00 – Cast-In-Place Concrete
- B. Section 04 20 00 – Unit Masonry
- C. Section 07 27 26 – Fluid Applied Air Barrier System
- D. Section 07 41 13 – Prefinished Metal Roofing
- E. Section 07 52 19 – Modified Bitumen Cool Roof Membrane Roofing System
- F. Section 09 21 16 – Gypsum Wallboard Systems (Exterior Sheathing)

#### **1.4 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
  - 2. Manufacturer's installation instructions.
- B. Certification: Manufacturer's affidavit that materials used in Project contain no asbestos.
- C. Compatibility: Submit letter from primary Fluid Applied Air Barrier System Manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from Manufacturer stating that cleaning materials used during installation are chemically compatible with adjacent materials proposed for use.

### **PART 2 - PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURER**

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Flexible flashing materials used shall be compatible with and not void any warranties of the air barrier system used. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be



considered.

## 2.2 MATERIALS

- A. Flashing:
1. Copper Laminated Flashing (Contractor's Option – in lieu of asphalt-free copper fabric flashing):
    - a. Flashing: A full sheet of copper weighing five (5) ounces per square foot coated or bonded on both sides with one (1) of the following:
      - 1) Modified asphalt compound coated.
      - 2) Asphalt saturated, waterproof glass fiber laminated fabric.
    - b. Approved Manufacturers:
      - 1) Advanced Building Products, Inc.
      - 2) Hohmann & Barnard, Inc.
      - 3) Sandell Manufacturing Company, Inc.
      - 4) York Manufacturing, Inc.
    - c. Mastic: Manufacturer recommended asphalt troweled mastic for sealing copper laminated flashings
  2. Asphalt-free Copper Fabric Flashing (Contractor's Option – in lieu of copper laminated flashing):
    - a. Glass fabric scrim bonded to a full sheet of copper for general through wall flashing as an alternative to asphalt coated copper specified above and where sealant compatibility is required. Provide manufacturers approved sealant or seam tape.
    - b. Approved Product / Manufacturer: Multi-flash 500 as manufactured by York Manufacturing, Inc.; or Copper-Fabric NA or Copper-Fabric SA as manufactured by Hohmann & Barnard, Inc. (No substitutions).
  3. Asphalt-free Stainless Steel Flexible Flashing (Contractor's Option – in lieu of copper laminated or asphalt-free copper fabric flashing):
    - a. Flexible minimum 2 mil thickness, Type 304 stainless steel sheet with factory applied adhesive with a release liner on one side for general through wall flashing as an alternative to asphalt coated copper specified above and where sealant compatibility is required. Provide manufacturers approved sealant or seam tape.
    - b. Approved Product / Manufacturer: York 304 as manufactured by York Manufacturing, Inc.; or Mighty-Flash-SA as manufactured by Hohmann & Barnard, Inc. (No substitutions).
  4. Membrane Flashing:
    - a. Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film. Provide compatible substrate primer as instructed by Manufacturer.
    - b. Approved Products / Manufacturers:
      - 1) "CCW-705 TWF" manufactured by Carlisle Coatings and Waterproofing
      - 2) "Perm-A-Barrier" manufactured by W. R. Grace & Co.
      - 3) "Blueskin TWF" manufactured by Henry Co.
      - 4) "Air-Shield Through wall flashing" manufactured by W.R. Meadows, Inc.
      - 5) "TW-Thru Wall Flashing" manufactured by Tamko Waterproofing.
      - 6) AquaFlash 500" manufactured by Fiberweb.
  5. Substrate Primer: Provide as instructed by Membrane Manufacturer.

6. Termination Bar: 14 ga. minimum thick by 1" minimum wide stainless steel, with pre-punched holes and ¼" minimum shouldered top flange. Provide with self-tapping screws.
7. Weathering Flange at Door / Window Openings: Provide a 20 gauge (0.040") stainless steel or .040 aluminum 2"x3" weathering flange at head, jamb and under sill pan of storefront window and hollow metal door systems. Screw attach into wood blockings or substrate walls and strip into air barrier system.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Flashing:
  1. Follow manufacturer's instructions for mechanically fastened installation with a termination bar.
  2. Application Guidelines - Install flashing at the following locations:
    - a. Membrane Flashing: material transitions inside exterior cavity walls, roof edge / exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior door and window frame perimeters, roof deck / exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps, or openings to ensure a continuously sealed building envelope. Utilize primer on substrates as instructed by manufacturer.
    - b. Copper Flashing: At all horizontal wall flashing, including (but not limited to) exterior wall sill / weep conditions, exterior door and window head / weep conditions, intermediate and / or shelf angles, masonry wall cap flashing and masonry wall base flashing.
  3. Apply substrate primer as instructed by membrane manufacturer to suit condition.
  4. Provide drip edge flashing at weep conditions with membrane flashing. Cut ¼" to ½" behind with outside edge of brick over top of drip edge flashing to alleviate exposure to UV degradation and deterioration of asphalt membrane.
  5. On Horizontal Surfaces: The flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches. Flashing will then be secured in back wall with termination bar.
  6. On Vertical Surfaces: Surfaces receiving the flashing shall be sufficiently spotted with asphalt mastic to hold in place until masonry is set. Secure in back wall with termination bar.
  7. Foundation Sill Dampproofing: The flashing for foundation sills shall be laid in a slurry of fresh mortar or in a full bed of mastic and topped with a fresh full bed of mortar. The flashing shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be sloped across the cavity and turned up the wall a minimum of ten (10) inches and

- secured to back wall with termination bar. Where sill and column meet, flashing shall be brought up a minimum of ten (10) inches up the column.
8. Thru-Wall Flashing: Shall be cut  $\frac{1}{4}$ " to  $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Carry flashing through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secure in back wall with termination bar.
  9. Lintel: Premolded or field molded end dams must be provided at each end of all lintels.
  10. Cavity Wall: Flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut  $\frac{1}{4}$ " to  $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secured in the back wall with termination bar. Vertical membrane joints shall be secured with termination bar as instructed by membrane manufacturer.
  11. Heads, Jambs and Sills: Flashing for heads and sills shall be cut  $\frac{1}{4}$ " to  $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise. Head flashing shall be carried six (6) inches beyond both end of the steel lintel. Both head and sill flashing shall be turned up at the sides to form a pan. All corners shall be folded, NOT CUT. Jambs are to be turned into the buildings to complete seal perimeter of window or door. Install weepholes.
  12. Windows: wrap all heads, sills, and jambs into opening with flexible flashings.
  13. Wood blockings: Flexible flashings are to cover wood blockings in their entirety.
  14. Spandrels: Spandrel flashing shall start from the outside toe of the shelf angle, go up the face of the beam and then through the wall, turned up on the inside not less than two (2) inches. Install weepholes.
  15. Parapet or Coping: Flashing for parapets or coping sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut  $\frac{1}{4}$ " to  $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Weepholes shall be installed immediately on top of the flashing.
  16. Lengths: Install flashings without longitudinal joints within walls, if possible. If required materials are not available in a single width, join by lapping material minimum two (2) inches and seal joint throughout its length with adhesive.
  17. End Joints: Avoid end joints in flashing. When end joints are necessary, lap flashing minimum six (6) inches and seal joint continuously with adhesive.
  18. Penetrations: Where anchors, pipes, and inserts penetrate flashing, make opening in flashing snug and seal with adhesive.
  19. Reglet Termination: Insert wedge into place and seal carefully with adhesive.
  20. Termination Bar: Install flashing with termination bars in accordance with manufacturer's instructions. Provide 3 coursing at all termination bars, typical.
  21. Top Coat: After flashing material is in place (except in masonry joints where bond and mortar is required) trowel full  $\frac{1}{8}$  inch protective coating or mastic on all flashing faces.
  22. Lintels: Provide pre-molded end dams at all lintel ends.
- B. Bed Joints: Coordinate work with Division 4, Masonry. Install thru-wall flashings between two (2) thin layers of masonry mortar without increasing thickness of mortar joint. Keep outer edge of flashing material back  $\frac{3}{4}$  inch from face of masonry.

**3.2 APPLICATION**

- A. Protect membrane from overexposure to direct sunlight.
- B. Follow manufacturer's recommendations for installation.
- C. Adjacent Work: Protect work by masking, covering, or other precautionary methods. Remove protection when no longer necessary.

**END OF SECTION 07 65 00**

## **SECTION 07 71 23 - MANUFACTURED GUTTERS AND DOWNSPOUTS**

### **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. Precast concrete splash pads.
  - 2. Sheet metal splash pans.
- B. Related Sections:
  - 1. Section 05 50 00 - Metal Fabrications: Metal downspout boots and downspout guards.
  - 2. Section 07 41 13 - Prefinished Metal Roofing: Standing seam metal roofing.
  - 3. Section 07 62 00 - Roof Related Sheet Metal.

#### **1.3 REFERENCE STANDARDS**

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Comply with SMACNA (ASMM) for sizing components for rainfall intensity determined by a storm occurrence of 1 in 5 years.
- B. Comply with applicable code for size and method of rain water discharge.
- C. Maintain one copy of each document on site.

#### **1.5 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data on prefabricated components.
- C. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.
- D. Samples: Submit two samples, 6 inch (150 mm) long illustrating component design, finish, color, and configuration.

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

- A. Refer to Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.
- C. Prevent contact with materials that could cause discoloration, staining, or damage.

#### **1.7 WARRANTY**

- A. Manufacturer's Product Warranty:
  - 1. Manufacturer's standard 30-year finish warranty signed by the manufacturer, with guarantee covering any failure of the fluoropolymer finish during the warranty period.
  - 2. Failure is defined to include, but not be limited to:
    - a. Deterioration of finish, such as fading, discoloring, peeling, cracking, corroding, etc.

3. Correction may include repair or replacement of failed product as outlined in Warranty Documents
  4. Finish warranty and wind warranty shall be delivered by the Contractor to the School District at the conclusion of project as part of project closeout documents.
- B. Contractor's Warranty:
1. The Contractor shall warrant the installation and related work to be free from defects in workmanship and materials, and that the gutters, downspouts, and conductor heads will be and remain watertight and secure, for a period of five (5) years from date of Substantial Completion.
  2. Defects shall include, but not be limited to:
    - a. Leaking water on the exterior of the building, causing staining or discoloration of wall / exterior surface.
    - b. Leaking water or bitumen within building or construction.
    - c. Becoming loose from substrate / blocking.
    - d. Loose or missing parts.
    - e. Finish failure as defined above.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
1. Scupper and Collectors:
    - a. ATAS International, Inc.: [www.atas.com/](http://www.atas.com/).
    - b. Metal-Era, an MTL Company: [www.metalera.com/](http://www.metalera.com/).

### **2.2 MATERIALS**

- A. Pre-Finished Galvanized Steel Sheet: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 0.02 inch (0.6 mm) thick base metal.
1. Finish: Shop pre-coated with modified silicone coating.
  2. Color: As indicated on Drawings.

### **2.3 COMPONENTS**

- A. Scuppers and Collectors:
1. Profile as indicated on Drawings.
  2. Collector Heads: Minimum 24-gauge prefinished galvanized steel (match color). As outlined in SMACNA; Refer to Figure 1-25F and Figure 1-28 with alternate Section A-A.
- B. Accessories:
1. Splash Pans: Same metal type as downspouts, formed to \_\_\_ by \_\_\_ inches (\_\_\_ by \_\_\_ mm) size; rolled sides \_\_\_ inch (\_\_\_ mm) high for inverted pan placement.
  2. Splash Pads: Precast concrete type, size and profiles indicated; minimum 3,000 psi (21 MPa) at 28 days, with minimum 5 percent air entrainment.
  3. Downspout Boots: Refer to Section 05 50 00 - Metal Fabrications.
  4. Downspout Guards: Refer to Section 05 50 00 - Metal Fabrications.

### **2.4 FABRICATION**

- A. Form gutters and downspouts of profiles and size(s) indicated on Drawings.
- B. Fabricate with required connection pieces.
- C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
- D. Hem exposed edges of metal.
- E. Fabricate gutter and downspout accessories; seal watertight.

## **2.5 FINISHES**

- A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604, multiple coat, thermally cured fluoropolymer finish system; color as selected by Architect from manufacturer's standard colors.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that surfaces are ready to receive work.

### **3.2 PREPARATION**

- A. Paint concealed metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.381 mm).

### **3.3 INSTALLATION**

- A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.
- B. Sheet Metal: Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.
- C. Slope gutters \_\_\_\_ inch per foot (\_\_\_\_ mm/m) , \_\_\_\_ percent minimum.
- D. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.
- E. Connect downspouts to downspout boots at \_\_\_\_ inches (\_\_\_\_ mm) above grade. Grout connection watertight.
- F. Set splash pans under downspouts. Secure in place with \_\_\_\_\_ .

**END OF SECTION 07 71 23**

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## **SECTION 07 72 00 - ROOF ACCESSORIES**

### **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 INSTALLATION RESPONSIBILITY**

- A. In addition to the items normally a part of this Section, coordinate the installation of roof accessory curbs and pipe flashings and equipment supports that may be specified elsewhere.
- B. Coordinate the Work specified herein with the following Work:
  - 1. Roofing
  - 2. Roofing sheet metal
  - 3. Mechanical equipment
  - 4. Plumbing
  - 5. Electrical

#### **1.3 REFERENCES**

- A. Federal Specifications (FS)
  - 1. TT-S-00227E
- B. National Roofing Contractors Association (NRCA)
- C. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
  - 1. Architectural Sheet Metal Manual

#### **1.4 SUBMITTALS**

- A. Product Data: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
- B. Shop Drawings: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.
- C. Contractor to provide proof of membrane material compatibility for roof bracing and supports.

#### **1.5 PRE-INSTALLATION CONFERENCE**

- A. Refer to Section 01 31 13 – Project Coordination.

#### **1.6 WARRANTY**

- A. Warranty the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

- B. Defects shall include, but not be limited to, the following:
  - 1. Noticeable deterioration of finish
  - 2. Leakage of water into the building or within the construction.
- C. Rooftop supports – 5-year limited warranty.
- D. Roof bracing – 20-year limited warranty included in roofing warranty.
  - 1. Water infiltration into the building or within the construction.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Specifications are based on products of named manufacturers. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

### **2.2 PREFABRICATED ROOF CURBS**

- A. Frames:
  - 1. Material: ASTM A 653 G90 hot-dipped galvanized steel.
    - a. Minimum 18 gauge, and as engineered by manufacturer.
    - b. Minimum 18 gauge for curbs supporting HVAC units
    - c. Minimum 20 gauge for expansion joint curbs.
  - 2. Corners: Mitered and welded (welds are micro sealed and prime painted after fabrication). Bolted connections not accepted.
  - 3. Base Plates: Integral to frame and welded.
  - 4. Internally reinforced with galvanized 1 inch by 1 inch by 12 gauge angles for curbs exceeding 3 foot length. Reinforce internal bulkhead at equipment curbs to support lateral loads.
  - 5. Wood Nailers: Factory installed; pressure treated. Size and width as suitable for support of items installed on curbs.
- B. Insulation: Factory installed 1-1/2 inch thick three-pound density fiberglass insulation.
- C. Curb Height: Minimum 8 inch above finished roof.
  - 1. Construct curbs to match roof slope with plumb and level top surface for mounting mechanical equipment.
- D. Gasketing: 1/4 inch thick, one (1) inch wide at roof top units.
- E. Counterflashing: 24-gauge stainless steel
- F. Counterflashing Cap: Stainless steel.
- G. Cants:
  - 1. Non-canted curb style installs either under or on top of metal decks with insulation.

2. Cants shall be provided under Section 07 54 23 – Fully Adhered PVC Membrane Roofing System.
- H. All insulated roof curbs shall be structural and shall include calculations signed and sealed by a registered Structural Engineer. Refer to installation drawings for any additional structural requirements. If curbs do not span a minimum of two bar joists, only two angles will be required. Coordination mechanical equipment weight loading on the roof with Structural Engineer.
- I. Approved Manufacturers:
1. Custom Curb, Inc.
  2. Roof Products, Inc.

### **2.3 PIPE SUPPORTS (Contractor built supports are not allowed)**

- A. Gas Pipe Supports:
1. Provide pipe roller type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (10" x 16" x 3"; 5.5 lbs. each) and stainless-steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PP10-R with roller for gas pipe 3" O.D. and smaller.
  2. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (12" x 12" x 3"; 3 lbs. each or 18" x 18" x 3"; 7 lbs. each or 18" round; 10.5 lbs. each) and stainless-steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 with hanger for gas pipe larger than 3" O.D.
  3. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.
- B. Electrical Conduit / Condensate Pipe Supports:
1. Provide channel / strut type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (10" x 16" x 3"; 5.5 lbs. each) and stainless-steel channel, rods, washers, and nuts; Basis of design, PHP Systems / Design Model PP10-C with channel for condensate pipe or conduit 3" O.D. and smaller.
  2. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (12" x 12" x 3"; 3 lbs. each or 18" x 18" x 3"; 7 lbs. each or 18" round; 10.5 lbs. each) and stainless-steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 with hanger for condensate pipe or conduit larger than 3" O.D. Contractor to provide channel clamp at each support. Provide dissimilar metal protection as required.
  3. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.
- C. Chilled Water Pipe Supports:
1. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (18" x 18" x 3"; 7 lbs. each or 18" round; 10.5 lbs. each) and stainless-steel rods, washers, and nuts; Basis of design, PHP Systems / Design Model PS-1-2 or Model PS-2-2 or Model PSE Custom as required with hanger(s) for chilled water pipe of any diameter.
  2. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.

## **2.4 ROOF TO ROOF EXPANSION JOINT**

- A. Stainless Steel expansion joint covers on new wood curbs, as detailed on drawings and outlined the NRCA and SMACNA manual.

## **2.5 MISCELLANEOUS ROOF BRACING AND SUPPORT SYSTEMS**

- A. Provide U- Anchors made of 304 stainless steel with 3/8" bolt and galvalume plate. Utilize same membrane as roofing manufacturer to be inclusive in 20 YEAR NDL warranty
- B. As manufactured by Anchor Products Model U-anchor 2000 Series as required for condition or nVent Caddy Pyramid Anchor system

## **2.6 ROOF PENETRATION HOUSING**

- A. Provide rain-proof our-piece configuration consisting of a removable vandal resistant lid, middle housing, insulation extension (ICE) and wide flanged curb that is light weight and watertight. To be used with our exclusive two-piece aluminum and/or stainless-steel flanged Exit Seal with SilX14TM gasket. Provide 20 Year insured warranty.
- B. As manufactured by Roof Penetration Housing Model AWI Series Vault as required for condition or Architect approved equal.

## **2.7 ROOF DRAIN / DOWNSPOUT WALL NOZZLE**

- A. Downspout Wall Nozzle at Concealed Roof Drain Leader / Discharge: Josam 25010 Series cast bronze Downspout Nozzle with loose flange and inlet threaded connection or Architect approved equal. Diameter appropriate to downspout size.

## **2.8 FALL ARREST ROOF ANCHORS**

- A. Fixed Roof Anchor: Provide fixed eye or stanchion type for continuous travel. Provide for structural anchorage as required for roof framing condition. Provide integral energy absorbing components. Provide with Type 304 stainless steel forged eye, anchor posts, intermediate / corner / end stanchions, and connection devices. Provide for dissimilar metal protection.
  - 1. Acceptable Manufacturers: Rooftop Anchor, Inc., "Horizontal Lifeline Systems"; FixFastUSA, "Travel 8 Static Line System – Top Mount SL200"; Thaler Metal
- B. Horizontal Wire Rope: Provide minimum breaking strength of a terminated wire rope to be at least twice the MAL, but not less than 6,500 lbf. The minimum rope diameter shall be 5/16". Wire rope lines shall comply with CSA G4.

## **2.9 PLUMBING PEDESTAL HYDRANT**

- A. Provide freeze-proof pedestal hose station / hydrant with stainless steel shroud, welded stainless steel flange, black powder coated cast aluminum dome handle, mail hose fitting and vacuum breaker. Provide powder coated under-deck support flange with hardware. Provide for dissimilar metal protection.

- B. As manufactured by MAPA Products Model MPH-24D:24/9 Pedestal Hydrant as required for condition or Architect approved equal.

## **2.10 ELECTRICAL PEDESTAL DISCONNECT / OUTLET**

- A. Provide rain-proof pedestal disconnect with stainless steel square tubing and welded stainless steel flange. Provide powder coated under-deck support flange with hardware. Provide for dissimilar metal protection.
- B. As manufactured by MAPA Products Model MPD-(XX) Pedestal Disconnect as required for condition or Architect approved equal.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install roof accessories in accordance with manufacturer's printed instructions and approved shop drawings. Installation of Portable Pipe Hangers shall not exceed six (6) feet on center.
- B. Coordinate with roofing operation for watertight integrity.
- C. Finished installation shall be water and air tight. Install sealant conforming to FS TT-S-00227E, Type II, Class A.

**END OF SECTION 07 72 00**

## **SECTION 07 72 33 - ROOF SCUTTLE, ROOF CROSSOVER**

### **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 RELATED WORK**

- A. Section 05 31 00 - Metal Deck
- B. Section 05 50 00 - Miscellaneous Metals
- C. Section 06 10 00 - Rough Carpentry
- D. Section 07 54 23 – Modified Bitumen Cool Roof Membrane Roofing System

#### **1.3 COORDINATION**

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a watertight installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

#### **1.4 SUBMITTALS**

- A. Product Data: Submit schedules, charts, literature and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
- B. Shop Drawings: Include materials, opening sizes, fabrication details, hardware, attachments, related and adjacent work, and finishes.

#### **1.5 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Miami-Dade County, FL Approved NOA
    - a. TAS 201 Impact test
    - b. TAS 202 Uniform Static Air Pressure
    - c. TAS 203 Cyclic Wind Pressure Loading
  - 2. OSHA 29 CFR 1910.23 Guarding floor and wall openings and holes
  - 3. OSHA 29 CFR 1926.502 Fall protection systems criteria
  - 4. International Building Code (IBC) Section 1013.6 Roof Access
  - 5. International Building Code (IBC) Section 1009.11 Means of Egress, Stairways, Stairway to Roof
  - 6. International Building Code for venting requirements
  - 7. IBC Section 410 for Stages and Platforms
  - 8. IBC Section 910 for Factory and Storage occupancies

9. IBC Section 1207 Sound Transmission
10. Underwriters Laboratories Inc, UL 793 Listed for Heat and Smoke Vents
11. FM Global, Factory Mutual, FM 4430 Heat and Smoke Vents for Roofs
12. Reference NFPA 204 for general maintenance of Heat and Smoke vents
13. ASTM E 90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

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

- A. Deliver materials to Project site ready use.
- B. Exercise proper care in handling of Work so as not to disrupt finished surfaces.
- C. Store materials under cover in a dry and clean location off the ground.

## **1.7 WARRANTY**

- A. Warrant the work specified herein for five (5) years, against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to, the following:
  1. Faulty, improper or inadequate attachment or installation.
  2. Difficult or noisy operation.
  3. Noticeable deterioration of finish.
  4. Leakage of water into the building or within the construction.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Basis of Design Product: Subject to compliance with requirements: The Bilco Company.
- B. Manufacturers listed below whose products are equivalent to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
  1. Acudor Products Inc.
  2. Babcock-Davis Hatchways, Inc.
  3. Dur-Red Products
  4. J. L. Industries, Inc.
  5. Karp Associates, Inc.
  6. Nystrom Building Products

### **2.2 ROOF SCUTTLES (HATCHES)**

- A. Size: 2'-6" x 3'-0", unless shown otherwise.
- B. Finish: White Powder Coat Aluminum.

- C. Thermally Broken Cover: Shall be 11 gauge aluminum with 3" concealed polyisocyanurate insulation, 5" beaded, overlapping flange, fully welded at corners, and internally reinforced for 40 psf live load., fully covered and protected by an aluminum liner. No water standing on top of the cover will be permitted.
- D. Thermally Broken Curb: Shall be 12 inches in height above finished roof surface and constructed of 11 gauge aluminum. It shall be formed with a 5-1/2 inch flange with holes provided for securing to the roof deck. Curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, full welded at the corners for weathertightness. Capflashing shall be equipped with the Bilclip™ flashing system, including stamped tabs and Pak-Rope. Insulation on the exterior of the curb shall be rigid fiber board three (3) inches in thickness.
- E. Thermally Broken Scuttle (Hatch): Shall be completely assembled with heavy pintle hinges, positive snap latch with turn handles, padlock hasps inside and outside, and a mechanically retained thermoplastic rubber gasket. Compression spring operators enclosed in telescopic tubes shall be provided for smooth, easy and controlled door operation throughout the entire arc of opening and closing. Operation shall not be affected by temperature. Cover shall be equipped with an automatic hold-open arm complete with red vinyl grip handle to permit easy release and one-hand control of the cover to its closed and latched position. All hardware shall be stainless steel. Gasket shall be extruded EPDM adhesive back seal and continuous around cover.
- F. Approved Model / Manufacturer: Type No. "S-50TB" Roof Scuttles (Hatches) for ladder access, or Architect approved equal.
- G. Roof Access Ladder: As specified in Section 05 50 00, Miscellaneous Metals. Ladder shall be oriented and mounted along the short dimension of the hatch.
- H. Fall Protection Safety Rail: 30"x36" Model SP 3036 manufactured by **SafePro L.C.** Guardrail height shall be 42" above finished roof surface. Color shall be powder coated safety yellow.
- I. Telescoping Ladder Safety Post: Model ER-1 Extend-A-Rail Ladders Safety Post as manufactured by Precision Ladders LLC. 1.62" OD Schedule 40 anodized aluminum pipe post and 16"x4"x¼" aluminum mounting plate. Provide with locking slot and knob. All mounting hardware shall be Type 316 stainless steel.

## 2.3 ROOF CROSSOVER

- A. A. Crossover Bridges: Custom designed to meet project specific requirements, OSHA 1910 Subpart D standards including handrails, and the following:
  - 1. Clearance Height Required: 36-inches.
  - 2. Clearance Length Required: 15-feet.
  - 3. Crossover Width Required: 22-inches.
  - 4. Deck Bases: Polycarbonate, 16 by 18 inch (406 by 457 mm).
  - 5. Deck Bases: Stainless steel, 12 by 16 inch (305 by 406 mm).



6. Deck Bases: Hot-dipped galvanized steel, 12 by 16 inch (305 by 406 mm).
7. Metal Components: Hot-dipped galvanized steel.
8. Metal Components: Stainless steel.
9. Walking Surfaces: 12 inch (305 mm) Punched Interlock Grating with anti-skid surface.
10. Walking Surfaces: Bar Grating with serrated surface.
12. Railings: Standard railings shall be provided on all stairways having 4 or more risers and platforms 4 feet (1.22 m) or more above adjacent level.
13. Toeboards: 4 inch (102 mm) Toeboards shall be provided whenever, beneath the open side:
  - a. A person can pass;
  - b. There is moving machinery;
  - c. Where falling material could create a hazard.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

A. Adjustable Supports: Adjust height of each support to achieve proper height and level before installing supported item.

1. Level hangers, rollers or struts before installing component.
2. Make final height adjustments to provide even distribution of load on all supports.

B. Fixed Anchor Stanchion Supports: Prior to installation of roof decking, insulation and roof membrane attach support to roof structure as indicated on drawings.

1. After installation of roof decking, insulation and membrane, install pipe or rooftop mechanical supports used in connection with fixed anchor supports.

#### **3.2 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. Coordinate installation of sealant and roofing cement with Work of this Section to ensure water tightness.

- D. Coordinate installation of components of this Section with installation of roof deck, roof structure, roofing membrane, and base flashing.
- E. Roof hatches shall be welded to structural steel frame of building.
- F. Install hatches in accordance with details on drawings, approved shop drawings, and manufacturer's instructions.
- G. Set units plumb, level, and true to line without warp or rack. Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.
- H. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a watertight and airtight seal.

### **3.3 ADJUSTING**

- A. Adjust movable parts for smooth operation.
- B. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation

### **3.4 CLEANING**

- A. Clean exposed surfaces per manufacturer's written instructions. Touch up damaged metal coatings.

**END OF SECTION 07 72 33**

## **SECTION 07 84 13 - PENETRATION FIRESTOPPING**

### **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. Penetrations in fire-resistance-rated walls.
  - 2. Penetrations in horizontal assemblies.
  - 3. Penetrations in smoke barriers.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- C. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2020a.
- D. FM 4991 - Approval Standard of Firestop Contractors; 2013.
- E. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.

#### **1.4 ALLOWANCES**

- A. Penetration firestopping Work is part of an allowance.

#### **1.5 UNIT PRICES**

- A. Work of this Section is affected by unit prices.

#### **1.6 PREINSTALLATION MEETINGS**

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

#### **1.7 SUBMITTALS**

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
  - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.
- C. Qualification Data: For Installer.
- D. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

#### **1.8 CLOSEOUT SUBMITTALS**

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

#### **1.9 QUALITY ASSURANCE**

- A. Installer Qualifications: A firm that has been approved by FM Global according to GlobalFM 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

### **1.10 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

### **1.11 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.

### **1.12 WARRANTY**

- A. Written warranty signed by manufacturer, installer, and Contractor in which manufacturer agree to repair or replace firestopping materials that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Two (2) years from date of Substantial Completion.

## **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 Global in its "Building Materials Approval Guide."

### **2.2 PENETRATION FIRESTOPPING SYSTEMS**

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
  - 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
  - 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
  - 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
  - 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
  1. Permanent forming/damming/backing materials.
  2. Substrate primers.
  3. Collars.
  4. Steel sleeves.

### **2.3 FILL MATERIALS**

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer 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 do not re-emulsify after cure 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 intumescent 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: Single-component, silicone-based, neutral-curing elastomeric sealants.

### **2.4 MIXING**

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
  - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
  - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

### **3.3 INSTALLATION**

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### **3.4 IDENTIFICATION**

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.
  - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
  - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
  - 2. Contractor's name, address, and phone number.
  - 3. Designation of applicable testing and inspecting agency.
  - 4. Date of installation.
  - 5. Manufacturer's name.
  - 6. Installer's name.

### **3.5 FIELD QUALITY CONTROL**

- A. School District will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

### **3.6 CLEANING AND PROTECTION**

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

**END OF SECTION 07 84 13**

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## **SECTION 07 84 43 - JOINT FIRESTOPPING**

### **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. Joints in or between fire-resistance-rated constructions.
  - 2. Joints at exterior curtain-wall/floor intersections.
  - 3. Joints in smoke barriers.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- B. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).
- C. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2023b.
- D. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2020a.
- E. FM 4991 - Approval Standard of Firestop Contractors; 2013.
- F. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

#### **1.4 PREINSTALLATION MEETINGS**

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

#### **1.5 SUBMITTALS**

- A. Product Data: For each type of product.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
  - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Qualification Data: For Installer.
- D. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

#### **1.6 CLOSEOUT SUBMITTALS**

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

#### **1.7 QUALITY ASSURANCE**

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 'sFM 4991, "Standard for the Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

## 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

## 1.9 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

## PART 2 PRODUCTS

### 2.1 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 SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 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 E2307.
  - 1. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
- D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
  - 1. L-Rating: Not exceeding 5.0 cfm/ft. (0.00775 cu. m/s x m) of joint at both ambient and elevated temperatures.
- E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.
- F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
  - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
  - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

### 3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
  - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
  - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
  - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
  - 1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
  - 2. Contractor's name, address, and phone number.
  - 3. Designation of applicable testing agency.
  - 4. Date of installation.
  - 5. Manufacturer's name.
  - 6. Installer's name.

### 3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

### **3.6 CLEANING AND PROTECTION**

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

**END OF SECTION 07 84 43**

## **SECTION 07 92 00 - JOINT SEALANTS**

### **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: Requirements including but not limited to:
  - 1. Control and expansion joints on exposed surfaces.
  - 2. Perimeter joints between wall surfaces and frames of doors and openings.
  - 3. Joints between plumbing fixtures and adjoining walls, floors, and counters.
  - 4. Joints indicated or as necessary.
  - 5. Accessories necessary for a complete installation.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).
- B. ASTM C834 - Standard Specification for Latex Sealants; 2017.
- C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2018.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- E. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2018.
- H. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2018.
- I. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).
- J. ASTM D1752 - Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2018.
- K. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- L. ASTM E2129 - Standard Practice for Data Collection for Sustainability Assessment of Building Products; Current.

#### **1.4 SUBMITTALS**

- A. Product Data: Technical data for each joint sealant product. Submit written certification from manufacturers of sealants attesting products are suitable for use indicated, verified through in house testing laboratory.
  - 1. Written certification from manufacturers of joint sealants attesting that products comply with specification requirements and suitable for use indicated verified through manufacturers testing laboratory within the past 36 months or since most recent reformulation, whichever is most recent.
    - a. Complete instructions for handling, storage, mixing, priming, installation, curing and protection of each type of sealant.
    - b. Manufacturer's letter, clearly indicating proposed lot numbers of each sealant supplied and expiration date sequence.
    - c. Instructions for handling, storage, mixing, priming, installation, curing, and protection of each type of sealant.

2. VOC Data: Submit manufacturer's product data for sealants. Indicate VOC limits of the product. Submit MSDS highlighting VOC limits.
  3. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this Section.
- B. Certificates and Reports:
1. Product Certificates: Manufacturer's product certificate for each kind of joint sealant and accessory.
  2. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
  3. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
  4. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
    - a. Materials forming joint substrates and sealant backings have been tested for compatibility and adhesion with sealants.
    - b. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
  5. Preconstruction Field Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified.
  6. Field Adhesion Test Reports: For each sealant application tested.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Firm having minimum 5 years documented experience and specializing in the installation of sealants.
1. Exposed sealant work (sealants used for air and weatherseals external to curtain wall systems at perimeter, metal panel to panel joints) shall be performed by a single (i.e. one) firm specializing in the installation of sealants who has successfully produced work comparable to project.
  2. Concealed sealant work (sealants which are internal to metal framed curtain wall systems, skylights, and providing an air seal) shall be the responsibility of the subcontractor providing erection of the respective system.
- B. Source Limitations: Obtain each type of joint sealant from a single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
  2. Test according to SWRI Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion in peel, and indentation hardness.
- D. Environmental Requirements:
1. Toxicity/IEQ: Comply with applicable regulations regarding toxic and hazardous materials.
    - a. VOC Content of Interior Sealants: Refer to Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions for VOC limits of sealants installed within the building.
    - b. Sealants containing aromatic solvents, fibrous talc, formaldehyde, halogenated solvents, mercury, lead, cadmium, chromium and their compounds, are not permitted.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer written instructions to prevent deterioration or damage due to moisture, high or low temperatures, contaminants, or other

causes.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 degrees F (4.4 degrees C).
  - 2. When joint substrates are wet. Should joints or backing materials become wet, remove and replace backing material with new.
- B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

## 1.8 WARRANTY

- A. 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: Five years from date of Substantial Completion.
- B. Warranties: Written warranties (weatherseal and stain resistance), signed by sealant manufacturer agreeing to furnish 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, durability, or appear to deteriorate in manner not specified in the manufacturer's data as an inherent quality of the material within specified warranty period.
  - 1. Warranty Period: 5 years from date of Substantial Completion, 20 years for silicone sealants.
- C. Warranties specified exclude deterioration or failure of sealants from:
  - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Compatibility: Provide joint sealants, backings, and related materials compatible with one another and with joint substrates, air barrier system, and masonry 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. Liquid Applied Sealants: Comply with ASTM C920 and requirements indicated for each liquid applied sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- C. Stain Test Response Characteristics: For sealants in contact with porous substrates, provide non-staining products that have undergone testing according to ASTM C1248 and do not stain porous joint substrates.
- D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. Colors: For fully concealed joints, provide standard color of sealant that has the best overall performance characteristics for the application shown. For exposed joints, match adjacent surface. For exposed joints, submit color samples to architect for approval, from manufacturer's full line of standard colors.

- F. Manufacturer's Representative: Use sealant produced by manufacturer who agrees to send a qualified technical representative to site upon request for the purpose of rendering advice concerning the recommended installation of manufacturer's materials.
- G. Sealants: Self leveling compounds for horizontal joints in pavements and non-sag compounds elsewhere except as shown or specified.
- H. Silicone Sealant: ASTM C920, Type M, Grade NS, Class 25; use NT, M, A and O.
  - 1. Use: Precast Concrete Joints between metals, glass, and plastics (Two part silicone sealants).
  - 2. Properties: Performance: Non-staining, non-bleeding, and non-streaking to sealed and adjacent substrates. The minimum pli value after 7 day immersion shall not be less than 13 when tested in strict accordance with ASTM C794 Adhesion and Peel.
  - 3. Cure System and Oil Content: Neutral Cure System specifically manufactured with controlled oil content to eliminate oil migration into sealed substrates and residue rundown over and onto adjacent substrates.
  - 4. Product and Manufacturer: Dow Corning; 756 Silicone Building Sealant - HP with Additive.
- I. Silicone Sealant: ASTM C920, Type S, Grade NS, Class 50, use NT.
  - 1. Use: Precast Concrete Joints between metals, glass, and plastics (Single component sealants).
  - 2. Properties: Performance: Non-staining, non-bleeding, and non-streaking to sealed and adjacent substrates.
  - 3. Cure System and Oil Content: Neutral Cure System specifically manufactured with controlled oil content to eliminate oil migration into sealed substrates and residue rundown over and onto adjacent substrates.
  - 4. Product and Manufacturer:
    - a. BASF Building Systems; Omniseal 50.
    - b. Dow Corning Corporation; 756 SMS, 791, 795, 995 as applicable.
    - c. GE Advanced Materials, Silicones; SilGlaze II SCS2800, SilPruf NB SCS9000, SilPruf SCS2000, or UltraPruf II SCS2900 as applicable.
    - d. Sika Corporation, Construction Products Division; SikaSil-C995.
- J. Polyurethane Sealants: ASTM C920, Type M, Grade NS, Class 25; use NT, M, A and O.
  - 1. Use: Typical Wall and Floor Joints (Two part polyurethane sealants).
  - 2. Properties: Performance: Non-staining, non-bleeding, non-streaking to sealed and adjacent substrates.
  - 3. Products and Manufacturers:
    - a. BASF Building Systems; Sonolastic NP-2.
    - b. Pecora Corporation; Dynatred.
    - c. Sika Corporation, Construction Products Division; Sikaflex 2c NS or Sikaflex 2c NS TG as applicable.
- K. Two Part Polyurethane Sealants: ASTM C920, Type M, Grade NS, Class 50; use NT, M, A and O.
  - 1. Use: Typical Wall and Floor Joints (Two Part Polyurethane Sealants).
  - 2. Properties: Performance: Non-staining, non-bleeding, and non-streaking to sealed and adjacent substrates. The minimum pli value after 7 day immersion shall not be less than 13 when tested in strict accordance with ASTM C794 Adhesion in Peel.
  - 3. Products and Manufacturers: One of the following:
    - a. Schnee-Morehead, Inc.; Permthane SM 7200.
    - b. Sika Corporation, Inc.; Sikaflex - 2c NS TG.
    - c. BASF Construction Chemicals; NP 2.
- L. Mildew Resistant Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT, Substrate uses G, A, and O; and containing fungicide for mildew resistance; acid curing.
  - 1. Use: Joints at toilet fixtures, toilet room countertops and vanities, wet areas, and janitor closet mop receptor to wall transition.



2. Products: Provide one of the following:
  - a. BASF Building Systems; Omniplus.
  - b. Dow Corning; 786 Mildew Resistant Silicone Sealant.
  - c. GE Silicones; Sanitary SCS 1700.
- M. Latex Sealant: Non-elastomeric, one part, non-sag, paintable latex sealant that is recommended for exposed applications on the interior. Complying with ASTM C834, Type OP (opaque sealants):
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pecora Corporation; AC-20 + Silicone.
    - b. BASF; Sonolastic Sonolac.
- N. Acoustical Joint Sealant: Non-sag, paintable, non-staining latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Hilti, Inc.
    - b. Pecora Corporation; AC-20 FTR or AIS-919.
    - c. Specified Technologies, Inc.
    - d. USG Corporation; SHEETROCK Acoustical Sealant.
- O. Sealant Backing: Provide sealant backings that are non-staining; compatible with joint substrates, sealants, primers, and joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
  1. Cylindrical Sealant Backings: Preformed, compressible, resilient, non-staining, non-waxing, non-extruding backings of flexible plastic foam complying with ASTM C1330, 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.
  2. Type C: Closed cell polyethylene foam material with surface skin, nonabsorbent to liquid water and gas, non-outgassing in unruptured state; one of the following:
    - a. HBR Closed Cell Backer Rod; Nomaco, Inc.
    - b. Sonolastic Closed-Cell Backer-Rod; BASF Construction Chemicals.
- P. Butyl Mastic Tape: High-tack, self-fusing butyl rubber mastic.
  1. Compatible with air barrier system.
  2. Locations: At masonry veneer anchors and where indicated on Drawings.
  3. Products: "Butyl Mastic Tape 2212" as manufactured by 3M or architect approved equal.
- Q. Miscellaneous Materials:
  1. Primer: Material recommended, as verified through compatibility and adhesion testing, by joint sealant manufacturer for the substrates indicated to be sealed.
  2. 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.
  3. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and which will not stain nor mar the finish of surface adjacent to joints to which it is applied.
  4. Cork Joint Filler: Resilient and non-extruding ASTM D1752, Type II.
  5. Bond Breaker Tape: Polyethylene, TFE fluorocarbon, or 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.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine joints indicated to receive joint sealants for compliance with requirements for joint configuration, installation tolerances, and conditions affecting sealant performance. Proceed with installation after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with the recommendations of joint sealant manufacturer and requirements:
  - 1. Remove foreign material from joint substrates interfering with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), existing joint sealants, oil, grease, water, surface dirt, and frost.
  - 2. Clean concrete, masonry, unglazed surfaces of tile and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil free compressed air.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean metal, glass, porcelain enamel, glazed surfaces of tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on prior testing and experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### **3.3 INSTALLATION**

- A. Silicone Glazing Sealants: Refer to Section 08 80 00 - Glazing.
- B. Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- C. Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants applicable to materials, applications, and conditions indicated.
- D. Sealant Backings: Install sealant backings to support sealants during application and at position necessary to produce cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings. Trim for tight fit around obstructions or elements penetrating the joint.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that become wet before sealant application and replace with dry sealant backings.
  - 4. Install bond breaker tape behind sealants where backings are not used between sealants and back of joints.
- E. Weeps and Vents: Install weeps and vents into joints at the same time sealants are being installed. Locate weeps and vents spaced recommended by sealant manufacturer and the window and curtain wall fabricator and erector. Do not install weeps and vents at outside building corners. Do not install vents at horizontal joints immediately below shelf angles, sills, and through wall flashings.

- F. Sealants: Install sealants by proven techniques resulting in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at same time sealant backings are installed.
  - 1. Apply sealants in depth in accordance with manufacturer's recommendations and recommended general proportions and limitations.
  - 2. Apply elastomeric sealants, in joints not subject to traffic or abrasion, to a depth equal to 50% of the joint width, but not less than 1/4 inch (6 mm) and not more than 1/2 inch (13 mm).
  - 3. Apply non-elastomeric sealants to a depth approximately equal to the joint width.
- G. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform, beads to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces. Tool exposed surfaces of sealants to the profile shown, or if none is shown, tool slightly concave.
  - 1. Use masking tape to protect adjacent surfaces of recessed tooled joints.
  - 2. Provide a slight wash on horizontal joints where horizontal and vertical surfaces meet.
  - 3. Against rough surfaces or in joints of uneven widths avoid the appearance of excess sealant or compound by locating the compound or sealant well back into joint wherever possible.
- H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.
- I. Acoustical Sealant Installation: At sound rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer written recommendations.

### 3.4 FIELD QUALITY CONTROL

- A. Field Adhesion Testing: Field test exterior wall joint sealant adhesion to joint substrates:
  - 1. Extent of Testing: Test completed and cured sealant joints:
    - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
    - b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per elevation.
  - 2. Test Method: Test joint sealants according to Method A, Field Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  - 3. Inspect tested joints and report on the following:
    - a. Whether sealants filled joint cavities and are free of voids.
    - b. Whether sealant dimensions and configurations comply with specified requirements.
    - c. Whether sealants in joints connected to pulled out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer field adhesion hand pull test criteria.
  - 4. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure original sealant surfaces are clean and new sealant contacts original sealant.
- B. Evaluation of Field Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

### **3.5 SITE ENVIRONMENTAL PROCEDURES**

- A. Indoor Air Quality: Provide temporary ventilation during work. Coordinate interior application of sealants with interior finishes schedule.

### **3.6 CLEANING AND PROTECTION**

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
- B. Protect joint sealants during and after curing from contact with contaminating substances and from damage so sealants are without deterioration or damage at time of Substantial Completion. If, despite protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

**END OF SECTION 07 92 00**

## **SECTION 07 95 13 - EXPANSION JOINT COVER ASSEMBLIES**

### **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. Expansion joint cover assemblies for floor, wall, ceiling, soffit, and \_\_\_\_\_ surfaces.
- B. Related Sections:
  - 1. Section 04 05 00 - Common Work Results for Masonry: Placement of joint cover assembly frames in masonry.
  - 2. Section 05 50 00 - Metal Fabrications: Custom fabricated metal expansion and control joint devices.
  - 3. Section 07 92 00 - Joint Sealants: Sealing expansion and control joints using gunnable and pourable sealants.
  - 4. Section 09 21 16 - Gypsum Board Assemblies: Gypsum board control joint trim.
  - 5. Section 09 21 16 - Gypsum Board Assemblies: Placement of expansion joint assemblies in gypsum board walls and ceilings.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- C. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2020.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

#### **1.5 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices, available colors and finish, and \_\_\_\_\_.
- C. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction, anchorage locations, and \_\_\_\_\_.
- D. Samples: Submit two samples \_\_\_\_\_ inch (\_\_\_\_\_ mm) long, illustrating profile, dimension, color, and finish selected.
- E. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

### **PART 2 PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
  - 1. Architectural Art Mfg, Inc: [www.archart.com](http://www.archart.com).
  - 2. Balco, Inc.: [www.balcousa.com](http://www.balcousa.com).
  - 3. Construction Specialties, Inc: [www.c-sgroup.com](http://www.c-sgroup.com).
  - 4. EMSEAL Joint Systems, Ltd: [www.emseal.com](http://www.emseal.com).

5. Inpro: [www.inprocorp.com](http://www.inprocorp.com).
  6. MM Systems Corp: [www.mmsystemscorp.com](http://www.mmsystemscorp.com).
  7. Nystrom, Inc: [www.nystrom.com](http://www.nystrom.com).
  8. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  9. SITURA Inc: [www.situra.com](http://www.situra.com).
  10. Watson Bowman Acme Corporation: [www.watsonbowmanacme.com](http://www.watsonbowmanacme.com).
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

## **2.2 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS**

- A. Interior Floor Joints Subject to Thermal Movement (EJC-1):
1. Basis of Design Manufacturer(s) and Product(s):
    - a. Inpro 806 Series Floor Expansion Joint Covers manufactured by Inpro.
- B. Interior Wall/Ceiling Joints Subject to Thermal Movement (EJC-3):
1. Basis of Design Manufacturer(s) and Product(s):
    - a. Inpro 811 Series Cover Plate Wall & Ceiling Expansion Joint Covers manufactured by Inpro.
- C. Exterior Wall Joints Subject to Thermal Movement (EJC-9):
1. Basis of Design Manufacturer(s) and Product(s):
    - a. 615 Series Flush Mount Exterior Expansion Joints manufactured by Inpro
- D. Exterior Roof Expansion Joint Covers (EJC-12):
1. Basis of Design Manufacturer(s) and Product(s):
    - a. Per National Roofing Contractor Association.

## **2.3 EXPANSION JOINT COVER ASSEMBLIES**

- A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
1. Joint Dimensions and Configurations: As indicated on drawings.
  2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
  3. Joint Cover Styles: As indicated on Drawings.
  4. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.
  5. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
  6. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.
- B. Floor Joint Covers: Coordinate with indicated floor coverings.
1. If floor covering is not indicated, obtain instructions from Architect before proceeding.
  2. If style is not indicated, provide extruded aluminum frame both sides, resilient seals, and minimize exposed metal.
- C. Resilient Seal Type Covers: Having flat exposed surface without crevices that could collect dirt; designed to withstand expected movement without extrusion of seal from joint assembly; for floors, provide style that is flush with top of floor covering; for exterior joints, weathertight.
- D. Sliding Cover Plate Type Covers: Provide plate with beveled edges and neat fit that does not collect dirt.
- E. Covers in Gypsum Board Assemblies: Provide style with anchoring wings that can be completely covered by joint compound.

## **2.4 MATERIALS**

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 alloy, T6 temper.
- B. Resilient Seals:
  - 1. For Ceilings: Any resilient material, flush, pleated, or hollow gasket.
  - 2. For Pedestrian Traffic Applications: EPDM rubber, Neoprene, or Santoprene; no PVC; Shore A hardness of 40 to 50 Durometer.
  - 3. Color: Gray.
- C. Anchors and Fasteners: As recommended by cover manufacturer.
- D. Ferrous Metal Anchors: Galvanized where embedded in concrete or in contact with cementitious materials.
- E. Threaded Fasteners: Aluminum.
- F. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.
- B. Verify that frames and anchors installed by others are in correct locations and suitable for installation of remainder of assembly.

### **3.2 INSTALLATION**

- A. Install components and accessories in accordance with manufacturer's instructions.
- B. Install expansion joints in accordance with TCA publication EJ171.
- C. Align work plumb and level, flush with adjacent surfaces.
- D. Rigidly anchor to substrate to prevent misalignment.

### **3.3 PROTECTION**

- A. Do not permit traffic over unprotected floor joint surfaces.
- B. Provide strippable coating to protect finish surface.

**END OF SECTION 07 95 13**

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## **SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES**

### **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. Provide items shown on the Drawings and specified, including, but not limited to the following:
  - 1. Standard steel doors for interior or exterior use.
  - 2. Thermally-insulated doors for exterior use.
  - 3. Steel frames for doors, sidelites, transoms, and windows.
  - 4. Vision lites in steel doors.
- B. Related Sections:
  - 1. Section 05 40 00 - Cold Formed Metal Framing.
  - 2. Section 07 92 00 - Joint Sealants.
  - 3. Section 08 80 00 - Glazing.
  - 4. Section 09 21 16 - Gypsum Board Assemblies.
  - 5. Section 09 24 00 - Cement Plastering.
  - 6. Section 09 90 00 - Painting and Coating.

#### **1.3 REFERENCE STANDARDS**

- A. ANSI A250.13 - Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies for Protection of Building Envelopes; 2018.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process; 2022a.
- D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- E. ASTM C1363 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus; 2019.
- F. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- G. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- H. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- I. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

#### **1.4 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's standard details and catalog data demonstrating compliance with specifications and referenced standards.
  - 2. Manufacturer's installation instructions.
- B. Shop Drawings:
  - 1. Indicate complete schedule in detail for each steel door and frame using the same reference number for details and openings as those on the contract Drawings. If any door is not by the steel door manufacturer, only the door opening number should be shown along with the type of door (wood, plastic laminate faced, etc.):

- a. Show details of construction, installation, connections, anchors, hardware reinforcement, hardware preparation, louvers, and floor and threshold clearances.
- C. Samples are required from non-Steel Door Institute members:
  - 1. 12 inch by 12 inch sample of a fire-rated and non-rated door, cut from corner of door, showing door construction.
  - 2. 12 inch by 12 inch sample of each type of door louver specified or required, showing louver construction.
  - 3. 6 inch long sample of a fire-rated, non-rated frame, and each type of glass stop specified or required, showing corner and construction.
- D. Certificates: Manufacturer's certification that oversized openings are in compliance with specifications.

### **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: A company specializing in the manufacturer of steel doors and frames of the type specified for this Project with a minimum of 5 years' experience.
- B. All steel doors and frames shall be by a single manufacturer, shop drawings to be submitted with manufacturer's insignia, which is being supplied.
- C. Furnish steel doors and frames to meet current ANSI/Steel Door Standards.
- D. Windstorm Resistance: Comply with ANSI A250.13.
- E. Structural Performance: Comply with ASTM E330/E330M.
- F. Air Leakage: Comply with ASTM E283/E283M.
- G. Regulatory Requirements:
  - 1. Wind Loads:
    - a. Provide hollow metal and door hardware assemblies approved by Authorities Having Jurisdiction (AHJ), including anchorage, capable of withstanding wind load design pressures calculated for this Project by a registered Architect or Engineer and are part of the construction documents.
  - 2. Hurricane-Resistance Test Performance:
    - a. Provide hollow metal and door hardware approved assemblies that pass large missile-impact tests, as required by authorities having jurisdiction:
  - 3. Accessibility Requirements:
    - a. Comply with applicable requirements:
      - 1) Texas Accessibility Standards (TAS).
- H. Pre-Installation Conference: Refer to Section 01 31 00 - Project Management and Coordination.

### **1.6 WARRANTY**

- A. Warrant the work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.
- B. Defects shall include, but not be limited to:
  - 1. Use of incorrect materials in opening.
  - 2. Incorrect labeled components installed within opening.
  - 3. Noisy, rough, or difficult operation.
  - 4. Failure to meet specified quality assurance requirements.

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

- A. Deliver and store products in accordance with manufacturer's instructions, and as follows:
  - 1. In manufacturer's original, clearly labeled, undamaged containers or wrappers.
  - 2. Containers or wrappers shall list the name of the manufacturer and product.
- B. Deliver materials to allow for minimum storage time at the Project site. Coordinate delivery with the scheduled time of installation.

- C. Protect products from moisture, construction traffic, and damage:
  - 1. Store under cover in a clean, dry place, protected from weather and abuse.
  - 2. Store in a manner that will prevent rust or damage.
  - 3. Store doors in a vertical position, spaced with blocking to permit air circulation.
  - 4. Do not use non-vented plastic or canvas shelters.
  - 5. Should containers or wrappers become wet, remove immediately.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
  - 1. Ceco Door, an ASSA ABLOY company: [www.cecodoor.com](http://www.cecodoor.com)
  - 2. CURRIES, an ASSA ABLOY company: [www.curries.com](http://www.curries.com)
  - 3. Pioneer Industries, Inc., an ASSA ABLOY company: [www.pioneerindustries.com](http://www.pioneerindustries.com)
  - 4. Republic Builders Products Company: [www.republicdoor.com](http://www.republicdoor.com)
  - 5. Steelcraft Mfg. Co., an Allegion company: [www.steelcraft.com](http://www.steelcraft.com)
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

### **2.2 MATERIALS, GENERAL**

- A. Exterior frames and interior frames where shown on Drawings or required in damp, moist, humid, and wet areas, i.e., toilets, locker rooms, showers, etc., to be manufactured of commercial quality, stretcher leveled flatness, cold rolled steel and galvanized to A-60 minimum coating weight standard per ASTM A653/A653M and ASTM A924/A924M, with coating weight of not less than 0.60 ounce per square foot (0.30 ounce per square foot per side).

### **2.3 FRAME FABRICATION**

- A. Minimum Gauges:
  - 1. Interior:
    - a. Openings less than 4 feet wide: 16 gauge.
    - b. Openings 4 feet in width and greater: 14 gauge.
  - 2. Exterior: 14 gauge.
- B. Design and Construction:
  - 1. Frames shall be custom made, welded units with integral trim of sizes and shapes shown on approved shop drawings. Hinge jambs that butt adjacent 90-degree walls shall have at least 4 inch wide frame face to assure the door trim will not strike the wall prior to the door opening at least 90 degrees. Frame profile shall match wall thickness where practical, i.e., 4-3/4 inch at 4 inch CMU, 6-3/4 inch at 6 inch CMU, and 8-3/4 inch at 8 inch CMU. At masonry wall openings, fabricate frames to suite masonry opening with 2 inch head member.
  - 2. Frames shall be strong and rigid, neat in appearance, square, true, and free of defects, warp, and buckle. Molded members shall be clean cut, straight, and of uniform profile throughout their length.
  - 3. Jamb depths, trim, profile, and backbends shall be as shown on approved shop drawings.
  - 4. Corner joints, including face and inside corners, shall have contact edges closed tight, with trim faces mitered and continuously welded, and stops butted. The use of gussets shall not be permitted. Face of frame shall be ground smooth. Knockdown (KD) frames are not permitted.
  - 5. Minimum depth of stops shall be 5/8 inch, except at fire windows where minimum depth of stops shall be 3/4 inch.

6. Frames for multiple openings shall have mullion and rail members that are closed tubular shapes having no visible seams or joints. Joints between faces of abutting members shall be securely welded and finished smooth. Mullions shall be key locked removable type. Keys shall be master keyed to School District's key system.
7. High-Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48 inch and wider with mortise/butt type hinges only at top hinge location to deter against hinge reinforcement sag.
8. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Section 08 71 00 - Door Hardware.
9. Provide countersunk flat or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops; provide security head screws at exterior locations.
10. Provide A60 galvanized coating at frames in the following locations:
  - a. Restrooms.
  - b. Kitchens / kitchen suites.
  - c. Locker rooms.
  - d. Rooms with showers.
  - e. Rooms with hydrotherapy pools.
11. Electrical Knock Out Boxes:
  - a. Factory weld 18 gauge electrical knock out boxes to frame for electrical hardware preps; included but not limited to electric thru wire hinges, electrical raceways, door position switches, electric strikes, jamb mount card readers, and magnetic locks as noted in door hardware sets in Section 08 71 00 - Door Hardware:
    - 1) Electrical knock out boxes are required at door position switches, electric strikes, card readers, and middle hinge locations.
    - 2) Provide electrical knock out boxes with 3/4 inch knockouts.
    - 3) Conduit to be coordinated and installed in field from middle hinge box and strike box to door position box.
    - 4) Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Section 08 71 00 - Door Hardware.
    - 5) Electrical knock out boxes for continuous hinges should be located in the center of the vertical dimension on the hinge jamb.
    - 6) Provide field installed conduit per Division 28 - Electronic Safety & Security Section for standardized plug connectors to accommodate up to 12 wires as required for electrified door hardware specified in hardware sets in Section 08 71 00 - Door Hardware. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.
12. Hardware reinforcements:
  - a. Frames shall be mortised, reinforced, drilled, and tapped at factory for fully template mortised hardware in accordance with approved hardware schedule and templates provided by Section 08 71 00 - Door Hardware. Where surface-mounted hardware is to be applied, frames shall have reinforcing plates only.
  - b. Minimum thickness of hardware reinforcing plates shall be as follows:
    - 1) Hinge and pivot reinforcements (1-1/4-inch x 10-inch minimum size): 7 gauge.
    - 2) Strike Reinforcements: 12 gauge stiffeners.
    - 3) Flush Bolt Reinforcements: 12 gauge.
    - 4) Closer Reinforcements: 12 gauge.
    - 5) Reinforcements for surface-mounted hardware, hold-open arms, and surface panic devices: 12 gauge.
13. Floor Anchors: Minimum 14 gauge, securely welded inside each jamb, with holes for floor anchorage.
14. Jamb Anchors:

- a. Frames for installation in masonry walls shall be provided with adjustable jamb anchors of the T-strap type. Anchors shall be not less than 16 gauge steel. The number of anchors provided at each jamb shall be as follows:
    - 1) Frames up to 7 feet 6 inches in height: Three (3) anchors.
    - 2) Frames 7 feet 6 inches to 8 feet in height: Four anchors.
    - 3) Frames over 8 feet in height: One anchor for each 2 feet or fraction thereof in height.
  - b. Frames for installation in wood or metal stud partitions shall be provided with steel anchors of suitable approved design, not less than 16-gauge thickness, securely welded inside each jamb as follows:
    - 1) Frames up to 7 feet 6 inches (7'-6") in height: Four anchors.
    - 2) Frames 7 feet 6 inches to 8 feet in height: Five anchors.
    - 3) Frames over 8 feet in height: Four anchors plus one additional for each 2 feet or fraction thereof over 8 feet.
  - c. Frames to be anchored to previously placed concrete, masonry, or structural steel shall be provided with anchors of suitable design as shown on approved shop drawings.
15. Dust Cover Boxes: Shall be of not less than 26 gauge steel and shall be provided at all mortised hardware items. 8 inch CMU walls with face brick shall have dual offset jamb anchors.
  16. Steel Spreader: Shall be provided on all frames, temporarily attached to bottoms of both jambs for bracing during shipping and handling.
  17. Loose glazing stops: Shall be of cold rolled steel, not less than 20 gauge, butted at corner joints and secured to the frame with countersunk cadmium or zinc-plated screws. Loose stops at exterior frames shall be placed on the interior side of the frames.
  18. At sound rated door openings and at masonry openings, coat inside of frame profile with corrosion resistant coating to minimum thickness of 1/16 inch.
- C. Frame Color: Field paint under Section 09 90 00 - Painting and Coating, color as indicated on Drawings.

## 2.4 DOOR FABRICATION

- A. Minimum Gauges:
  1. Doors: 0.047 inch or 18 gauge (16 gauge for high frequency doors).
  2. 16 gauge (14 gauge for windstorm rated doors).
- B. Design and Construction:
  1. Thickness shall be 1-3/4 inch, unless specifically noted or shown otherwise.
  2. Exterior doors: Provide doors with 22 gauge steel z-channels placed at 6 inches apart with foamed in place polyurethane core, with a thermal insulation calculated R factor of 11.01 per ASTM C518 Standards.
  3. Fabrication:
    - a. Doors shall be strong, rigid, and neat in appearance, free from warpage and buckle.
    - b. Corner bends shall be true, straight, and of minimum radius for gage of metal used.
    - c. Provide stiffeners with polystyrene core spaced maximum 6 inches on center and extending full height of door.
    - d. Fill interior with noncombustible fiberglass insulation. Use rock mineral wool board filler as required for labeled doors.
    - e. Faces shall be joined at vertical edges of door by a continuous weld extending full height of door. Welds shall be ground, filled, and dressed smooth to provide a smooth flush surface.
    - f. Top and bottom edges of doors shall be closed with a continuous recessed steel channel not less than 16 gauge, extending full width of door and spot weld to both faces. Exterior doors shall have an additional flush closing channel at top and bottom edges. Openings shall be provided in the bottom closure channel at top and bottom edges. Openings shall be provided in the bottom closure of exterior doors to permit

- the escape of entrapped moisture.
- g. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Section 08 71 00 - Door Hardware.
  - h. Electrical Raceways: Provide raceways for standardized plug connectors to accommodate up to 12 wires as required for electrified door hardware specified in hardware sets in Division 08: Openings. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.
  - i. Doors in wet or humid areas shall have a top cap and solid foam interior core to prevent internal moisture accumulation and galvannealed.
  - j. Edge profile shall be provided on both vertical edges of door as follows:
    - 1) Single-acting swing doors: Beveled 1/8 inch in 2 inches.
  - k. Hardware Reinforcements:
    - 1) Doors shall be mortised, reinforced, drilled, and tapped at factory for fully template hardware, in accordance with the approved hardware schedule and templates provided by Section 08 71 00 - Door Hardware. Where surface-mounted hardware is to be applied, doors shall have reinforcing plates only.
    - 2) Minimum gauges for hardware reinforcing plates shall be as follows:
      - (a) Hinge and pivot reinforcements: 7 gauge.
      - (b) Reinforcements for lock face, flush bolts, concealed holders, concealed or surface-mounted closers: 12 gauge.
4. Glass Moldings and Stops: Loose stops shall be not less than 20-gauge steel, with butt corner joints, secured to frame opening by countersunk screws. Snap-on attachments will not be acceptable.
5. Louvers: Shall be inverted "V" blade, sight-proof type, unless noted otherwise.
6. Edge Clearances:
  - a. Between door and frame at head and jambs: 1/8 inch.
  - b. At doorsills with no threshold: 5/8 inch to 3/4 inch above finished floor.
  - c. At doorsills with threshold: As required to suit threshold.
  - d. Between meeting edges of double doors: 1/8 inch.
- C. Finish:
  - 1. Shop paint steel (whether galvanized or ungalvanized) stops and accessories as follows:
    - a. Clean surfaces free of mill scale, rust, oil, grease, dirt, and other foreign matter.
    - b. Chemically treat surfaces and apply one (1) coat of an approved baked-on rust-inhibitive primer paint to provide a minimum 0.5 mil dry film thickness.
  - 2. Field painted under Section 09 90 00 - Painting and Coating.
- D. Thermal Insulated Door: Total insulation R-Value of 44 measured in accordance with ASTM C1363, unless otherwise noted on Drawings.

## **PART 3 EXECUTION**

### **3.1 COORDINATION**

- A. Coordinate the work of this Section.
- B. Coordinate hardware installation with opening construction. Door hardware is specified in Section 08 71 00 - Door Hardware.
- C. Coordinate doors, frames, and windows with glazing specified in Section 08 80 00 - Glazing.
- D. Coordinate doors and frames with painting specified in Section 09 90 00 - Painting and Coating.

### **3.2 INSTALLATION**

- A. Separate dissimilar metals. Protect against galvanic action.
- B. Frames:
  - 1. Anchorage and connections: Secure to adjacent construction. Where practical, interior door frames shall be flush with the pull side wall to minimize or eliminate the reveal and

- allow full 180 degree door swing.
  - 2. Install frames in accordance with manufacturer's instructions and install labeled frames in accordance with NFPA 80.
  - 3. Frame spreader bars: Leave intact until frames are set perfectly square and plumb and anchors are securely attached.
  - 4. Remove hardware, with the exception of prime-coated items, tag box, and reinstall after finish paint work is completed. Do not remove or paint over labels on labeled frames.
- C. Doors:
- 1. Install hardware in accordance with hardware manufacturer's templates and instructions.
  - 2. Install doors in accordance with manufacturer's instructions and install labeled doors in accordance with NFPA 80.
  - 3. Adjust operable parts for correct function.
  - 4. Remove hardware, with the exception of prime-coated items, tag, box, and reinstall after finish paint Work is completed. Do not remove or paint over labels on labeled doors.

### **3.3 ADJUST AND CLEAN**

- A. Adjust doors for proper operation, free from binding or other defects.
- B. Clean and restore soiled surfaces.
- C. Remove scraps and debris, and leave site in clean condition.

**END OF SECTION 08 11 13**

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## **SECTION 08 14 16 - FLUSH WOOD DOORS**

### **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 requirements including but not limited to:
  - 1. WI Certified, fire-rated and non-rated, flush panel wood doors.
  - 2. Solid core doors with MDF and plastic laminate faces.
  - 3. Integration of a security system.
  - 4. Factory fitting flush wood doors to frames and factory machining for hardware.
  - 5. Accessories necessary for a complete installation.
- B. Related Sections:
  - 1. Section 05 50 00 - Metal Fabrications.
  - 2. Section 07 92 00 - Joint Sealants.
  - 3. Section 08 11 13 - Hollow Metal Doors and Frames.
  - 4. Section 08 80 00 - Glazing.
  - 5. Section 09 21 16 - Gypsum Board Assemblies.
  - 6. Section 09 24 00 - Cement Plastering.

#### **1.3 REFERENCE STANDARDS**

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- C. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
- D. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- E. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- F. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

#### **1.4 SUBMITTALS**

- A. Product Data:
  - 1. Technical data for each type of door indicated:
    - a. Include details of core and edge construction, louvers, and trim for openings.
    - b. Include factory finishing specifications.
    - c. Include laboratory test report results of hinge loading, cycle/slam, stile edge screw withdrawals, and stile edge split resistance for fire rated doors.
- B. Shop Drawings:
  - 1. Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
    - a. Dimensions and locations of blocking.
    - b. Dimensions and locations of mortises and holes for hardware.
    - c. Dimensions and locations of cutouts.
    - d. Undercuts.
    - e. Requirements for veneer matching.
    - f. Doors to be factory finished and finish requirements.
    - g. Fire-protection ratings for fire rated doors.
- C. Certificate of Compliance for Fire Rated Doors: Provide copies of Certificate of Compliance for fire rated door assemblies and smoke and draft control door assemblies.

- D. Certificate of Compliance regarding WI construction grade.
- E. Certificate of Compliance regarding WI installation requirements.

### **1.5 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Fire rated wood doors - NFPA 80 listed and labeled by UL for fire protection ratings indicated, based on testing at positive pressure according to UL 10C:
    - a. Oversize fire rated door assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
    - b. Temperature rise limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 degrees F (250 degrees C) above ambient after 30 minutes of standard fire-test exposure.
  - 2. Smoke and draft control door assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
  - 3. Accessibility requirements - comply with applicable requirements:
    - a. Americans with Disabilities Act of 1990, as amended:
      - 1) ADA Title II Regulations & the 2016 ADA Standards for Accessible Design.
  - 4. Quality standard: In addition to requirements specified, comply with Woodwork Institute WI Manual of Millwork
  - 5. Maintain at least one copy of WI Manual for reference at jobsite throughout installation period.
- B. Source Limitations: Obtain flush wood doors through one (1) source from a single manufacturer.
- C. Pre-Installation Conference: Conduct conference at site.

### **1.6 WARRANTY**

- A. Warranty:
  - 1. Written warranty signed by manufacturer, installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship. A representative of the door manufacturer shall inspect the installed doors and shall note on the warranty that no provisions of the warranty have been nullified in the manufacture and/or installation:
    - a. Failures include, but are not limited to, the following:
      - 1) Warping (bow, cup, or twist) more than 1/4-inch (6.4 mm) in a 42-inch by 84-inch (1,067 mm by 2,134 mm) section.
      - 2) Telegraphing of core construction in face veneers exceeding 0.01-inch in a three-inch (0.25 mm in a 76.2 mm) span.
    - b. Warranty include installation and finishing that may be required due to repair or replacement of defective doors.
    - c. Warranty period for solid core exterior doors: Five (5) years from date of Substantial Completion.
    - d. Warranty period for solid core interior doors: Life of installation.

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

- A. Protect wood doors during transit, storage, and handling to prevent damage, soiling, and deterioration. Store wood doors on a flat level surface in a dry, well ventilated, place. Keep wood doors a minimum of 3-1/2 inches (85 mm) off floor surface and protected by a protective covering under the bottom door and over the top door. Covering should protect wood doors from dirt, water, and abuse but allow for air circulation under and around the stack. Do not store wood doors in direct sunlight. Comply with requirements of referenced standard and manufacturer's written instructions.

- B. Package doors individually in heavy duty cardboard cartons prior to shipment from factory. Mark each door on top and bottom rail with opening number used on shop drawings using temporary, removable, or concealed markings.
- C. Handle wood doors with clean gloves. Lift and carry wood doors when moving them around the site; do not drag wood doors across one another.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
  - 1. Flush Wood Doors:
    - a. Haley Brothers, Inc.
    - b. Oshkosh Door Company.
    - c. Oregon Door.
    - d. Weyerhaeuser.
  - 2. High Pressure Laminate:
    - a. Formica Corp.
    - b. Panolam Surface Systems.
    - c. Wilsonart LLC.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

### **2.2 MATERIALS**

- A. Fire Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
  - 1. Cores: Provide core specified or mineral core as necessary to provide fire protection rating indicated.
  - 2. Edge construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
  - 3. Pairs: Provide fire retardant stiles listed and labeled for applications indicated without formed steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
  - 4. Pairs:
    - a. Provide formed steel edges and astragals with intumescent seals:
      - 1) Finish steel edges and astragals with baked enamel same color as doors.
      - 2) Finish steel edges and astragals to match door hardware (locksets or exit devices).
- B. Smoke and Draft Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
- C. Particleboard Core Doors:
  - 1. Blocking:
    - a. Provide wood blocking in particleboard core doors as necessary to eliminate through-bolting hardware:
      - 1) Five-inch (125 mm) top rail blocking in all doors, whether or not closers are scheduled.
      - 2) Five-inch (125 mm) bottom rail blocking, in exterior doors and doors indicated to have protection plates.
      - 3) Five-inch (125 mm) midrail blocking, in doors indicated to have exit devices.
      - 4) 4-1/2 inch by 10 inch (114 mm by 250 mm) lock blocks, in doors indicated with lock and latch sets.

2. Provide doors with glued wood stave or structural composite lumber cores instead of particleboard cores for doors indicated to receive exit devices.
- D. Fire Rated Wood Doors with Plastic Laminate Face - Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C:
  1. Core: Noncombustible mineral product complying with requirements and testing and inspecting agency for fire protection rating indicated.
  2. Blocking:
    - a. Provide composite blocking with improved screw-holding capability approved for use in doors of fire protection ratings indicated as follows:
      - 1) 5 inch (125 mm) top rail blocking in all doors, whether or not closers are scheduled.
      - 2) 5 inch (125 mm) bottom rail blocking, in doors indicated to have protection plates.
      - 3) 5 inch (125 mm) midrail blocking, in doors indicated to have exit devices.
      - 4) 4-1/2 inch by 10 inch (114 mm by 250 mm) lock blocks, in doors indicated with lock and latch sets.
  3. Edge Construction:
    - a. Provide fire rated door edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges:
      - 1) At hinge stiles, provide laminated edge construction with improved screw holding capability and split resistance:
        - (a) Screw holding capability: 550 lbf (2440 N) per WDMA T.M.-10.
      - 2) Pairs:
        - (a) Provide fire retardant stiles listed and labeled for applications indicated without formed steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges. Where required, provide formed steel edges and astragals with intumescent seals. Finish steel edges and astragals with baked enamel.
  4. Smoke and draft control door assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.

### **2.3 WOOD VENEER-FACED DOORS (TRANSPARENT FINISH)**

- A. Particleboard Core Doors with Wood Veneer Face:
  1. Grade and construction: WI custom grade, PC-5; 1-3/4 inch unless otherwise indicated.
  2. Core - ANSI A208.1, particleboard or MDF, made with binder containing no urea formaldehyde resin: Provide doors with glued block or structural composite lumber cores instead of particleboard cores at locations where exit devices are indicated.
  3. Blocking:
    - a. Provide wood blocking in particleboard core doors necessary to eliminate through bolting hardware:
      - 1) 5 inch (125 mm) top rail blocking. in all doors, whether or not closers are scheduled.
      - 2) 5 inch (125 mm) bottom rail blocking in doors indicated to have protection plates.
      - 3) 5 inch (125 mm) midrail blocking, in doors indicated to have exit devices.
      - 4) 4-1/2 inch by 10 inch (114 mm by 250 mm) lock blocks, in doors indicated with lock and latch sets.
  4. Construction: Five (5) plies. Bond stiles and rails to core, then abrasive plane entire unit before faces and crossbands are applied. Bond faces to core using a hot press.
  5. Crossbanding: Minimum 1/16-inch thick, low density hardwood, composite, or high density hardboard.
  6. Face: Wood Veneer.
    - a. Species: Maple.

- b. Cut: Plain Sliced (Flat Cut).
- c. Matching: Random.
- d. Finish: Clear.
- 7. Exposed Vertical and Horizontal Edges:
  - a. Material: Wood veneer.
  - b. Finish: Match face.

## 2.4 LIGHT FRAMES AND LOUVERS

- A. Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048 inch (1.2 mm) thick, cold-rolled steel sheet; factory primed for paint.
  - 1. Finish: Match door color.
- B. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048 inch (1.2 mm) thick, cold-rolled steel sheet; factory primed for paint with baked-enamel or powder-coated finish, and approved for use in doors of fire-protection rating indicated.
  - 1. Finish: Match door color.

## 2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated:
  - 1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame shop drawings, BHMA-156.115-W, and hardware templates:
  - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
  - 2. Metal astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Transom and Side Panels:
  - 1. Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles:
    - a. Fabricate door and transom panels with full-width, solid-lumber, rabbeted, meeting rails. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.
- D. Openings:
  - 1. Factory cut and trim openings through doors:
    - a. Light openings: Trim openings with moldings of material and profile indicated.
    - b. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 80 00 - Glazing.
    - c. Louvers: Factory install louvers in prepared openings.
- E. Exterior Doors:
  - 1. Factory treat exterior doors with water repellent after fabrication has been completed but before shop priming or factory finishing:
    - a. Flash top of out-swinging doors with manufacturer's standard metal flashing.

## 2.6 SHOP PRIMING

- A. Doors for Opaque Finish: Shop prime faces, all four edges, edges of cutouts, and mortises with one (1) coat of wood primer specified in Section 09 90 00 - Painting and Coating.
- B. Doors for Transparent Finish: Shop prime faces and all four edges with stain (if required), other required pretreatments, and first coat of finish as specified in Section 09 90 00 - Painting and Coating. Seal edges of cutouts and mortises with first coat of finish.

## 2.7 FACTORY FINISHING

- A. General – For factory finish doors, factory finish doors that are indicated to receive transparent finish, and factory finish doors where indicated in schedules or on Drawings as factory finished:
  - a. Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing:
    - 1) Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Transparent Finish:
  - 1. Grade: Premium.
  - 2. Finish: WI's Architectural Woodwork Standards System 9, UV curable, acrylated epoxy, polyester, or urethane; refer to Drawings for finish designation.
  - 3. Staining: As selected by the Architect from manufacturer's full range.
  - 4. Effect: Semi-filled finish, produced by applying an additional finish coat to partially fill the wood pores.
  - 5. Sheen: Semigloss.
- C. Opaque Finish:
  - 1. Grade: Premium.
  - 2. Finish: AWMAC's and WI's Architectural Woodwork Standards System 10, UV curable, water based; refer to Drawings for finish designation.
  - 3. Color: As selected by the Architect from manufacturer's full range.
  - 4. Sheen: Semigloss.

## PART 3 EXECUTION

### 3.1 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

### 3.2 EXAMINATION

- A. Examine doors and installed door frames, with installer present, before hanging doors:
  - 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
  - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Hardware: For installation, refer to Section 08 71 00 - Finish Hardware.
- B. Installation Instructions:
  - 1. Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated:
    - a. Install fire-rated doors according to NFPA 80.
    - b. Install smoke and draft-control doors according to NFPA 105.
- C. Job-Fitted Doors:
  - 1. Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining:
    - a. Clearances:
      - 1) Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 3/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering

unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated:

- (a) Comply with NFPA 80 for fire-rated doors.
  - b. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
  - c. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Factory Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

### **3.4 ADJUSTING**

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

**END OF SECTION 08 14 16**

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## **SECTION 08 33 23 - OVERHEAD COILING DOORS**

### **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:
- B. Related Sections:
  - 1. Section 05 50 00 - Metal Fabrications: Door opening jamb and head members.
  - 2. Section 06 10 00 - Rough Carpentry: Door opening jamb and head members.
  - 3. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
  - 4. Section 09 90 00 - Painting and Coating: Field paint finish.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

#### **1.4 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide general construction, electrical equipment, and component connections and details.
- C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
- D. Samples: Submit two slats, 6 inches (610 mm) in size illustrating shape, color and finish texture.
- E. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.
- F. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.
- G. Executed warranties.
- H. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in School District's name and registered with manufacturer.

#### **1.5 QUALITY ASSURANCE**

#### **1.6 WARRANTY**

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Manufacturer Warranty: Provide five-year manufacturer warranty for three-ply multifilament polyester fabric curtain. Complete forms in School District's name and register with manufacturer.
- C. Manufacturer Warranty: Provide lifetime manufacturer warranty for counterweights and tension springs. Complete forms in School District's name and register with manufacturer.

### **PART 2 PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
  - 1. Overhead Coiling Doors:
    - a. C.H.I. Overhead Doors: [www.chiohd.com](http://www.chiohd.com).

- b. Cornell Iron Works, Inc: [www.cornelliron.com](http://www.cornelliron.com).
  - c. Overhead Door Corporation: [www.overheaddoor.com](http://www.overheaddoor.com).
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

## 2.2 NON-INSULATED OVERHEAD COILING DOORS

## 2.3 INSULATED OVERHEAD COILING DOORS

- A. Exterior, Manual, Insulated, Overhead Coiling Doors:
- 1. Basis of Design Product:
    - a. Thermiser Model ESD20 manufactured by Cornell.
  - 2. Curtain Material (Exterior Face / Interior Face): Galvanized Steel / Galvanized Steel.
    - a. Manufacturer recommended gauge based on performance requirements. Minimum 24 gauge, Grade 40, ASTM A653/A653M galvanized steel zinc coating.
  - 3. Insulation: 7/8 inch (22 mm) foamed-in-place, closed cell urethane.
    - a. R-Value: 8.0, minimum.
  - 4. Curtain Finishes:
    - a. Exterior Finish:
      - 1) Powder Coat.
        - (a) Color: As selected by the Architect.
    - b. Interior Finish:
      - 1) Powder Coat.
        - (a) Color: Match exterior.
  - 5. Nominal Slat Size: Refer to Basis of Design product.
  - 6. Endlocks: Provide windlocks as required to meet specified wind load.
  - 7. Bottom Bar: Insulated bottom bar.
    - a. Reinforced extruded aluminum interior face with full depth insulation and exterior skin slat to match curtain material and gauge. Minimum 4" tall x 1-1/16" thickness.
    - b. Finish: Match slats.
  - 8. Guides: Structural steel.
    - a. Minimum 3/16 inch (4.76 mm) angles. Provide windlock bars of same material when windlocks are required to meet specified wind load. Top of inner and outer guide angles to be flared outwards to form bellmouth for smooth entry of curtain into guides. Provide removable guide stoppers to prevent over travel of curtain and bottom bar.
    - b. Top 16-1/2 inches (419.10 mm) of coil side guide angles to be removable for ease of curtain installation and as needed for future curtain service.
    - c. Finish:
      - 1) Powder coat.
        - (a) Color: Match curtain.
  - 9. Counterbalance Shaft Assembly: As recommended by manufacturer.
  - 10. Brackets:
    - a. Material: As recommended by manufacturer.
    - b. Size: As recommended by manufacturer.
    - c. Finish: Match guides.
  - 11. Hood Enclosure:
    - a. Material: As recommended by manufacturer.
    - b. Size: As recommended by manufacturer.
    - c. Finish: Match slats.
  - 12. Weatherstripping:
    - a. Bottom Bar:
      - 1) Manual Doors: Replaceable, bulb-style, compressible EDPM gasket extending into guides.

- 2) Motorized Doors: Sensing/weather edge with neoprene astragal extending full width of door bottom bar.
13. Operation:
  - a. Manual: Chain hoist operation.
  - b. Motorized:
    - 1) Electric Motor: As recommended by manufacturer.
    - 2) Safety Devices: As required by applicable regulations.
14. Mounting: As indicated on Drawings.
15. Locking Devices:
  - a. Manual Doors: Padlockable slide bolt on coil side of bottom bar at each jamb extending into slots in guides..
  - b. Motorized Doors: None.

## **2.4 MATERIALS AND COMPONENTS**

- A. Metal Curtain Construction: Interlocking slats.
  1. Curtain Bottom for Slat Curtains: Fitted with angles to provide reinforcement and positive contact in closed position.
  2. Weatherstripping for Exterior Doors: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.
- B. Guide Construction: Continuous, of profile to retain door in place with snap-on trim, mounting brackets of same metal.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install units in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

**END OF SECTION 08 33 23**

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## **SECTION 08 43 13 - ALUMINUM-FRAMED STOREFRONTS**

### **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 requirements including but not limited to:
  - 1. Exterior and interior storefront framing.
  - 2. Exterior and interior manual swing entrance doors.
  - 3. Accessories necessary for a complete installation.
- B. Related Sections:
  - 1. Section 05 12 00 - Structural Steel Framing.
  - 2. Section 05 40 00 - Cold Formed Metal Framing.
  - 3. Section 05 50 00 - Metal Fabrications.
  - 4. Section 07 62 00 - Roof Related Sheet Metal.
  - 5. Section 07 92 00 - Joint Sealants.
  - 6. Section 08 13 16 - Aluminum Doors.

#### **1.3 REFERENCE STANDARDS**

- A. 2012 TAS - Texas Accessibility Standards; 2012.
- B. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- H. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2020.
- I. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- J. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).
- K. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials; 2019.
- L. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2023.

#### **1.4 SUBMITTALS**

- A. Product Data: Technical data for each type of product indicated including construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum framed systems.

- B. Shop Drawings:
  - 1. Submit aluminum storefront framing and entrances shop drawings including plans, elevations, sections, full size details, and attachments to other work:
    - a. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
    - b. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- C. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- D. Engineer's calculations of performance requirements.
- E. Maintenance Data: For aluminum framed systems to include in maintenance manuals.

### **1.5 PERFORMANCE REQUIREMENTS**

- A. Aluminum framed systems shall withstand the effects of specified performance requirements without exceeding performance criteria or fail due to defective manufacture, fabrication, installation, or other defects in construction:
  - 1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
  - 2. Dimensional tolerances of building frame and other adjacent construction.
  - 3. Failure includes the following:
    - a. Deflection exceeding specified limits.
    - b. Thermal stresses transferring to building structure.
    - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
    - d. Noise or vibration created by wind and by thermal and structural movements.
    - e. Loosening or weakening of fasteners, attachments, and other components.
    - f. Sealant failure.
    - g. Failure of operating units.
- B. Structural Loads:
  - 1. Refer to Structural.
- C. Deflection of Framing Members:
  - 1. Deflection normal to wall plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed  $L/175$  of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to  $3/4$  inch (19 mm), whichever is less.
  - 2. Deflection parallel to glazing plane: Limited to  $L/360$  of clear span or  $1/8$  inch (3.2 mm), whichever is smaller.
- D. Structural Test Performance - Provide aluminum framed systems tested according to ASTM E330/E330M as follows:
  - 1. When tested at positive and negative wind load design pressures, systems do not evidence deflection exceeding specified limits.
  - 2. When tested at 150 percent of positive and negative wind load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
  - 3. Test durations: As required by design wind velocity, but not fewer than 10 seconds.
- E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E331 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).

- F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- G. Windborne Debris Impact Resistance:
  - 1. Pass missile impact and cyclic pressure tests when tested according to ASTM E1886 and testing information in ASTM E1996 for Wind Zone \_\_\_\_\_:
    - a. Large missile test: For glazed openings located within 30 feet (9.1 m) of grade.
- H. Thermal Movements:
  - 1. Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss:
    - a. Temperature change (range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
    - b. Interior ambient-air temperature: 75 degrees F (24 degrees C).
- I. Condensation Resistance: Provide aluminum framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.
- J. Thermal Conductance: Provide aluminum framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x degrees F (3.23 W/sq. m x K) when tested according to AAMA 1503.

## 1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Accessibility requirements:
    - a. 2019 California Building Code: Section 11B-404.3 accessible route.
    - b. 2019 California Building Code: Section 11B-309.4 operable parts interior usage.
    - c. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
    - d. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
- B. Installer Qualifications: Installer having minimum 10 years' documented experience who is an authorized representative of the manufacturer and is trained and approved for installation of units required.
- C. Engineering Responsibility: Prepare data for aluminum framed systems, including shop drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated.
- D. Product Options:
  - 1. Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in service performance:
    - a. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- E. Source Limitations: Obtain aluminum framed entrances from single source from single manufacturer.
- F. Pre-Installation Conference: Conduct conference at site.

## 1.7 WARRANTY

- A. Written warranty signed by manufacturer, Contractor, and installer in which manufacturer agrees to repair or replace components of aluminum framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including, but not limited to, excessive deflection.
    - b. Noise or vibration caused by thermal movements.
    - c. Water leakage through fixed glazing and framing areas.
    - d. Failure of operating components.
  - 2. Warranty period: 2 years from date of Substantial Completion.
- B. Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering:
  - 1. Warranty period: 10 years from date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Manufactureres:
  - 1. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
    - a. Kawneer: [www.kawneer.us](http://www.kawneer.us).
    - b. Oldcastle BuildingEnvelope: [www.obe.com](http://www.obe.com).
    - c. Tubelite, Inc.: [www.tubeliteusa.com](http://www.tubeliteusa.com).
    - d. US Aluminum Corporation: [www.usalum.com](http://www.usalum.com).
    - e. YKK America AP, Inc.: [www.ykkap.com](http://www.ykkap.com).
  - 2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
    - a. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
- B. Basis of Design:
  - 1. Standard Systems:
    - a. Trifab VersaGlaze 451 and 451T manufactured by Kawneer.
- C. General:
  - 1. Maximum design pressure +/- 45 psf.
  - 2. Refer to Drawings for frame size and locations. Subject to compliance with requirements, provide comparable storefront system by one of the following:
- D. Aluminum:
  - 1. Alloy and temper recommended by manufacturer for type of use and finish indicated:
    - a. Sheet and plate: ASTM B209/B209M.
    - b. Extruded bars, rods, profiles, and tubes: ASTM B221/ASTM B221M.
    - c. Extruded structural pipe and tubes: ASTM B429/B429M.
- E. Framing Members:
  - 1. Extruded aluminum framing members of thickness required and reinforced necessary to support imposed loads:
    - a. Construction: Non-Thermal or Thermal, as indicated on Drawings.
    - b. Glazing system: Retained mechanically with gaskets on four sides.
    - c. Glazing Plane: Front.
- F. Accessories:
  - 1. Brackets and reinforcements: High strength aluminum with nonstaining, nonferrous shims for aligning system components.



2. Fasteners and accessories:
    - a. Corrosion resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials:
      - 1) Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
      - 2) Reinforce members as required to receive fastener threads.
  3. Concrete and masonry inserts: Hot dip galvanized cast iron, malleable iron, or steel inserts, complying with ASTM A123/A123M or ASTM A153/A153M.
  4. Concealed flashing: Corrosion resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
  5. Framing system gaskets and sealants: Recommended by manufacturer for joint type.
- G. Glazing:
1. Refer to Section 08 80 00 - Glazing for impact resistant laminated insulating glazing units
  2. Glazing Gaskets: Compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
  3. Spacers and Setting Blocks: Elastomeric type.
- H. Entrance Doors:
1. Refer to Section 08 13 16 - Aluminum Doors.
- I. Accessories:
1. Joint Sealants: For installation at perimeter of aluminum framed systems, refer to Section 07 92 00 - Joint Sealants.
  2. Bituminous Paint: Cold applied, asphalt mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30 mil (0.762 mm) 30 mil (0.762 mm) thickness per coat.

## 2.2 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Framing Members:
1. Fabricate components that, when assembled, have specified characteristics:
    - a. Profiles that are sharp, straight, and free of defects or deformations.
    - b. Accurately fitted joints with ends coped or mitered.
    - c. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
    - d. Physical and thermal isolation of glazing from framing members.
    - e. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
    - f. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
    - g. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
    - h. Provide sill receptors with end dams at all sill conditions.
- C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- D. Storefront Framing: Fabricate components for assembly using screw spline system.
- E. Entrance Door Frames:
1. Reinforce as required to support loads imposed by door operation and for installing entrance door hardware:
    - a. At exterior doors, provide weather stripping at fixed stops.
    - b. At interior doors, provide weather stripping at stops to prevent metal to metal contact.
- F. After fabrication, clearly mark components to identify their locations in Project according to shop drawings.

## **2.3 ALUMINUM FINISHES**

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.
- B. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31 Clear anodic coating not less than 0.4 mils (0.01 mm) thick.
- C. Touch-Up Materials: As recommended by coating manufacturer for field application.

## **PART 3 EXECUTION**

### **3.1 PROJECT CONDITIONS**

- A. Field Measurements: Verify actual locations of structural supports for aluminum framed systems by field measurements before fabrication and indicate measurements on shop drawings.

### **3.2 EXAMINATION**

- A. Examine areas and conditions for compliance with requirements for installation tolerances and conditions affecting performance of the work. Proceed with installation after correcting unsatisfactory conditions.

### **3.3 INSTALLATION**

- A. Comply with aluminum framed storefront manufacturer recommended installation instructions. Coordinate installation with curtain wall work:
  - 1. Do not install damaged components.
  - 2. Fit joints to produce hairline joints free of burrs and distortion.
  - 3. Rigidly secure nonmovement joints.
  - 4. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
  - 5. Seal joints watertight unless otherwise indicated.
  - 6. Min anchorage #8 with 2 inch minimum embedment; minimum 2 inches from edges. Refer to shop drawings.
- B. Metal Protection:
  - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
  - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 - Joint Sealants to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Install glazing specified in Section 08 80 00 - Glazing.
- G. Entrance Doors and Hardware:
  - 1. Install doors to produce smooth operation and tight fit at contact points:
    - a. Exterior doors: Install to produce weathertight enclosure and tight fit at weather stripping.
    - b. Field installed entrance door hardware: Install surface mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- H. Install perimeter joint sealants as specified in Section 07 92 00 - Joint Sealants to produce weathertight installation.

### **3.4 ERECTION TOLERANCES**

- A. Install aluminum framed systems to comply with the following maximum erection tolerances:
  - 1. Location and plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
  - 2. Alignment:
    - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
    - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).
- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

### **3.5 ADJUSTING**

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer:
  - 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3 second closer sweep period for doors to move from a 70 degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

### **3.6 MAINTENANCE SERVICE**

- A. Entrance Door Hardware:
  - 1. Maintenance tools and instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for School District's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
  - 2. Initial maintenance service: Beginning at Substantial Completion, provide six (6) months full maintenance by skilled employees of entrance door hardware installer. Include quarterly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

**END OF SECTION 08 43 13**

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SECTION 08 7100  
FINISH HARDWARE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Work under this section comprises of furnishing and installing hardware specified herein and noted on drawings for a complete and operational system, including any electrified hardware components, systems, controls, and hardware for aluminum entrance doors. Any door shown on the drawing and not specifically referenced in the hardware sets shall be provided with identical hardware as specified on other similar openings and shall be included in the finish hardware suppliers bid. All fire rated door shall be provided with fire rated hardware as required by local code Authority as part of the hardware supplier's base bid. The hardware supplier shall verify all cylinder types specified for all special doors with locking devices furnished as a part of the door system.
- B. The General Contractor and the Hardware Supplier shall notify the Architect in writing of any discrepancies (five (5) days prior to bid date) that could and/or would result in hardware being supplied that is none functional, hardware specified and/or hardware that has not been specified that will result in any code violations and any door that is not covered in this specification. Failure of the general contractor and hardware supplier to address any such issue shall be considered acceptance of the hardware specified and all discrepancies shall be corrected at the general contractor and hardware supplier's expense and considered a part of their base bid. Change orders shall not be issued if deemed by the Architect and/or Edinburg CISD to fall under and/or be covered as a part of the contractor and supplier's base bid, due to failure to comply with this instruction notification.
- C. Items include but are not limited to the following:
1. Hinges - Pivots
  2. Flush Bolts
  3. Exit Devices
  4. Locksets and Cylinders
  5. Push Plates - Pulls
  6. Coordinators
  7. Closers
  8. Kick, Mop and Protection Plates
  9. Stops, Wall Bumpers, Overhead Controls
  10. Electrified Hold Open Devices
  11. Thresholds, Seals and Door Bottoms
  12. Silencers
  13. Miscellaneous Trim and Accessories
- 1.02 RELATED DOCUMENTS, drawings, and general provisions of contract, including General and Supplementary Conditions, and Division 1 Specification sections, apply to this section.
- 1.03 RELATED WORK specified elsewhere that should be examined for its effect upon this section:
- A. Section 06 20 00 - Finish Carpentry
  - B. Section 08 11 13 – Steel Doors and Frames
  - C. Section 08 14 16 – Flush Wood Doors
  - D. Sections within 08 31 13 – Access Doors
  - E. Section within 08 41 13 – Aluminum Entrances, Storefront and Window Framing
  - F. Sections within 08 80 00 – Glass and Glazing

- G. Sections within 09 91 00 - Painting
- H. Division 26 – Electrical
- I. Division 28 – Access Control

1.04 REFERENCES SPECIFIED in this section subject to compliance as directed:

- A. NFPA-80- Standard for Fire Doors and Windows
- B. NFPA-101 - Life Safety Code
- C. ADA - The Americans with Disabilities Act - Title III - Public Accommodations
- D. ANSI-A 117.1 - American National Standards Institute - Accessible and Usable Buildings and Facilities
- E. ANSI-A 156.5 - American National Standards institute -Auxiliary Locks and Associated Products
- F. UFAS - Uniform Federal Accessibility Standards
- G. UL - Underwriter's Laboratories
- H. WHI - Warnock Hersey International, Testing Services
- I. State and Local Codes including Authority Having Jurisdiction
- J. UL10C – Positive Pressure
- K. IBC-2021 - International Building Code
- L. NFPA-70 – National Electrical Code

1.05 SUBMITTALS

- A. HARDWARE SCHEDULES submit copies of schedule in accordance with Division 1, General Requirements. Schedule to be in vertical format, listing each door opening, including handing of opening, all hardware scheduled for opening or otherwise required to allow for proper function of door opening as intended, and finish of hardware. At doors with door closers or door controls include degree of door opening. Supply the schedules all Finish Hardware within two (2) weeks from date purchase order is received by the hardware supplier.
- B. Submit manufacturer's cut/catalog sheets on all hardware items and any required special mounting instructions with the hardware schedule.
- C. Certification of Compliance:
  - 1. Submit any information necessary to indicate compliance to all of these specifications as required.
  - 2. Submit a statement from the manufacturer that electronic hardware and systems being supplied comply with the operational descriptions exactly as specified.
- D. Submit any samples necessary as required by the Architect.
- E. Templates for finish hardware items to be sent to related door and frame suppliers within three (3) working days of receipt of approved hardware schedule.
- F. Electronic Security Hardware: Coordinate installation of the electronic security with the Architect and provide installation and technical data to the Architect and other related sub-contractor(s). Upon completion of the electronic security hardware installation, verify that all components are working properly and state in the required guarantee that this inspection has been performed.
- G. Wiring Diagrams: Provide complete wiring diagrams for each opening requiring electrified hardware, except openings where only magnetic hold-opens are specified. Provide a copy

with each hardware schedule submitted after approval. Supply a copy with delivery of hardware to job site and another copy to owner at time of job completion.

- H. Doors and Frames used in positive pressure opening assemblies shall meet UL10C in areas where this specification includes Seals for smoke door.

#### 1.06 QUALITY ASSURANCE

- A. Hardware supplier to be a qualified, Factory Authorized, direct distributor of the products to be furnished. In addition, the supplier to have in their regular employment an A.H.C. or person of equivalent experience who will be made available at reasonable times to consult with the Architect/Contractor and/or Edinburg CISD regarding any matters affecting the finish hardware on this project.
- B. All hardware used in labeled fire or smoke rated openings to be listed for those types of openings and bear the identifying label or mark indicating UL. (Underwriter's Laboratories) approved for fire. Exit devices in non-labeled openings to be listed for panic.

#### 1.07 DELIVERY, HANDLING AND PACKAGING

- A. Furnish all hardware with each unit clearly marked and numbered in accordance with the hardware schedule. Include door and item number for each.
- B. Pack each item of hardware completes with all necessary parts and fasteners.
- C. Properly wrap and cushion each item to prevent scratches and dents during delivery and storage.

#### 1.08 SEQUENCING AND SCHEDULING

Any part of the finish hardware required by the frame or door manufacturers or other that is needed in order to produce doors or frames is to be sent to those suppliers in a timely manner, so as not to interrupt job progress.

#### 1.09 WARRANTY

All finish hardware shall be supplied with a Two- (2) year warranty against defects in materials and workmanship, commencing with substantial completion of the project except as follows:

1. All Closers to have a thirty-(30) year written warranty.
2. All Exit Devices to have a five-(5) year written warranty.
3. All Locksets to have a ten-(10) year written warranty.
4. All Continuous Hinges to have a ten-(10) year written warranty.

### PART 2 – PRODUCTS

#### 2.01 FASTENERS

- A. Furnish with finish hardware all necessary screws, bolts and other fasteners of suitable size and type to anchor the hardware in position for a long life under hard use.
- B. Furnish fastenings where necessary with expansion shields, toggle bolts and other anchors designated by the Architect according to the material to which the hardware is to be applied and the recommendations of the hardware manufacturer. All closers and exit devices on

labeled wood doors shall be through-bolted if required by the door manufacturer. All thresholds shall be fastened with stainless steel sleeve anchors. Where specified in the hardware sets, security type fasteners of the type called for are to be supplied.

- C. Design of all fastenings shall harmonize with the hardware as to material and finish.

## 2.02 ENVIRONMENTAL CONCERN FOR PACKAGING

Hardware shipped to the project jobsite is to be packaged in biodegradable packs such as paper or cardboard boxes and wrapping.

## 2.03 HINGES

- A. All hinges to be of one manufacturer as hereafter listed for continuity and consideration of warranty. Provide one of the following manufacturers Ives, Mc Kinney or Stanley.
- B. Unless otherwise specified provide five-knuckle, heavy-duty, button tip, full mortise template type hinges with non-rising loose pins. Provide non-removable pins for out swinging doors at secured areas or as called for in this specification.
- C. Provide all exterior out-swinging door hinges of solid bronze or stainless steel with non-removable pins or security studs as called for in this specification, unless otherwise specified in 3.02 Hardware Sets.
- D. Provide interior hinges manufactured from bronze, steel, stainless steel that matches the specified finish shown on other hardware items. Furnish three (3) hinges up to 90 inches high and one (1) additional hinge for every 30 inches or fraction thereof.
- E. Provide size 4½" x 4½" for all 1¾" thick doors up to and including 36 inches wide. Doors over 1¾" through 2¼" thick, use 5" x 5" hinges. Doors over 36 inches use 5" x 4½" unless otherwise specified in 3.02 Hardware Sets.
- F. Where required to clear the trim and/or to permit the doors to swing 180 degrees furnish hinges of sufficient throw.
- G. Provide heavy weight hinges on all doors over 36 inches in width and all doors with overhead stops or holders.
- H. At labeled door's stainless steel, bearing-type hinges shall be provided. For all doors equipped with closers and all other doors provide bearing-type hinges.
- I. Finishes
  - 1. At wood doors, hinges are to be plated to match adjacent hardware or as called for in Hardware Sets.
  - 2. At hollow metal doors, hinges are to be stainless steel at exterior in-swinging and out-swinging doors, unless otherwise specified in 3.02 Hardware Sets.
- J. Continuous hinges shall be as specified and manufactured by Ives, Select or ABH Products. All exterior doors shall be prepared and receive continuous hinges as specified.
- K. Pivots shall not be used on any Edinburg C. I. S. D. projects.

## 2.04 LOCK AND LOCK TRIM



- A. All the locksets, latch sets, and trim to be of one manufacturer as hereafter listed for continuity of design and consideration of warranty. Provide Schlage "ND" Vandlguard series with the Rhodes lever. All locks, passage and privacy sets shall be provided in a Dull Chrome (626) finish. All locksets shall be prepared for Schlage Conventional Classic keyways as required by Edinburg C. I. S. D. All locks are to be the Vandlguard series functions as specified.
- B. Provide metal wrought box strike boxes and curved lip strikes with proper lip length to protect trim of the frame, but not to project more than 1/8 inch beyond frame trim or the inactive leaf of a pair of doors.
- C. Mechanical Locks shall meet ANSI Operational Grade 1, Series 4000 as specified.
  - 1. Hand of lock is to be easily field-reversible or non-handed.
  - 2. All lever trim is to be through-bolted through the door.
  - 3. Provide 3/4" latch bolt-throw at all pairs of doors specified with lock sets.
  - 4. Provide all locks specified with sound and/or light seal with a 3-3/4" back-set.
  - 5. Provide the ND95PD Rhodes XN12-035 Security Classroom function lock at all Classroom area doors.
  - 6. Provide the ND91PD Rhodes Entry Lock function at all office doors within the Administration area.

#### 2.05 CYLINDERS AND KEYING

- A. Provide locks and Exit devices requiring cylinders with Schlage Everest Conventional Classic keyway (No Substitution) key system that complies with performance requirements of ANSI A156.5. All keys shall be manufactured from nickel silver material. All locks are to be keyed to the existing Schlage Everest Classic Keyway Master-key system as directed by Edinburg C. I. S. D.
- B. Furnish all exterior locks and cylinders with temporary keyed construction Master keyed cylinders for the duration of construction. Provide ten (10) construction keys total.
- C. Cylinders shall be keyed as directed by Edinburg C. I. S. D. and the Architect (After the supplier has had a minimum of two (2) meetings on site to discuss the permanent keying). Provide four-(4) cut or blank keys per cylinder and ten-(10) cut Master keys per Master key used. The hardware supplier and the general contractor shall meet with Edinburg C. I. S. D. Representatives to determine exactly how all the locks are to be keyed and keys supplied (Cut or Blank). The hardware supplier in the presents of the Edinburg C. I. S. D. representative installs permanent cylinders and demon-straight that the keys function and lock or exit device work properly as installed. All permanent keys shall be turned over to Edinburg C. I. S. D. with a complete bitting list of all key changes used on the project. The bitting list shall include additional bittings equal to 200% expansion of the key system.
- D. Stamp all keys "Do not duplicate" and with key symbol as directed by Edinburg C. I. S. D.

#### 2.06 EXIT DEVICES

- A. All exit devices and trim, including electrified items, to be of one manufacturer as hereafter listed and in the hardware sets for continuity of design and consideration of warranty: electrified devices and trim to be the same series and design as mechanical devices and trim. All devices shall conform to NFPA 80 and NFPA 101 requirements.

- B. Exit Devices to be "UL" listed for life safety. All exit devices for labeled doors shall have "UL" label for "Fire Exit Hardware". All devices mounted on labeled wood doors are to be through-bolted or per the manufacturer's listing requirements.
- C. All exit devices to be of a heavy duty, chassis mounted design, with one-piece removable covers, eliminating necessity of removing the device from the door for standard maintenance and keying requirements.
- D. All trims to be through-bolted to the lock stile case. Lever design shall be the same as specified with the lock sets.
- E. Exit Devices to be the modern push rail design. Finish shall be Satin Aluminum (628).
- F. All devices shall carry a five- (5) year warranty against manufacturing defects and workmanship.
- G. Exit Devices shall be Precision "2100" series. All Exit Devices shall be installed with sex-nut-bolts provided by the Manufacturer.

## 2.07 SURFACE MOUNTED DOOR CLOSERS

- A. All closers for this project shall be the products of a single manufacturer for continuity of design and consideration of warranty. All door closers shall be mounted as to achieve the maximum degree of opening (trim permitting).
- B. All closers to be heavy duty, surface-mounted, fully hydraulic, rack and pinion action with high strength cast iron cylinder to provide control throughout the entire door opening cycle.
- C. Size all closers in accordance with the manufacturer's recommendations at the factory.
- D. All closers to have adjustable spring power sizes 1 through 4 or 6 as specified and separate tamper resistant, brass, non-critical regulating screw valves for closing speed, latching speed and back-check control as a standard feature unless specified otherwise.
- E. All closer covers to be rectangular, full cover type of non-ferrous, non-corrosive material painted to match closer. Install all door closers with sex-nut-bolts as provided by the closer manufacturer.
- F. Closer to have heavy-duty arms. All closer arms shall be of sufficient length to accommodate the reveal depth and to insure proper installation.
- G. Supply appropriate arm assembly for each closer so that closer body and arm are mounted on non-public side of door opening and on the interior side of exterior openings, except where required otherwise in the hardware sets.
  - 1. All parallel arm mounted closers to be factory indexed to insure proper installation.
  - 2. Furnish heavy-duty cold forged parallel arms for all parallel arm mounted closers.
- H. Provide closers with special application and heavy-duty arms as specified in the hardware sets or as otherwise called for to insure a proper operating, long lasting opening.
- I. Finish: Sprayed enamel finish shall match all other hardware.
- J. Door closer shall be LCN 1461 Interior and 4040XP Exterior as specified.

## 2.08 DOORSTOPS AND HOLDERS

- A. Doorstops are to be furnished for every door leaf. Every door is to have a floor, wall, or an overhead stop.
- B. Place doorstops in such a position that they permit maximum door swing, but do not present a hazard of obstruction. Furnish floor strikes for floor holders of proper height to engage holders of doors.
- C. Where overhead stops and holders are specified, or otherwise required for proper door operation, they are to be heavy duty and of extruded brass, bronze or stainless steel with no plastic parts as specified.
- D. Finish: Same as other hardware where available.
- E. Acceptable Products
  - 1. Floor and wall stop as listed in hardware sets. Equivalent products as manufactured by Ives, Rockwood and Trimco are acceptable.

## 2.09 PUSH PLATES, DOOR PULLS, AND KICKPLATES

- A. All push plates, door pull's, kick plates and other miscellaneous hardware as listed in hardware sets. Equivalent products as manufactured by Ives, Rockwood and Trimco are acceptable.
- B. Kick plates to be 10 inches high and Mop plates to be 6 inches high, both by 2 inches or 1 inch less than door width (LDW) as specified. They are to be of 16 gauge (.050 inches) thick stainless steel. For door with louvers or narrow bottom rails, kick plate height to be 1 inch less dimension shown from the bottom of the door to the bottom of the louver or glass.
- C. Where required armor plates, edge guards and other protective hardware shall be supplied in sizes as scheduled in the hardware sets.
- D. Finish: Same as other hardware where available.

## 2.10 FLUSH BOLTS AND COORDINATORS

- A. Provide Flush bolts with Dust Proof Strikes as indicated in the individual hardware sets by Ives, Rockwood and Trimco are acceptable. Finish shall match adjacent hardware.

## 2.11 THRESHOLDS AND GASKETING

- A. Provide materials and finishes as listed in hardware sets. Equivalent product by National Guard Products and Reese are acceptable. All thresholds must be in accordance with the requirements of the ADA and ANSI A117.1.
- B. Provide thresholds with 226 stainless steel sleeve anchors. Supply all necessary anchoring devices for weather strip and sound seal. All thresholds, weather strip, door bottoms, etc. shall be provided with silicone inserts as specified. Provide all thresholds with full body strength fill "V3".
- C. Seals shall comply with requirements of UL10C. All inserts shall be silicone as specified.

- D. Seals shall comply with the requirements of the Wood Door Manufacturer's certification requirements.

## 2.12 FINISHES

- A. Finishes for all hardware are as required in this specification and the hardware sets.
- B. Special care is to be taken to make uniform the finish of all various manufactured items.

## 2.13 DOOR SILENCERS

- A. Provide door silencers at all openings without gasket. Provide two- (2) each at each pair of doors and three- (3) each for each single door (coordinate with the frame manufacturer).

## 2.14 PROPRIETARY PRODUCTS

- A. References to specific products are used to establish quality standards of utility and performance. Unless otherwise approved provide only the specified product.
- B. All other materials, not specifically described, but required for a complete and proper finish hardware installation, are to be selected by the Contractor, subject to the approval of the Architect and Edinburg CISD.
- C. Architect and Edinburg CISD reserve the right to approve all the substitutions proposed for this specification. All requests for substitution to be made prior to bid in accordance with Division 1, General Requirements, and are to be in writing, hand delivered to the Architect. Two (2) copies of the manufacturer's brochures and a physical sample of each item in the appropriate design and finish shall accompany requests for substitution.

## PART 3 - EXECUTION

### 3.01 INSTALLATION OF FINISH HARDWARE

- A. Hardware is to be installed by experienced finish hardware installers after a pre-installation and pre-wiring meeting between the hardware supplier, lock, exit device and closer manufacturer's representative, electrical contractor, security contractor, hollow metal supplier, wood door supplier and hardware installer. Hardware installer shall have a minimum of ten (10) years of experience in the installation of finish hardware.
- B. Check hardware against the reviewed hardware schedule upon delivery. Store the hardware in a dry and secure location to protect against loss and damage.
- C. Install finish hardware in accordance with approved hardware schedule and manufacturers' printed instructions. Pre-fit hardware before finish is applied to door; remove and reinstall after finish is complete and dry. Install and adjust hardware so that parts operate smoothly, close tightly, and do not rattle.
- D. Mortise and cutting to be done neatly, and evidence of cutting to be concealed in the finished work. Protect all Finish hardware from scratching or other damage.

### 3.02 HARDWARE SETS:

#### **MISC ITEMS REQUIRED**

PROVIDE THE FOLLOWING:

(10) EXTERIOR CONSTRUCTION KEYS		SCH
(4) KEYS	PER CYLINDER	SCH
(3) GMKYS	KEY	SCH
(6) MKYS (PER SET)	KEY	SCH
KEY STAMPING	STAMPING (AS DIRECTED BY OWNER)	SCH
KEY BITTING LIST WITH EXPANSION		SCH
KNOX BOX (1 EACH)	3200-SERIES X RMK (HINGED DOOR)	BLK KNO

108873 OPT0365095 Version 1  
 Hardware Group No. 001  
 For use on Door #(s):

A110A	A110B	A110C	A111B		
Provide each RU door(s) with the following:					
QTY	EA	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	MORTISE CYLINDER	20-001 (CAM AS REQ)	626	SCH
		NOTE	REMAINDER OF HARDWARE BY DOOR MANUFACTURER		

-Coordinate hardware with door MFR.

Hardware Group No. 101R  
 For use on Door #(s):

B133	B134	B135	C163		
Provide each SGL door(s) with the following:					
QTY	EA	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	VANDL OFFICE LOCK	ND91P6D RHO	626	SCH
1	EA	SURFACE CLOSER	1461 HD/HDPA FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	8144S PSA H & J	BK	ZER

Hardware Group No. 201CR  
 For use on Door #(s):

B141					
Provide each SGL door(s) with the following:					
QTY	EA	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	VANDL STOREROOM LOCK	ND96P6D RHO	626	SCH
1	EA	SURFACE CLOSER	1461 SCUSH FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	8144S PSA H & J	BK	ZER

Hardware Group No. 201R  
 For use on Door #(s):

A109	B127	B132	B136	C158	C159
C164	C168	C169	C172		

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	VANDL STOREROOM LOCK	ND96P6D RHO	626	SCH
1	EA	SURFACE CLOSER	1461 HD/HDPA FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	8144S PSA H & J	BK	ZER

Hardware Group No. 207R  
 For use on Door #(s):

C147

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	VANDL STOREROOM LOCK	ND96P6D RHO	626	SCH
1	EA	OH STOP	100S (SIZE/MNT AS REQD)	630	GLY
1	EA	SURFACE CLOSER	1461 HD/HDPA FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	8144S PSA H & J	BK	ZER

Hardware Group No. 214R  
 For use on Door #(s):

C173

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
2	EA	MANUAL FLUSH BOLT	FB458-LENGTH REQ	626	IVE
1	EA	DUST PROOF STRIKE	DP1	626	IVE
1	EA	VANDL STOREROOM LOCK	ND96P6D RHO	626	SCH
1	EA	COORDINATOR	3780	600	ABH
2	EA	SURFACE CLOSER	4040XP SCUSH ST-1595 SPEC	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	SET	JAMB SEAL	328AA-2PC-JAMB HEIGHT	AA	ZER
1	EA	MEETING STILE	328AA-2 PCS DOOR HEIGHT	D	ZER
1	EA	HEADER SEAL	429AA-1PC HEADER WIDTH	AA	ZER
2	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
1	EA	STRIKE ASTRAGAL	43SP X 188S	SP	ZER
1	EA	THRESHOLD	65A-V3-226	A	ZER

Hardware Group No. 341  
 For use on Door #(s):

D177                    D178

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S RHO OS-OCC	626	SCH
1	EA	SURFACE CLOSER	1461 HD/HDPA FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	COAT HOOK	582B	626	IVE
3	EA	SILENCER	SR65	GRY	IVE

Hardware Group No. 341R

For use on Door #(s):

A103                    A106                    A114                    B118                    B124                    B125  
 B129                    B130                    B138                    C161                    C162

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S RHO OS-OCC	626	SCH
1	EA	SURFACE CLOSER	1461 HD/HDPA FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	8144S PSA H & J	BK	ZER
1	EA	COAT HOOK	582B	626	IVE

Hardware Group No. 401R

For use on Door #(s):

A102                    A104                    A105                    A107                    A113                    A115  
 B117                    B119                    C155

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	SURFACE CLOSER	1461 HD/HDPA FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	8144S PSA H & J	BK	ZER
1	EA	COAT HOOK	582B	626	IVE

Hardware Group No. 501R  
 For use on Door #(s):

C146	C148A	C165			
Provide each SGL door(s) with the following:					
QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	VANDL CLASSROOM LOCK	ND94P6D RHO	626	SCH
1	EA	SURFACE CLOSER	1461 HD/HDPA FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	8144S PSA H & J	BK	ZER

Hardware Group No. 551CR  
 For use on Door #(s):

B131	C145	C151	C152	C153	C154
Provide each SGL door(s) with the following:					
QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	VANDL CLASSROOM SEC	ND95P6D RHO XN12-035	626	SCH
1	EA	SURFACE CLOSER	1461 SCUSH FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	8144S PSA H & J	BK	ZER

Hardware Group No. 551R  
 For use on Door #(s):

A101	A108	A112	B116	B123	B128
B137	B143	B144	C149	C150	C160
C166	C167	C167A	C171		
Provide each SGL door(s) with the following:					
QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	VANDL CLASSROOM SEC	ND95P6D RHO XN12-035	626	SCH
1	EA	SURFACE CLOSER	1461 HD/HDPA FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	8144S PSA H & J	BK	ZER

Hardware Group No. 701CR  
 For use on Door #(s):

C175	D176				
Provide each SGL door(s) with the following:					
QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	FIRE EXIT DEVICE	FL2108 - 4900A - SNB	628	PRE
1	EA	RIM CYLINDER	20-021	626	SCH
1	EA	SURFACE CLOSER	1461 SCUSH FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	8144S PSA H & J	BK	ZER



Hardware Group No. 701R  
 For use on Door #(s):

C157                      C157A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	FIRE EXIT DEVICE	FL2108 - 4900A - SNB	628	PRE
1	EA	RIM CYLINDER	20-021	626	SCH
1	EA	SURFACE CLOSER	1461 HD/HDPA FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	8144S PSA H & J	BK	ZER

Hardware Group No. 715  
 For use on Door #(s):

A111                      B120A                      B122A                      C166A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY HEIGHT AS REQ	628	IVE
1	EA	EXIT DEVICE	2103 - 4900A - SNB	628	PRE
1	EA	RIM CYLINDER	20-021	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH ST-1595 SPEC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	SET	JAMB SEAL	328AA-2PC-JAMB HEIGHT	AA	ZER
1	EA	HEADER SEAL	429AA-1PC HEADER WIDTH	AA	ZER
1	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
1	EA	THRESHOLD	65A-V3-226	A	ZER

Hardware Group No. 715R  
 For use on Door #(s):

A100                      A100B                      A108A                      A111A                      A112A                      B120  
 B122

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY HEIGHT AS REQ	628	IVE
1	EA	FIRE EXIT DEVICE	FL2103 - 4900A - SNB	628	PRE
1	EA	RIM CYLINDER	20-021	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH ST-1595 SPEC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	SET	JAMB SEAL	328AA-2PC-JAMB HEIGHT	AA	ZER
1	EA	HEADER SEAL	429AA-1PC HEADER WIDTH	AA	ZER
1	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
1	EA	THRESHOLD	65A-V3-226	A	ZER

Hardware Group No. C201R  
 For use on Door #(s):

B139                      B145

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	652	IVE
1	EA	VANDL EU STOREROOM	ND96P6DEU RHO CON 12V/24V DC	626	SCH
1	EA	SURFACE CLOSER	1461 HD/HDPA FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	8144S PSA H & J	BK	ZER
1	EA	HARNESS (1 IN DOOR)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
		POWER SUPPLY	PROVIDED BY SECURITY CONTRACTOR		
		CARD READER	PROVIDED BY SECURITY CONTRACTOR		
		DOOR POSITION SWITCH	PROVIDED BY SECURITY CONTRACTOR		

- INGRESS BY THE CARD READER OR KEY OVERRIDE.
- EGRESS BY THE LEVER.

Hardware Group No. C710CM  
 For use on Door #(s):

B140

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY EPT HEIGHT AS REQ	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	KEYED MULLION & STORAGE KIT		689	PRE
1	EA	ELECTRIFIED EXIT DEVICE	C-ELR-TS-2103 - 4900A - SNB	628	PRE
1	EA	ELECTRIFIED EXIT DEVICE	C-TS-2102 - 4900A - SNB	628	PRE
1	EA	MORTISE CYLINDER	20-001 (CAM AS REQ)	626	SCH
1	EA	RIM CYLINDER	20-021	626	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH 4040XP-18PA 4040XP-30	689	LCN
1	EA	MEETING STILE	328AA-2 PCS DOOR HEIGHT	D	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	SILENCER	SR65	GRY	IVE
2	EA	HARNESS (1 IN DOOR) POWER SUPPLY	TYPE & LENGTH AS REQ PROVIDED BY SECURITY CONTRACTOR		
		CARD READER	PROVIDED BY SECURITY CONTRACTOR		
		DOOR POSITION SWITCH	PROVIDED BY SECURITY CONTRACTOR		

-INGRESS BY THE CARD READER OR KEY OVERRIDE.

-EGRESS BY THE PUSH PADS.

Hardware Group No. C714AM  
 For use on Door #(s):

B140A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY EPT HEIGHT AS REQ	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	KEYED MULLION & STORAGE KIT		689	PRE
1	EA	ELECTRIFIED EXIT DEVICE	C-ELR-TS-2103 - 4900A - SNB	628	PRE
1	EA	ELECTRIFIED EXIT DEVICE	C-TS-2102 - 4900A - SNB	628	PRE
1	EA	MORTISE CYLINDER	20-001 (CAM AS REQ)	626	SCH
1	EA	RIM CYLINDER	20-021	626	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH 4040XP-18PA 4040XP-30	689	LCN
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
1	EA	THRESHOLD	65A-V3-226	A	ZER
2	EA	HARNES (1 IN DOOR)	TYPE & LENGTH AS REQ		
		PERIMETER SEAL	BY FRAME MANUFACTURER		
		ASTRAGAL	BY DOOR MANUFACTURER		
		POWER SUPPLY	PROVIDED BY SECURITY CONTRACTOR		
		CARD READER	PROVIDED BY SECURITY CONTRACTOR		
		DOOR POSITION SWITCH	PROVIDED BY SECURITY CONTRACTOR		

-INGRESS BY THE CARD READER OR KEY OVERRIDE.

-EGRESS BY THE PUSH PADS.

Hardware Group No. C714M

For use on Door #(s):

C174

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY EPT HEIGHT AS REQ	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	KEYED MULLION & STORAGE KIT		689	PRE
1	EA	ELECTRIFIED EXIT DEVICE	C-ELR-TS-2103 - 4900A - SNB	628	PRE
1	EA	ELECTRIFIED EXIT DEVICE	C-TS-2102 - 4900A - SNB	628	PRE
1	EA	MORTISE CYLINDER	20-001 (CAM AS REQ)	626	SCH
1	EA	RIM CYLINDER	20-021	626	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH ST-1595 SPEC	689	LCN
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	SET	JAMB SEAL	328AA-2PC-JAMB HEIGHT	AA	ZER
1	EA	MEETING STILE	328AA -2 PCS DOOR HEIGHT	D	ZER
1	EA	HEADER SEAL	429AA-1PC HEADER WIDTH	AA	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
1	EA	THRESHOLD	65A-V3-226	A	ZER
2	EA	HARNESS (1 IN DOOR)	TYPE & LENGTH AS REQ		
		POWER SUPPLY	PROVIDED BY SECURITY CONTRACTOR		
		CARD READER	PROVIDED BY SECURITY CONTRACTOR		
		DOOR POSITION SWITCH	PROVIDED BY SECURITY CONTRACTOR		

-INGRESS BY THE CARD READER OR KEY OVERRIDE.

-EGRESS BY THE PUSH PADS.

Hardware Group No. C715R  
 For use on Door #(s):

B146

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY EPT HEIGHT AS REQ	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELECTRIFIED FIRE EXIT DEVICE	C-ELR-TS-FL2103 - 4900A - SNB	628	PRE
1	EA	RIM CYLINDER	20-021	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH ST-1595 SPEC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	SET	JAMB SEAL	328AA-2PC-JAMB HEIGHT	AA	ZER
1	EA	HEADER SEAL	429AA-1PC HEADER WIDTH	AA	ZER
1	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
1	EA	THRESHOLD	65A-V3-226	A	ZER
1	EA	HARNES (1 IN DOOR)	TYPE & LENGTH AS REQ		
		POWER SUPPLY	PROVIDED BY SECURITY CONTRACTOR		
		CARD READER	PROVIDED BY SECURITY CONTRACTOR		
		DOOR POSITION SWITCH	PROVIDED BY SECURITY CONTRACTOR		

-INGRESS BY THE CARD READER OR KEY OVERRIDE.

-EGRESS BY THE PUSH PAD.

END OF SECTION

## **SECTION 08 80 00 - GLAZING**

### **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: Requirements including but not limited to:
  - 1. Float Glass (GG).
  - 2. Tempered Glass (GT).
  - 3. Spandrel Glass (GS).
  - 4. Insulated Glass (GI).
  - 5. Laminated Safety Glazing (GL).
  - 6. Fire Resistant Glazing (GF).
  - 7. Glazing Sealants.
  - 8. Glass Film Overlay.
  - 9. Accessories necessary for a complete installation.

#### **1.3 REFERENCE STANDARDS**

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- D. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).
- E. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- G. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.
- H. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2018.
- I. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- J. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials; 2019.
- K. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2023.
- L. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
- M. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- N. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- O. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.
- P. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014, with Errata (2017).
- Q. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2017.

- R. UL 752 - Standard for Bullet-Resisting Equipment; Current Edition, Including All Revisions.

#### 1.4 DEFINITIONS

- A. Glass Thickness: Indicated by thickness designations in millimeters according to ASTM C1036.  
B. Interspace: Space between lites of an insulating glass unit.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design glass panels including comprehensive engineering analysis by a qualified professional engineer lawfully licensed in the State of Texas, using performance requirements and design criteria indicated.
- B. Installed Glazing: Design glazing systems to withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E1300.
1. Design Wind Pressures: As indicated on Structural Drawings.
  2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
    - a. Wind Design Data: As indicated on Structural Drawings.
    - b. Basic Wind Speed: As indicated on Structural Drawings.
    - c. Importance Factor: As indicated on Structural Drawings.
  3. Exposure Category: As indicated on Structural Drawings.
  4. Design Snow Loads: As indicated on Structural Drawings.
  5. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
  6. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
  7. Maximum Lateral Deflection: For glass supported on all four edges, limit center of glass deflection at design wind pressure to not more than 1/50 times the short side length or 1 inch (25 mm), whichever is less.
- D. Windborne Debris Impact Resistance: Exterior glazing shall comply with -protection testing requirements in ASTM E1996 for when tested according to ASTM E1886. Test specimens shall be no smaller in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.
1. Large Missile Test: For glazing located within 30 feet (9.1 m) of grade
  2. Small Missile Test: For glazing located more than 30 feet (9.1 m) above grade
- E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II
- F. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For monolithic glass lites, properties are based on units with lites 6 mm thick.
  2. For laminated glass lites, properties are based on products of construction indicated.
  3. For insulating glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  4. U-Factors: Center of glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
  5. Solar Heat Gain Coefficient and Visible Transmittance: Center of glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.



## 1.6 SUBMITTALS

- A. Product Data: Technical data for each type of product including recommended installation and cleaning procedures.
- B. Glass Samples: For each type of glass required. Prepare samples from same material to be used for Work.
- C. Glazing Schedule: List glass types and thickness for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Product Certificates: Submit glass product certificates required by Code.
  - 1. Glass Manufacturer Certificate: The glass manufacturer shall submit a letter certifying it has reviewed the glazing details proposed for the project, including the use of gaskets and sealants, and that each product furnished is recommended for the application shown and compliance with the Code.
- F. Thermal Stress and Wind Load Analyses: 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 the expected service temperature ranges and the effects of partial and full shading on the glass.
    - a. Attach 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 indicate the statistical probability of breakage at the design wind pressure does not exceed the specified statistical probability of breakage.
- G. Product Test Reports: Submit test reports for insulating glass and glazing sealants, for tests performed by a qualified testing agency.
  - 1. Glazing Sealants: Provide test reports based on testing current sealant formulations within previous 36 month period.
  - 2. Glazing Sealants: Preconstruction adhesion and compatibility test report.

## 1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Building Code: Comply with applicable requirements of the IBC for glazing.
  - 2. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
    - a. 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, published in the Code of Federal Regulations) and ANSI Z97.1.
    - b. Permanently mark safety glass with certification label of Safety Glazing Certification Council.
  - 3. Insulating Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
  - 4. Glazing Publications: Comply with published recommendations of glass product organizations
    - a. GANA: Glazing Manual.
    - b. IGMA: SIGMA TM-3000 Vertical Glazing Guidelines.
    - c. GANA: Laminated Glazing Reference Manual.
    - d. AAMA: AAMA GDSG-1 Glass Design for Sloped Glazing.
    - e. AAMA: TIR A7 Sloped Glazing Guidelines.

- f. IGMA for Sloped Glazing: IGMA TB-3001 Guidelines for Sloped Glazing.
      - g. IGMA for Insulating Glass: SIGMA TM-3000 North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use.
  5. Fire Rated Door Assemblies: Assemblies complying with NFPA 80 listed and labeled by UL for fire ratings indicated, based on testing according to NFPA 252.
  6. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
    - a. Minimum Glass Thickness for Exterior Lites: 6 mm.
    - b. Thickness of Tinted Glass: Provide same thickness for each tint color indicated.
  7. Strength: Where annealed float glass is indicated, provide annealed float glass, heat strengthened float glass, or fully tempered float glass necessary to comply with performance requirements.
    - a. Where heat strengthened float glass is indicated, provide heat strengthened float glass or fully tempered float glass necessary to comply with performance requirements.
    - b. Where fully tempered float glass is indicated, provide fully tempered float glass.
- B. Manufacturer Qualifications for Insulating Glass Units with Sputter Coated, Low E Coatings: Insulating glass manufacturer who is approved and certified by coated glass manufacturer.
- C. Installer Qualifications, Glazer: Experience entity having minimum 5 years documented experience and who employs glass installers certified under the National Glass Association's Certified Glass Installer Program.
- D. Installer Qualifications, Decorative Film: Experience entity having minimum 5 years documented experience in the installation of glass films.
- E. Source Limitations for Glass and Glass Accessories: Obtain each type of glass and glass accessories from a single source.
- F. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- G. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
- H. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
- I. Install glazing in mockups specified in to match glazing systems required for Project, including glazing methods.
  1. Subject to compliance with requirements, approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.
- J. Pre-Construction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass framing member for adhesion to and compatibility with elastomeric glazing sealants.
  1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
  2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
  3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
  4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
  5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.
- K. Pre-Installation Conference: Conduct conference at site.

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

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by manufacturer.
- D. Exercise exceptional care to prevent edge damage to glass, and damage/deterioration to coating on glass.
- E. Comply with insulating glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

## **1.9 FIELD CONDITIONS**

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
  - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 degrees F (4.4 degrees C).
- B. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

## **1.10 COORDINATION**

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

## **1.11 WARRANTY**

- A. Coated Glass Products: Written warranty signed by manufacturer in which glass manufacturer agrees to replace coated glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
  - 1. Warranty Period: Ten (10) years from date of Substantial Completion
- B. Laminated Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace laminated glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
  - 1. Warranty Period: Ten (10) years from date of Substantial Completion.
- C. Insulating Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace insulating glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
  - 1. Warranty Period: Ten (10) years from date of Substantial Completion.
- D. Glass Film: Written warranty signed by glass film manufacturer and installer in which manufacturer and installer agree to replace glass film that crack, peel, delaminate, discolor,

change appearance, or failure to meet solar criteria within specified warranty period.

1. Warranty Period: Five (5) years from date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
  1. Glass:
    - a. Cardinal Glass Industries: [www.https://www.cardinalcorp.com](https://www.cardinalcorp.com).
    - b. Guardian Industries: [www.guardianglass.com](http://www.guardianglass.com).
    - c. Pilkington North America, a subsidiary of Nippon Sheet Glass Co., Ltd.: [www.pilkington.com/#s](http://www.pilkington.com/#s).
    - d. Vetrotech Saint-Gobain International AG: [www.vetrotech.com](http://www.vetrotech.com).
    - e. Vitro Architectural Glass: [www.vitroglazings.com](http://www.vitroglazings.com).
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

### **2.2 ACCEPTABLE FABRICATORS:**

- A. Manufacturer-certified fabricators.

### **2.3 MATERIALS**

- A. Clear, Annealed, Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- B. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.
- C. Fully-Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
  1. Fabrication Process: By horizontal (roller hearth) process with roll wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- D. Ceramic Coated Vision Glass: ASTM C1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in GANA Engineering Standards Manual.

### **2.4 INSULATING GLAZING UNITS**

- A. Insulating Glazing Units: Factory assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190.
- B. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
  1. Spacer: Aluminum with black, color anodic finish. Thermally broken aluminum
  2. Desiccant: Molecular sieve or silica gel, or a blend of both.
  3. Performance Properties: Refer to Glazing schedule.
- C. Spandrel Glass:
  1. Silicone Coated Spandrel Glass: ASTM C1048, Type I, Condition C, Quality-Q3.
  2. Fallout Resistance: Provide spandrel units identical to those passing fallout resistance test for spandrel glass specified in ASTM C1048.

### **2.5 GLAZING ACCESSORIES**

- A. Compatibility: Provide glazing sealants compatible with one another and with other materials in contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of service and application, demonstrated by sealant manufacturer based on testing and field experience.
- B. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

- C. Colors of Exposed Glazing Sealants: As selected by Architect.
- D. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dow Corning Corporation.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.
    - c. May National Associates, Inc.; a subsidiary of Sika Corporation.
    - d. Pecora Corporation.
    - e. Sika Corporation.
- E. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corporation; Construction Systems.
    - b. Dow Corning Corporation.
    - c. GE Construction Sealants; Momentive Performance Materials Inc.
    - d. May National Associates, Inc.; a subsidiary of Sika Corporation.
    - e. Pecora Corporation.
    - f. Polymeric Systems, Inc.
    - g. Sika Corporation.
- F. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Bostik, Inc.
    - b. Dow Corning Corporation.
    - c. GE Construction Sealants; Momentive Performance Materials Inc.
    - d. May National Associates, Inc.; a subsidiary of Sika Corporation.
    - e. Polymeric Systems, Inc.
    - f. Schnee-Morehead, Inc., an ITW company.
    - g. Sika Corporation.
- G. Glazing Sealant: Acid curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corporation; Construction Systems.
    - b. Bostik, Inc.
    - c. Dow Corning Corporation.
    - d. GE Construction Sealants; Momentive Performance Materials Inc.
    - e. May National Associates, Inc.; a subsidiary of Sika Corporation.
    - f. Pecora Corporation.
    - g. Polymeric Systems, Inc.
    - h. Schnee-Morehead, Inc., an ITW company.
    - i. Sika Corporation.
- H. Glazing Sealants for Fire-Resistance-Rated Glazing Products: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Dow Corning Corporation.
- b. GE Construction Sealants; Momentive Performance Materials Inc.
2. Colors of Exposed Glazing Sealants: As selected by Architect.
- I. Back Bedding Mastic Glazing Tapes: Preformed, butyl based, 100 percent solids elastomeric tape; non-staining and non-migrating in contact with nonporous surfaces; with or without spacer rod recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
  1. AAMA 804.3 tape, where indicated.
  2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- J. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
  1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
  2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.
- K. Miscellaneous Glazing Accessories: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with proven record of compatibility with surfaces contacted in installation.
  1. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
  2. Setting Blocks: Silicone, minimum 4 inches long and wide enough to fully support all lites of glazing unit.
  3. Spacers: Silicone blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
  4. Edge Blocks: Silicone material of hardness needed to limit glass lateral movement (side walking).
  5. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
  6. Perimeter Insulation for Fire Resistant Glazing: Product approved by testing agency listed and labeled fire resistant glazing product with which it is used for application and fire protection rating indicated.

## 2.6 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
  1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
    - a. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
  2. Edge and Surface Conditions: Comply with the recommendations of AAMA Structural Properties of Glass for clean cut edges, except comply with manufacturer's recommendations.
  3. Exposed Glass Edges and Surface Condition: Finish edges flat with an arrissed edge profile (small bevel of uniform width not exceeding 1.5 mm at an angle of approximately 45 degrees to the surface of the glass) with polished (surface is reflective in appearance similar to the major surface of the glass) surface.
- B. Cutting: Wheel cut or sawed edges and seamed at manufacturer's option. For site cut glass, provide glass 2 inches (50.8 mm) larger than required in both dimensions to facilitate cutting of clean cut edges without the necessity of seaming or nipping. Do not cut, seam, nip or abrade

heat treated glass.

- C. Butt Glazing: Clean cut or flat grind vertical edges of butt glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
  - 1. Edges: Grind smooth and polish exposed glass edges and corners.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep systems.
  - 3. Minimum required face and edge clearances.
  - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation after correcting unsatisfactory conditions.

#### **3.2 PREPARATION**

- A. Clean glazing channels and framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
  - 1. Comply with manufacturer instructions for wiping of surfaces immediately before application of primers.
  - 2. Wipe metal surfaces with IPA (isopropyl alcohol) unless otherwise required by compatibility and adhesion testing results.
- B. Inspect each piece of glass immediately before installation. Do not install pieces improperly sized or with damaged edges, scratches, abrasion, or evidence damage. Remove labels from glass immediately after installation.
- C. Examine glazing units to locate exterior and interior surfaces. Label or mark units so exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.
- D. Seal vent (breather or capillary) tubes in insulating glass units in accordance with insulating glass manufacturer written recommendations.
- E. Glass Film Preparation:
  - 1. Remove particulate matter on the glass surface using a scraping blade.
  - 2. Place an absorbent towel on window sill or sash to absorb moisture generated by the film application.

#### **3.3 GLAZING**

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  2. Provide 1/8 inch (3 mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
1. Square cut wedge shaped gaskets at corners and install gaskets as recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
- K. Tape Glazing: Position tapes on fixed stops so that, when compressed by glass, the exposed edges are flush with or protrude slightly above sightline of stops.
1. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make tapes fit opening.
  2. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
  3. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
  4. Do not remove release paper from tape until right before each glazing unit is installed.
  5. Apply heel bead of elastomeric sealant.
  6. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
  7. Apply cap bead of elastomeric sealant over exposed edge of tape.
- L. Gasket Glazing (Dry): Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
1. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
  2. Installation with Drive in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
  3. Installation with Pressure Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
  4. Install gaskets to protrude past face of glazing stops.
- M. Sealant Glazing (Wet): Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure.



Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

1. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
  2. Tool exposed surfaces of sealants to provide a substantial wash away from glass.
- N. Structurally Glazed 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.
1. Align glass unit edges over vertical mullion continuous structural gasket/spacers and secure with manufacturers recommended temporary cleats.
  2. 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 light; remove excess structural silicone from glass and metal substrates.
  3. After full cure of structural silicone sealant remove temporary cleats. Immediately seal holes left in the vertical mullions caused by temporary cleats.
  4. 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.
  5. Place silicone weatherseal sealant into void and tool flush with adjacent exterior glass light faces; remove excess sealant from glass and metal substrates.
- O. Glass Film Overlay: Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, in single sheet completely overlaying in pattern indicated on Drawings to the interior face of clean glass, according to manufacturer's written instructions, using the squeegee technique to remove moisture.
1. Cut film edges neatly and square at a uniform distance of 1/16 inch (1.5 mm) to 1/32 inch (0.75 mm) of the window sealing device. Avoid scoring glass when cutting film.
- P. Erection Tolerances:
1. Maximum Deviation from Vertical: 1/8 inch in any story and 1/4 inch in any 45 foot run.
  2. Maximum Deviation from Horizontal: 1/8 inch in any 30 foot run.
  3. Maximum Deviation from True Alignment: 1/32 inch for any two (2) abutting units. Allow no edge projections.
  4. Maximum Joint Gap: 1/32 inch.

### **3.4 CLEANING AND PROTECTION**

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  1. If contaminating substances come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

## **PART 4 SCHEDULE**

### **4.1 GLAZING SCHEDULE**

- A. Acoustical Glazing (GA):
  1. GA1: Acoustical Glazing: Glass unit consisting of 1/4 inch (6 mm) clear, tempered glass laminated to 3/8 inch (9 mm) clear float glass comprised of two 3/16 inch (4.5 mm) clear float glass lites laminated to each other with clear 0.060 inch thick polyvinyl butyral (PVB)

interlayer.

- B. Bullet-Resistant Glazing (GB):
  - 1. GB1: Bullet-Resistant Glazing Unit: Laminated glass and interlayer unit, 1 inch nominal thickness, complying with UL 752 Threat Level 3.
- C. Ceramic-Coated Vision Glazing (GC):
  - 1. GC1: Ceramic-Coated Glazing: Ceramic-Coated Vision Glass: ASTM C1048, Condition C, Type I, Class 1 (clear), Quality-Q3; and complying with Specification No. 95-1-31 in GANA Engineering Standards Manual.
- D. Float Glass (GG):
  - 1. GG1: Float Glass: 1/4 inch (6 mm) clear float glass.
  - 2. GG2: Float Glass: 1/4 inch (6 mm) tinted float glass.
  - 3. GG3: Float Glass: 1 inch (25 mm) tinted float glass.
- E. Insulating Glazing Units (GI):
  - 1. GI1: 1 inch thick insulating glazing unit comprised of a 1/4 inch thick glazing quality Low-e, tinted, tempered, float glass exterior lite with a 1/4 inch thick glazing quality clear tempered float glass interior lite, separated by a 1/2 inch air space and having the following properties:
    - a. Performance Requirements:
      - 1) U-Factor: 0.50 (maximum).
      - 2) Solar Heat Gain Coefficient: 0.25 (maximum).
    - b. Basis of Design: SunGuard SNX 62/27 on UltraClear manufactured by Guardian Advanced Architectural Glass.
      - 1) Assembly:
        - (a) Exterior Lite: Two layers of 1/4 inch (6 mm) Guardian UltraClear glass with 0.030 PVB interlayer.
        - (b) Sunguard SNX 62/27 on surface #2.
        - (c) Gap: 10% air / 90% Argon.
        - (d) Interior Lite: 1/4 inch (6 mm) Guardian UltraClear Glass.
      - 2) Performance:
        - (a) Visible Light:
          - (1) Visible Transmittance: 64%.
          - (2) Reflectance Outside: 11%.
          - (3) Reflectance Inside: 13%.
          - (4) General Color Rendering Index (CRI): 95.0.
        - (b) Ultraviolet:
          - (1) Transmittance UV: 8%.
        - (c) Solar Energy:
          - (1) Solar Transmittance: 24%.
          - (2) Reflectance Outside: 51%.
          - (3) Reflectance Inside: 55%.
          - (4) Solar Absorptance: 25%.
          - (5) Solar Heat Gain Coefficient (SHGC): 0.26.
          - (6) Shading Coefficient: 0.30.
        - (d) Thermal Properties:
          - (1) Winter Night U-value: 0.238.
          - (2) Summer Day U-Value: 0.209.
        - (e) Light to Solar Gain:
          - (1) Light to Solar Gain Ratio (LSG): 2.44.
- F. Tempered Glazing (GT):
  - 1. Type GT1: 1/4 inch thick glazing quality, clear, tempered float glass.

**END OF SECTION 08 80 00**

## **SECTION 08 87 23 - SAFETY AND SECURITY FILMS**

### **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. Glazing film applied to existing and new glazing assemblies.
  - 2. New Glazing: Factory or shop install film to glazing before installation in frames.
- B. Related Requirements:

#### **1.3 ABBREVIATIONS AND ACRONYMS**

- A. CFR - Code of Federal Regulations.
- B. GSA - General Services Administration.

#### **1.4 REFERENCE STANDARDS**

#### **1.5 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Shop Drawings: Detailing installation of film, anchoring accessories, and sealant.
- C. Samples: For each film product to be used, minimum size 4 inches (102 mm) by 6 inches (152 mm), representing actual product, color, and patterns.
- D. Samples, Supplemental Anchors: Where supplemental anchors are necessary to achieve specified performance submit detailed information in accordance with substitution procedures; include two samples, minimum length 2 inches (51 mm).
- E. Test Reports: Detailed reports of full-scale chamber tests to specified criteria, using assemblies identical to those required for this project.
- F. Specimen Warranty.

#### **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Glazing film manufacturer specializing in manufacture of safety glazing films with minimum 10 years successful experience.
- B. Installer Qualifications: Certified by glazing film manufacturer.

#### **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, in accordance with requirements of authorities having jurisdiction.

#### **1.8 FIELD 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. Refer to Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Provide 10 year manufacturer's replacement warranty to cover film against peeling, cracking, discoloration, and deterioration.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

### **2.2 SAFETY AND SECURITY GLAZING FILM**

#### **2.3 MATERIALS**

- A. Accessory Materials: As recommended or required by film manufacturer.
- B. Glass Cleaner: As recommended by glazing film manufacturer.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Field -Applied Film: Verify that existing conditions are adequate for proper application and performance of film.
- B. Examine glass and frames. Verify that existing conditions are adequate for proper application and performance of film.
- C. Verify glass is not cracked, chipped, broken, or damaged.
- D. Verify that frames are securely anchored and free of defects.
- E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### **3.2 PREPARATION**

- A. Clean glass of dust, dirt, paint, oil, grease, mildew, mold, and other contaminants that would inhibit adhesion.
- B. Immediately prior to applying film, thoroughly wash glass with neutral cleaning solution.
- C. Protect adjacent surfaces.
- D. Do not begin installation until substrates have been properly prepared.

### **3.3 INSTALLATION**

- A. Do not apply glazing film when surface temperature is less than 40 degrees F (4 degrees C) or if precipitation is imminent.
- B. Install in accordance with manufacturer's instructions, without air bubbles, wrinkles, streaks, bands, thin spots, pinholes, or gaps, as required to achieve specified performance.
- C. Accurately cut film with straight edges to required sizes allowing 1/16 inch (2 mm) to 1/8 inch (3 mm) gap at perimeter of glazed panel unless otherwise required by anchorage method.
- D. Seams: Seam film only as required to accommodate material sizes; form seams vertically without overlaps and gaps; do not install with horizontal seams.
- E. Clean glass and anchoring accessories following installation. Remove excess sealants and other glazing materials from adjacent finished surfaces.
- F. Remove labels and protective covers.

### **3.4 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

**END OF SECTION 08 87 23**

## **SECTION 08 91 19 - FIXED LOUVERS**

### **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 requirements including but not limited to:
  - 1. Fixed, extruded aluminum and formed metal louvers.
  - 2. Accessories necessary for a complete installation.

#### **1.3 REFERENCE STANDARDS**

- A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- C. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2023.
- D. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- F. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
- G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- J. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).
- K. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.
- L. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- M. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

#### **1.4 DEFINITIONS**

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).
- C. Vertical Louver: Louver with vertical blades (i.e., the axes of the blades are vertical).
- D. Drainable Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- E. Wind Driven Rain Resistant Louver: Louver that provides specified wind driven rain performance determined by testing according to AMCA 500-L.

## 1.5 SUBMITTALS

- A. Product Data: Technical data for each type of product indicated. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings:
  - 1. For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing:
    - a. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
    - b. Show mullion profiles and locations.
    - c. Windstorm: Design loads as indicated on drawings.
- C. Samples: Submit for units with factory applied color finishes.

## 1.6 QUALITY ASSURANCE

- A. Delegated Design Submittal: For louvers indicated to comply with structural and seismic performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
- C. Regulatory Requirements:
  - 1. SMACNA Standard: Comply with recommendations in SMACNA (ASMM) Architectural Sheet Metal Manual for fabrication, construction details, and installation procedures.
  - 2. Welding - Qualify procedures and personnel according to the following:
    - a. AWS D1.2/D1.2M Structural Welding Code - Aluminum.
- D. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory applied color finish.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B221/ASTM B221M , Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B209/B209M, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Galvanized Steel Sheet: ASTM A653/A653M, G90 (Z275) zinc coating, mill phosphatized.
- D. Stainless Steel Sheet: ASTM A240/A240M, Type 304, No. 4 finish, with grain running parallel to length of blades and frame members..
- E. Fasteners - Use types and sizes to suit unit installation conditions:
  - 1. Use tamper resistant screws for exposed fasteners unless otherwise indicated.
  - 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
  - 3. For fastening galvanized steel, use hot dip galvanized steel or 300 series stainless steel fasteners.
  - 4. For fastening stainless steel, use 300 series stainless-steel fasteners.
  - 5. For color finished louvers, use fasteners with heads that match color of louvers.
- F. Post installed Fasteners for Concrete and Masonry: Torque controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

## 2.2 FIXED, EXTRUDED ALUMINUM LOUVERS

- A. Horizontal Continuous Line, Drainable Blade Louver: Drainable blade louver with blade gutters (drains) in rear two-thirds of blades only and with semirecessed mullions capable of collecting and draining water from blades:
1. Manufacturers are subject to compliance with requirements. Provide products of one of the following:
    - a. Aiolite Company, LLC (The).
    - b. Arrow United Industries.
    - c. Construction Specialties, Inc.
    - d. Greenheck Fan Corporation.
    - e. Ruskin Company; Tomkins PLC.
  2. Louver Depth: 6 inch (150 mm) hes (150 mm).
  3. Frame and Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm).
  4. Louver Performance Ratings:
    - a. Free Area: Not less than 7.8 sq. ft. (0.72 sq. m) for 48 by 48 inches (1220 by 1220 mm) louver (48 percent).
    - b. Point of Beginning Water Penetration: Not less than 850 fpm (4.3 m/s).
    - c. Air Performance: Not more than 0.10 in. wg (25 Pa) static pressure drop at 800 fpm (4.3 m/s) free area exhaust velocity.

## 2.3 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies:
1. Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field bolted assembly with close fitting joints in jambs and mullions, reinforced with splice plates:
    - a. Continuous Vertical Assemblies: Fabricate units without interrupting blade spacing pattern unless horizontal mullions are indicated.
    - b. Horizontal Mullions: Provide horizontal mullions at joints unless continuous vertical assemblies are indicated.
- C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill to produce uniform appearance.
- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- E. Include supports, anchorages, and accessories required for complete assembly.
- F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inch (1830 mm) o.c., whichever is less:
1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close fitting blade splices designed to permit expansion and contraction.
  2. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
  3. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.

- 4. Exterior Corners: Prefabricated corner units with mitered blades with concealed close fitting splices and with fully recessed mullions at corners.
- G. Provide subsills made of same material as louvers or extended sills for recessed louvers.
- H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

## **2.4 FINISHES**

- A. Comply with NAAMM Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designating finishes.
- B. Aluminum Finishes:
  - 1. Finish louvers after assembly.
  - 2. Baked Enamel or Powder Coat Finish:
    - a. AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish:
      - 1) Color and Gloss: Selected by the Architect.
  - 3. High Performance Organic Finish:
    - a. Two coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions:
      - 1) Color and Gloss: Selected by the Architect.
- C. Galvanized Steel Sheet Finishes:
  - 1. Finish louvers after assembly.
  - 2. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and repair according to ASTM A780/A780M.
  - 3. Baked Enamel or Powder Coat Finish:
    - a. Immediately after cleaning and pretreating, apply two coat, baked on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 2 mil (0.05 mm):
      - 1) Color and Gloss: Selected by the Architect.
- D. Stainless Steel Sheet Finishes: Repair sheet finish by grinding and polishing irregularities, weld spatter, scratches, and forming marks to match surrounding finish.

## **PART 3 EXECUTION**

### **3.1 FIELD CONDITIONS**

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

### **3.2 EXAMINATION**

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation after correcting unsatisfactory conditions.

### **3.3 PREPARATION**

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.



### **3.4 INSTALLATION**

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 07 92 00 - Joint Sealants for sealants applied during louver installation.

### **3.5 ADJUSTING AND CLEANING**

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by the Architect, remove damaged units and replace with new units:
  - 1. Touch up minor abrasions in finishes with air dried coating that matches color and gloss of, and is compatible with, factory applied finish coating.

**END OF SECTION 08 91 19**

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## **SECTION 09 05 00 - COMMON WORK RESULTS FOR FINISHES**

### **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. Substrate testing.
  - 2. Waterproof membranes.
- B. Related Sections:
  - 1. Section 03 30 00 - Cast-In-Place Concrete: Concrete design, underslab vapor barrier and finished concrete surface required to accept flooring adhesive and finish flooring system.
  - 2. Section 03 54 00 - Cast Underlayment: Leveling of existing concrete slabs.
  - 3. Section 05 75 00 - Decorative Formed Metal: Extruded metal transitions and trim.
  - 4. Section 06 10 00 - Rough Carpentry: Wood-based panel underlayment required to accept installation of finish flooring systems.
  - 5. Section 06 16 00 - Sheathing: For proper wood-based panel underlayment required to accept installation of finish flooring systems.
  - 6. Section 09 05 61 - Common Work Results for Flooring Preparation.
  - 7. Section 09 30 00 - Tiling.
  - 8. Section 09 65 13 - Resilient Base and Accessories.
  - 9. Section 09 68 00 - Carpeting.

#### **1.3 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- C. ASTM C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method; 2007 - Not Active.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.
- F. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.
- G. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- H. ASTM F1482 - Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring; 2021.
- I. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- J. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- K. ISO/IEC 17025 - General Requirements for the Competence of Testing and Calibration Laboratories; 2017.

#### **1.4 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  - 1. Adhesives.

2. Leadership in Energy and Environmental Design (LEED).
3. Volatile Organic Compound (VOC)

### 1.5 SUBMITTALS

- A. Product Data:
  1. Submit manufacturer's printed descriptions of materials, components and systems; performance criteria; use limitations; preparation instructions and recommendations; storage and handling requirements and recommendations; and installation methods.
- B. Certificates:
  1. Submit with manufacturer's signature certifying that each product and/or system meets the requirements of the performance characteristics, physical criteria, and applicable standards specified.
    - a. Provide Master Grade Certificate as specified in ANSI A137.1.
- C. Test and Evaluation Reports:
  1. Submit certified test results by a recognized testing laboratory in accordance with specified test methods for each product and/or system indicating physical, chemical and performance characteristics.
- D. Samples:
  1. Submit samples showing full range of color and texture variations expected.
  2. Full size units of each type and composition of tile and for each color and finish required.
  3. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required; minimum 12 inches (300 mm) square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
  4. Waterproof membrane in 6 inch by 6 inch (150 mm by 150 mm) sample.
  5. Thresholds in 6 inch (150 mm) lengths.
- E. Closeout Submittals:
  1. Operation and Maintenance Data: Including, but not limited to, methods for maintaining installed products and precautions against cleaning materials with methods detrimental to finishes and performance.
  2. Executed Warranty Documentation: Manufacturers' material warranties and installers workmanship warranty.
  3. Record Documents: Drawings, Specifications, Product Data.

### 1.6 PERFORMANCE REQUIREMENTS

- A. Refer to the following for specific sub-flooring and finish flooring requirements:
  1. Section 03 30 00 - Cast-In-Place Concrete.
  2. Section 03 54 00 - Cast Underlayment.
  3. Section 06 10 00 - Rough Carpentry: Sub-flooring.
  4. Section 09 30 00 - Tiling.
  5. Section 09 68 00 - Carpeting.
- B. Static Coefficient of Friction (SCOF): For tile installed on walkway surfaces which are not anticipated to be wet, provide products with values determined by testing identical products per ASTM C1028:
  1. Level Surfaces: Minimum 0.6.
  2. Ramp Surfaces: Minimum 0.8.
- C. Dynamic Coefficient of Friction (DCOF): Per ANSI A137.1 Section 9.6 DCOF AcuTest:
  1. Wet Level Surfaces: Minimum 0.42 unless noted otherwise.

### 1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
  1. Surface Burning Characteristics: ASTM E84; identify products with appropriate markings of applicable testing agency.

- a. Flame Spread Index: 25 or less.
    - b. Smoke Developed Index: 450 or less.
  2. Accessibility Requirements: Comply with applicable requirements.
    - a. ADA Standards.
    - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
- B. Qualifications:
  1. Installer / Applicator: Perform installation with skilled, experienced and trained workmen supervised by trained personnel who shall have a minimum three (3) years successful experience in installations of similar size and scope.
  2. Testing Agency: An independent testing agency with the experience and capability to conduct the testing indicated, meeting requirements of ISO/IEC 17025 or ASTM E329 and ASTM E699.
- C. Source Limitations:
  1. Obtain spray-applied adhesive through one source from a single manufacturer.
  2. Obtain tile of same type and color or finish from one source or producer. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
  3. Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.
    - a. Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
      - 1) Waterproofing.
      - 2) Joint sealants.
      - 3) Cementitious backer units.
      - 4) Metal edge strips.
- D. Sustainability Standards and Certifications:
  1. Adhesive and Sealant VOC Limits: According to South Coast Air Quality Management District Rule 1168 and GS-36 for aerosols.
  2. VOC Limits: As tested using U.S. EPA Reference Test Method 24 and as defined by
    - a. South Coast Air Quality Management District Rules: In areas where exposure to freeze/thaw conditions and direct exposure to moisture will not occur.
      - 1) SCAQMD Rule 1168, Adhesive and Sealant Applications
    - b. California Air Resources Board: For areas where freeze/thaw conditions do exist or direct exposure to moisture can occur.
      - 1) CARB for containers 16 oz. or less.
- E. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Build mockup of each type of floor tile installation.
  2. Build mockup of each type of wall tile installation.
  3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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

- A. Delivery, Storage and Handling per manufacturer's recommendations, Section 01 60 00 - Product Requirements, and as follows:
  1. Delivery and Acceptance Requirements
    - a. Deliver materials to Project site in an undamaged condition, in original, unopened and undamaged packages or containers bearing manufacturer's intact label, names, brand names, types and thicknesses of contents, and proper handling, storing, unpacking, protecting, and installation instructions, as warranted.
      - 1) Comply with requirements in ANSI A137.1 for labeling tile packages.
    - b. Inspect shipped materials on delivery to ensure compliance with requirements of Contract Documents and to ensure that products are undamaged and properly

protected. Reject damaged goods and accept properly ordered, protected and undamaged goods.

2. Storage and Handling Requirements
  - a. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided. Store liquid materials in unopened containers and protected from freezing.
  - b. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.
  - c. Store adhesive materials in a dry, temperature-controlled interior area at 65-80 deg F (18-27 deg C). Protect materials from damage from improper handling, exposure to temperature extremes, and the action of other trades.
3. Packaging Waste Management
  - a. Request in writing that manufacturers, fabricators, suppliers and shippers provide least amount of packaging that adequately and properly protects, supports and contains the items shipped, and is reusable, returnable or recyclable.

### **1.9 PROJECT 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. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products.
- C. Maintain temperatures at 50 degrees F or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

### **1.10 EXTRA STOCK**

- A. Refer to related sections for extra stock requirements.

### **1.11 PRE-INSTALLATION CONFERENCE**

- A. Refer to Section 01 31 00 - Project Management and Coordination.

### **1.12 WARRANTY**

- A. Refer to related sections for specific product warranty requirements.

## **PART 2 PRODUCTS**

### **NOT USED**

## **PART 3 EXECUTION**

### **3.1 FIELD CONDITIONS**

- A. Conditions and Measurements: Visit jobsite to verify installation conditions and floor measurements.
- B. Ambient Conditions per manufacturer's written recommendations, and as follows:
  1. New concrete slabs shall be flat, clean and dry meeting all moisture tests passing manufacturer's written requirements.
  2. Environmental Limitations: Maintain temperature and relative humidity per manufacturer's recommendations.
    - a. Maintain space, substrate temperatures, and RH for time prior to, during and after installation as recommended.
  3. Acclimate floor finish materials into spaces they will be installed a minimum 48 hours in advance of installation.

- a. Do not install until all floor finish materials are same temperature as space where they are to be installed.

### **3.2 EXAMINATION - GENERAL**

- A. Contractor shall examine preparatory work by others, with Installer/Applicator present, for compliance with requirements affecting Work performance.
  1. Contractor shall notify Architect of any issues which would affect installation of finish. Absence of such notification shall constitute acceptance of responsibility by Contractor.
- B. Verify that field measurements, surfaces, substrates, structural support, tolerances, levelness, plumbness, temperature, humidity, moisture content level, cleanliness, and other conditions are as required by the manufacturer, and ready to receive Work.

### **3.3 EXAMINATION - FLOORING**

- A. Verify that concrete floors to receive resilient flooring meet ASTM F710 requirements and are flat as recommended by floor finish manufacturer.
- B. Verify that wood and panel type underlayment substrates to receive resilient flooring meet ASTM F1482 requirements and are flat as recommended by floor finish manufacturer.
- C. Test substrates as required by manufacturer to verify proper conditions.
  1. Portland-Cement Concrete:
    - a. Perform moisture testing to verify that concrete substrate is sound and dry. Both of the following tests are required:
      - 1) Perform relative humidity (RH) test using in situ probes per ASTM F2170 . Proceed with installation only after each substrate measures a maximum 75 percent RH.
      - 2) Perform anhydrous calcium chloride testing per ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 7 lbs of water/1000 sf (3.18 kg of water/92.9m<sup>2</sup>) in 24 hours.
    - b. Perform alkalinity testing to verify pH level is 11 or below per ASTM F710.
    - c. Perform bond testing per ASTM F710 to determine compatibility of adhesive to concrete substrate.
  2. Wood Underlayment: Shall be dry, clean, structurally sound, well nailed and/or glued, free of voids and with joints that do not exceed 1/16 inch (1.6mm) per floor finish manufacturer's installation instructions.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.
    - a. Commencement of work related to this Section will constitute acceptance of conditions.

### **3.4 INSTALLATION - GENERAL**

- A. Lay out tiling so that no tile is cut to less than 1/2 of its full size in either direction.
- B. Slope tile within 3 foot diameter of a floor drain, unless otherwise noted.
- C. Form internal angles square.

### **3.5 INSTALLATION - STONE THRESHOLDS**

- A. Set marble thresholds in accordance with TCA TR611 and manufacturer's instructions.

### **3.6 FIELD QUALITY CONTROL**

- A. Site Tests and Inspections:
  1. Inspect floor finish system installation for non-conforming Work including, but not limited to, the following:
    - a. Lack of adequate adhesion.
    - b. Adhesive overspray.
      - 1) Clean off water-based adhesive overspray with a damp cloth.
    - c. Improper substrate preparation as indicated by:
      - 1) Air blisters.

- 2) Buckling.
- 3) Cracks.

**3.7 CLEANING**

- A. Clean finishes as required and in accordance with manufacturer's recommendations.

**3.8 CLOSEOUT ACTIVITIES**

- A. Refer to Section 01 77 00 - Closeout Procedures.

**END OF SECTION 09 05 00**



## **SECTION 09 05 61 - COMMON WORK RESULTS FOR FLOORING PREPARATION**

### **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. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
    - a. Thin-set tile.
  - 2. Preparation of new and existing concrete floor slabs for installation of floor coverings.
  - 3. Testing of concrete floor slabs for moisture and alkalinity (pH).
  - 4. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
    - a. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- B. Related Sections:
  - 1. Section 01 40 00 - Quality Requirements: Additional requirements relating to testing agencies and testing.
  - 2. Section 01 74 19 - Construction Waste Management and Disposal: Handling of existing floor coverings removed.
  - 3. Section 02 41 00 - Demolition: Removal of existing flooring.
  - 4. Section 03 54 00 - Cast Underlayment: Self-leveling underlayment applied as remediation treatment.
  - 5. Section 09 68 00 - Carpeting.

#### **1.3 REFERENCE STANDARDS**

#### **1.4 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  - 1. Adhesives.
  - 2. Volatile Organic Compound (VOC).

#### **1.5 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

#### **1.6 SUBMITTALS**

- A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
  - 1. Moisture and alkalinity (pH) limits and test methods.
  - 2. Manufacturer's required bond/compatibility test procedure.
- B. Testing Agency's Report:
  - 1. Description of areas tested; include floor plans and photographs if helpful.
  - 2. Summary of conditions encountered.
  - 3. Moisture and alkalinity (pH) test reports.
  - 4. Copies of specified test methods.
  - 5. Recommendations for remediation of unsatisfactory surfaces.
  - 6. Product data for recommended remedial coating.
  - 7. Include certification of accuracy by authorized official of testing agency.

8. Submit report directly to School District.
  9. Submit report to Architect.
  10. Submit report not more than two business days after conclusion of testing.
- C. Adhesive Bond and Compatibility Test Report.
- D. Floor Moisture Testing Technician Certificate: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician- Grade I certificate.

### **1.7 PERFORMANCE REQUIREMENTS**

- A. Refer to the following for specific sub-flooring and finish flooring requirements:

### **1.8 QUALITY ASSURANCE**

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Contractor may perform adhesive and bond test with Contractor's own personnel or hire a testing agency.
- C. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
  2. Acceptable Testing Agencies:
    - a. Other testing agency approved by School District.
    - b. Substitutions: Not permitted.
- D. Contractor's Responsibility Relating to Independent Agency Testing:
1. Provide access for and cooperate with testing agency.
  2. Confirm date of start of testing at least 10 days prior to actual start.
  3. Allow at least 4 business days on site for testing agency activities.
  4. Achieve and maintain specified ambient conditions.
  5. Notify School District when specified ambient conditions have been achieved and when testing will start.
  6. Notify Architect when specified ambient conditions have been achieved and when testing will start.
- E. Floor Moisture Testing Technician Qualifications: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician Certification- Grade I.
- F. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

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

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

### **1.10 FIELD CONDITIONS**

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F (18 degrees C) or more than 85 degrees F (30 degrees C).
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

### **2.2 MATERIALS**

- A. Patching Compound: Refer to Section 03 54 00 - Cast Underlayment
- B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.

## **PART 3 EXECUTION**

### **3.1 REMOVAL OF EXISTING FLOOR COVERINGS**

- A. Refer to Section 02 41 00 - Demolition.

### **3.2 CONCRETE SLAB PREPARATION**

- A. Follow recommendations of testing agency.
- B. Perform following operations in the order indicated:
  - 1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
    - a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
    - b. Removal of existing floor covering in accordance with Section 02 41 00 - Demolition.
  - 2. Existing concrete slabs with coatings or penetrating sealers/hardeners/dustproofers:
    - a. Do not attempt to remove coating or penetrating material.
    - b. Do not abrade surface.
  - 3. Preliminary cleaning.
  - 4. Moisture vapor emission tests; 3 tests in the first 1000 square feet (100 square meters) and one test in each additional 1000 square feet (100 square meters), unless otherwise indicated or required by flooring manufacturer.
  - 5. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
  - 6. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
  - 7. Specified remediation, if required.
  - 8. Patching, smoothing, and leveling, as required.
  - 9. Other preparation specified.
  - 10. Adhesive bond and compatibility test.
  - 11. Protection.
- C. Remediations:
  - 1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
  - 2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
  - 3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the

level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

### **3.3 PRELIMINARY CLEANING**

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

### **3.4 MOISTURE VAPOR EMISSION TESTING**

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet (1.4 kg per 93 square meters) per 24 hours.
- F. Report: Report the information required by the test method.

### **3.5 INTERNAL RELATIVE HUMIDITY TESTING**

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F2170 Procedure A and as follows.
- D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
- F. Report: Report the information required by the test method.

### **3.6 ALKALINITY TESTING**

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
  - 1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
  - 2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch (25 mm) in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
  - 3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.
- C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test

value is over 10.

### **3.7 PREPARATION**

- A. Refer to individual floor covering section(s) for additional requirements.
- B. Comply with recommendations of testing agency.
- C. Comply with requirements and recommendations of floor covering manufacturer.
- D. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- E. Do not fill expansion joints, isolation joints, or other moving joints.

### **3.8 ADHESIVE BOND AND COMPATIBILITY TESTING**

- A. Comply with requirements and recommendations of floor covering manufacturer.

### **3.9 APPLICATION OF REMEDIAL FLOOR COATING**

- A. Comply with requirements and recommendations of coating manufacturer.

### **3.10 INSTALLATION OF REMEDIAL FLOOR SHEET MEMBRANE**

- A. Install in accordance with sheet membrane manufacturer's instructions.

### **3.11 PROTECTION**

- A. Cover prepared floors with building paper or other durable covering.

**END OF SECTION 09 05 61**

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## **SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES**

### **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. Gypsum board.
  - 2. Partition framing systems.
  - 3. Exterior gypsum board for ceilings and soffits.
  - 4. Tile backing panels.
  - 5. Ceiling suspension systems.
  - 6. Accessories necessary for a complete installation.
- B. Related Sections:
  - 1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
  - 2. Section 05 40 00 - Cold Formed Metal Framing: Structural steel stud framing.
  - 3. Section 05 75 00 - Decorative Formed Metal: Decorative metal reveals and trim.
  - 4. Section 06 10 00 - Rough Carpentry: Building blocking.
  - 5. Section 07 21 00 - Thermal Insulation: Thermal insulation.
  - 6. Section 07 27 26 - Fluid-Applied Air Barrier System: Vapor barriers.
  - 7. Section 07 84 13 - Penetration Firestopping.
  - 8. Section 07 92 00 - Joint Sealants: Acoustical joint sealant.
  - 9. Section 08 43 13 - Aluminum-Framed Storefronts.
  - 10. Section 09 81 00 - Acoustic Insulation.

#### **1.3 REFERENCE STANDARDS**

- A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.
- B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2019.
- C. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- G. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017.
- H. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.
- I. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- J. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.
- K. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2018.

- L. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2020.
- M. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2019.
- N. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- O. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- P. ASTM C1288 - Standard Specification for Discrete Non-Asbestos Fiber-Cement Interior Substrate Sheets; 2017.
- Q. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2021.
- R. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- S. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2019.
- T. ASTM C1766 - Standard Specification for Factory-Laminated Gypsum Panel Products; 2015 Edition, February 1, 2015.
- U. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- V. ASTM D3274 - Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation; 2009 Edition, March 1, 2009
- W. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- X. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- Y. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- Z. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.
- AA. ASTM E1190 - 2021 Edition, November 15, 2021 Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members; 2021 Edition, November 15, 2021.
- BB. ASTM F1267 - Standard Specification for Metal, Expanded, Steel; 2018 (Reapproved 2023).

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Performance Requirements: Comply with manufacturer's load tables and the following design pressures and deflections:
  - 1. Stairs, Elevator Hoistways, and Vertical Shafts: 1/120 at 10 psf.
  - 2. Ground Floor Lobbies: 1/120 at 15 psf.
  - 3. Partitions Receiving Stone Cladding, Lath and Plaster, or Plaster Veneer: 1/360 at 15 psf.
  - 4. Partitions Receiving Monitors, Televisions, Heavy Audio/Visual Equipment: 1/360 at 15 psf.
  - 5. Typical Partitions: 1/240 at 5 psf.
  - 6. Other Partitions: 1/240 at 5 psf.
    - a. Maximum Deflection:
      - 1) L/240 at 5 lbf per sq. ft.
      - 2) L/120 at 5 lbf per sq. ft.
      - 3) L/120 at 7.5 lbf per sq. ft.
      - 4) L/120 at 10 lbf per sq. ft.



- B. Fire Resistance Rated Assemblies: For fire resistance rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- C. STC Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

### **1.5 SUBMITTALS**

- A. Product Data: Submit For each type of drywall including calculations for loadings and stresses of exterior walls and specially fabricated framing based on manufacturer's load tables.
- B. Shop Drawings: Indicate locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of work.
- C. Samples:
  - 1. Trim Accessories: Full size Sample in 12 inch (300 mm) long length for each trim accessory indicated.
  - 2. Textured Finishes: 12 inch by 12 inch (300 mm by 300 mm) for each textured finish indicated and on same backing indicated for work.
- D. Calculations: Submit calculations verifying steel partition stud minimum base metal thickness and depth compliance with Code and ASTM C645 for height, load, and deflection.
- E. Evaluation Reports: ICC-ES reports for dimpled steel studs and runners and firestop tracks.

### **1.6 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Comply with applicable requirements of building code for interior finishes.
  - 2. Fire Resistance Rated Assemblies: For fire resistance rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. Single Source Responsibility:
  - 1. Framing Members: Obtain steel framing members from single manufacturer.
  - 2. Panel Products: Obtain each type of gypsum board and other panel products from single manufacturer.
  - 3. Finishing Materials: To the extent possible, obtain finishing materials from same manufacturer supplying gypsum board products. When not possible, obtain materials from manufacturer acceptable to gypsum board manufacturer.

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

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

### **1.8 PROJECT CONDITIONS**

- A. Environmental Limitations: Comply with ASTM C840 for gypsum board manufacturer's written instructions, whichever are more stringent.
  - 1. Do not install paper faced gypsum panels until installation areas are enclosed and conditioned.
- B. Room Temperatures: Maintain minimum 40 degrees F (4 degrees C). For adhesive attachment and finishing of gypsum board, maintain minimum 50 degrees F (10 degrees C) for 48 hours before application and continuously after until dry. Do not exceed 95 degrees F (35 degrees C) when using temporary heat sources.

- C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.
- D. Do not install panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
  - 1. Steel Studs and Tracks:
    - a. CEMCO: [www.cemcosteel.com](http://www.cemcosteel.com).
    - b. ClarkDietrich: [www.clarkdietrich.com](http://www.clarkdietrich.com).
    - c. Custom Stud, Inc.: [www.customsteelcraft.com](http://www.customsteelcraft.com).
    - d. MBA Building Supplies: [www.mbastuds.com](http://www.mbastuds.com).
    - e. MRI Steel Framing, LLC: [www.mristeel Framing.com](http://www.mristeel Framing.com).
    - f. Phillips Manufacturing Co.: [www.phillipsmfg.com](http://www.phillipsmfg.com).
    - g. Steel Network, Inc. (The): [www.steelnetwork.com](http://www.steelnetwork.com).
    - h. Telling Industries: [www.tellingindustries.com](http://www.tellingindustries.com).
  - 2. Ceiling Suspension System:
  - 3. Gypsum Board:
    - a. Certaineed Corporation: [www.certainteed.com](http://www.certainteed.com).
    - b. Georgia Pacific: [www.gp.com](http://www.gp.com).
    - c. National Gypsum Company: [www.nationalgypsum.com](http://www.nationalgypsum.com).
    - d. USG Corporation: [www.usg.com](http://www.usg.com).
  - 4. Tile Backer Board:
  - 5. Glass Mat Gypsum Sheathing Board:
  - 6. Cementitious Board:
  - 7. Trim:
    - a. Fry Reglet Corporation: [www.fryreglet.com](http://www.fryreglet.com).
    - b. Gordon, Inc.: [www.gordon-inc.com](http://www.gordon-inc.com).
    - c. Pittcon Industries: [www.pittconindustries.com](http://www.pittconindustries.com).
    - d. Schluter Systems: [www.schluter.com](http://www.schluter.com).
  - 8. Extruded Partition Closure:
  - 9. Security Mesh:
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

### **2.2 MATERIALS**

- A. Framing Members: ASTM C754 for component sizes and conditions under specified maximum deflection and lateral loading conditions indicated.
  - 1. Steel Sheet Components: Comply with ASTM C645 requirements for metal.
  - 2. Protective Coating:
    - a. Standard: ASTM A653/A653M, G40, hot dip galvanized.
    - b. Enhanced: ASTM A653/A653M, G60, hot dip galvanized.
- B. Steel Framing Components: ASTM C754 for conditions indicated; hot dip galvanize complying with ASTM A653/A653M Z180.

1. Steel Studs and Runners: ASTM C645, 0.0179 inch (0.45 mm) minimum base metal thickness; depth indicated on Drawings.
  2. Dimpled Steel Studs and Runners: ASTM C645, equivalent to minimum base metal thickness indicated on Drawings for depth indicated on Drawings.
  3. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
  4. Cold-Rolled Channel Bridging: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges; depth indicated on Drawings.
  5. Clip Angle: Not less than 1-1/2 inches by 1-1/2 inches (38.1 mm by 38.1 mm), 0.068 inch (1.73 mm) thick, galvanized steel.
  6. Hat Shaped, Rigid Furring Channels: ASTM C645; 0.0179 inch (0.45 mm) minimum base metal thickness; depth indicated on Drawings.
  7. Resilient Furring Channels: 1/2 inch (12.7 mm) deep, steel sheet members designed to reduce sound transmission. Configuration: Asymmetrical or hat shaped.
  8. Cold Rolled Furring Channels 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges.
    - a. Depth: As indicated on Drawings.
    - b. Furring Brackets: Adjustable, corrugated edge type of steel sheet with minimum bare steel thickness of 0.0312 inch (0.79 mm).
    - c. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59 mm) diameter wire, or double strand of 0.0475 inch (1.21 mm) diameter wire.
  9. Z-Shaped Furring Channels: With slotted or non-slotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.
  10. Auxiliary Framing Materials: Fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
  11. Slip Type Head Joints: Where indicated, provide one of the following:
    - a. Single Long Leg Runner System: ASTM C645 top runner with 2 inch (50.8 mm) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging, located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
    - b. Double Runner System: ASTM C645 top runners, inside runner with 2 inch (50.8 mm) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
    - 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. Provide one of the following:
      - 1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
      - 2) Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
      - 3) Superior Metal Trim; Superior Flex Track System (SFT).
  12. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire resistance rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs. Provide one of the following:
    - a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
    - b. Grace Construction Products; FlameSafe FlowTrak System.
    - c. Metal-Lite, Inc.; The System.
    - d. Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series as applicable.
- C. Ceiling Suspension System:
1. Basis of Design:
    - a. Drywall Grid Systems manufactured by Armstrong World Industries, Inc.
    - b. 640-C manufactured by Chicago Metallic Corporation.
    - c. Drywall Suspension System manufactured by USG Corporation.

2. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59 mm) diameter wire, or double strand of 0.0475 inch (1.21 mm) diameter wire.
  3. Hanger Attachments to Concrete:
    - a. Anchors: Post-installed, chemical anchor or post-installed, expansion anchor fabricated from corrosion resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E488/E488M by an independent testing agency.
    - b. Powder Actuated Fasteners: Suitable for application indicated, fabricated from corrosion resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E1190 by an independent testing agency.
  4. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.162 inch (4.12 mm) diameter.
  5. Carrying Channels: Cold rolled, commercial steel sheet with base metal thickness of 0.0538 inch (1.37 mm) and minimum 1/2 inch (12.7 mm) wide flanges. Depth indicated on Drawings.
  6. Furring Channels (Furring Members):
    - a. Cold Rolled Channels: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges, 3/4 inch (19.1 mm) deep.
    - b. Steel Studs: ASTM C645; minimum base metal thickness of 0.0312 inch (0.79 mm); Depth as indicated on Drawings.
    - c. Hat Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch (22.2 mm) deep; Minimum base metal thickness of 0.0312 inch (0.79 mm).
  7. Resilient Furring Channels: 1/2 inch (12.7 mm) deep members designed to reduce sound transmission.
  8. Grid Suspension System for Ceilings: ASTM C645, direct hung system composed of main beams and cross furring members that interlock.
- D. Gypsum Board: ASTM C1396/C1396M, applicable to type of gypsum board indicated and whichever is more stringent.
1. Wall Board:
    - a. Type: X.
    - b. Thickness: 5/8 inch (15.9 mm).
    - c. Long Edges: Tapered and featured (rounded or beveled) for pre-filling.
  2. Ceiling Board: Manufactured for sag resistance
    - a. Type: X typical, C at fire-resistance-rated ceiling assemblies.
    - b. Thickness: 1/2 inch (13 mm).
    - c. Long Edges: Tapered.
  3. Moisture and Mold Resistant Type: Type X with moisture and mold resistant core and surfaces.
    - a. Type: X.
    - b. Thickness: 5/8 inch (15.9 mm).
    - c. Long Edges: Tapered.
  4. Shaft Liner Type:
    - a. Type: X.
    - b. Thickness: 1 inch (25.4 mm).
  5. Fire-Resistant Core, Foil-Backed: ASTM C1396/C1396M
    - a. Basis of Design: Gold Bond® Foil Back Gypsum Board manufactured by National Gypsum Company.
    - b. Thickness: 5/8 inch (15.9 mm).
    - c. Core: Type X.
    - d. Edges: Tapered.

- E. Impact Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.
  - 1. Core and Thickness: 5/8 inch (15.9 mm), Type X.
  - 2. Surface Abrasion: ASTM C1629/C1629M, meet or exceed Level 1 requirements.
  - 3. Indentation: ASTM C1629/C1629M, meet or exceed Level 1 requirements.
  - 4. Soft Body Impact: ASTM C1629/C1629M, meet or exceed Level 1 requirements.
  - 5. Hard Body Impact: ASTM C1629/C1629M, meet or exceed Level 1 requirements according to test in Annex A1.
  - 6. Long Edges: Tapered.
  - 7. Mold Resistance: ASTM D3273, score of 10 as rated according to STM D3274.
- F. Acoustically Enhanced Gypsum Board: ASTM C1766. Multilayer products constructed of two layers of gypsum boards sandwiching a viscoelastic sound-absorbing polymer core.
  - 1. Manufacturers: Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of ten (10) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
    - a. CertainTeed Corp.; Silent FX QC.
    - b. National Gypsum Company; Sound Break.
    - c. PABCO; QuietRock.
    - d. G-P/Temple Inland; Comfort Guard Sound.
  - 2. Core: Regular Type.
  - 3. Long Edges: Tapered.
- G. Reinforced Gypsum Sheathing (Tile Backer Board): ASTM C1178/C1178M, standard edges. Cellulose fiber reinforced panels may be used in lieu of cementitious board.
  - 1. Core and Thickness: 5/8 inch (15.9 mm) to match conditions, Type X.
  - 2. Long Edge: Tapered.
  - 3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
- H. Glass Mat Gypsum Sheathing Board: ASTM C1177/C1177M, with fiberglass mat laminated to both sides and with standard edges.
  - 1. Core: Type X.
  - 2. Thickness: 5/8 inch (15.9 mm).
  - 3. Size: 48 inches by 96 inches (1219 mm by 2438 mm).
  - 4. Long Edges: Tapered
- I. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325.
  - 1. Thickness: 1/2 inch (12.7 mm) and 5/8 inch (15.9 mm) to match conditions.
  - 2. Long Edges: Standard.
  - 3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
- J. Exterior Trim: ASTM C1047, hot dip galvanized steel sheet, plastic, or rolled zinc.
  - 1. Shapes:
    - a. Cornerbead.
    - b. LC Bead: J shaped; exposed long flange receives joint compound.
    - c. Expansion (Control) Joint: One piece, rolled zinc with V shaped slot and removable strip covering slot opening.
- K. Interior Trim: ASTM C1047; galvanized or aluminum coated steel sheet, rolled zinc, plastic, or paper faced galvanized steel sheet.
  - 1. Shapes:
    - a. Cornerbead.
    - b. Bullnose bead.
    - c. LC Bead: J shaped; exposed long flange receives joint compound.
    - d. L Bead: L shaped; exposed long flange receives joint compound.
    - e. U Bead: J shaped; exposed short flange does not receive joint compound.

- L. Expansion (Control) Joint.
  - 1. Manufacturers: Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
    - a. Fry Reglet Corp.
    - b. Gordon, Inc.
    - c. Pittcon Industries.
- M. Decorative Trim and Reveals: Refer to Section 05 75 00 - Decorative Formed Metal.
- N. Continuous Corner Bead: Extruded Aluminum; continuous integral fin for surface contact with gypsum board; 7/8 inch (22 mm) wide, tapered to edge; punched with holes staggered to accept screw fastening. Prime with corrosion resistant primer.
  - 1. Manufacturer: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
    - a. Fry Reglet Corporation.
    - b. Pittcon Industries.
    - c. Schluter Systems.
  - 2. Basis of Design Product: Pittcon Softforms SO-HSE-90
- O. Joint Treatment: ASTM C475/C475M.
  - 1. Joint Tape:
    - a. Exterior Gypsum Soffit Board: Paper.
    - b. Joint Compound for Exterior Applications, Glass Mat Gypsum Sheathing Board: Recommended by sheathing board manufacturer.
    - c. Joint Tape, Interior Gypsum Board: Paper.
  - 2. Joint Compound:
    - a. Gypsum Board: Pre-Filling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting type taping compound.
      - 1) Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting type taping compound.
        - (a) Use setting type compound for installing paper faced metal trim accessories.
      - 2) Fill Coat: For second coat, use setting type, sandable topping compound.
      - 3) Finish Coat: For third coat, use setting type, sandable topping compound.
      - 4) Skim Coat: For final coat of Level 5 finish, use setting type, sandable topping compound.
    - b. Cementitious Units: Recommended by backer unit manufacturer.
    - c. Tile Backing Panels: Recommended by backer unit manufacturer.
    - d. Water Resistant Gypsum Backing Board: Use setting type taping compound and setting-type, sandable topping compound.
    - e. Joint Compound, Glass Mat Sheathing Board: Recommended by sheathing board manufacturer.
- P. Partition Closure:
  - 1. Description: Extruded aluminum partition closures are pre-assembled and spring-loaded to provide a tight fit for vertical junctures of partitions and window assemblies.
  - 2. Basis of Design: "Mullion Mate High STC" as manufactured by Gordon, Inc.
  - 3. Material: 6063-T5 temper, tensile strength 31 KSI (ASTM B221/ASTM B221M).
  - 4. Sound Transmission: STC 50 minimum.
  - 5. Width: As required.
  - 6. Accessories:

- a. Partition End Caps.
7. Finish: Match adjacent storefront, window wall, or curtain wall system.
- Q. Auxiliary Materials: Comply with referenced installation standards and manufacturer's written recommendations.
  1. Steel Drill Screws: ASTM C1002, use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
  2. Sound Attenuation Blankets: Refer to Section 09 81 00 - Acoustic Insulation.
  3. Security Mesh:
    - a. Material: Type II, Class 2 – Galvanized mesh complying with ASTM F1267.
    - b. Gauge: 16 ga.
    - c. Basis of Design Product: BM50 manufactured by ClarkDietrich.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas and substrates including welded hollow metal frames, cast in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

#### **3.3 INSTALLATION**

- A. Installation Standard: ASTM C754, except comply with framing sizes and spacing indicated.
- B. Gypsum Board Assemblies: Comply with requirements in ASTM C840 applicable to framing installation.
- C. Suspension System: Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
  1. Suspend hangers from building structure:
    - a. Install hangers plumb and free from contact with insulation or objects within ceiling plenum that are not part of supporting structural or suspension system. Splay hangers where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
    - b. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
      - 1) Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
    - c. Do not attach hangers to steel roof deck.
    - d. Do not attach hangers to permanent metal forms. Furnish cast in place hanger inserts that extend through forms.
    - e. Do not attach hangers to rolled in hanger tabs of composite steel floor deck.
    - f. Do not connect or suspend steel framing from ducts, pipes, or conduit.
  2. Fire Resistance Rated Assemblies: Wire tie furring channels to supports.
  3. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
  4. Ceiling Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross furring members

to each other and butt cut to fit into wall track.

- D. Framing Assembly: Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
1. Install studs so flanges within framing system point in same direction. Space studs in single layer application as indicated on drawings.
  2. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
    - a. Door Openings: 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.
      - 2) Install cripple studs at head adjacent to each jamb stud, with minimum 1/2 inch (12.7 mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
      - 3) Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
    - b. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  3. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.
- E. Sound Insulation: Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- F. Gypsum Panels: Comply with ASTM C840. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
1. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
  2. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
  3. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
  4. Form control and expansion joints with space between edges of adjoining gypsum panels.
  5. Cover both faces of support framing with gypsum panels in concealed spaces, except in chases braced internally.
    - a. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
    - b. Fit gypsum panels around ducts, pipes, and conduits.
    - c. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4 inch to 3/8 inch (6.4 mm to 9.5 mm) wide joints to install sealant.
  6. Isolate perimeter of gypsum board applied to non-load bearing partitions at structural abutments, except floors. Provide 1/4 inch to 1/2 inch (6.4 mm to 12.7 mm) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
  7. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.



- G. Gypsum Board: Install interior gypsum board where indicated on drawings.
1. Single Layer Application:
    - a. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
    - b. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire resistance rated assembly, and minimize end joints. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    - c. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
  2. Multilayer Application:
    - a. 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.
    - b. On Z shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
    - c. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- H. Backing Panels:
1. Cementitious Backer Units: ANSI A108.11; install where indicated with 1/4 inch (6.4 mm) gap where panels abut other construction or penetrations. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.
- I. Exterior Gypsum Board Soffits: Apply panels perpendicular to supports, with end joints staggered and located over supports.
1. Install with 1/4 inch (6.4 mm) open space where panels abut other construction or structural penetrations.
  2. Fasten with corrosion-resistant screws.
- J. Trim Accessories: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Attach trim according to manufacturer's written instructions.
1. Control Joints: Install control joints according to ASTM C840 (30 feet maximum), at each door and window jamb (unless noted otherwise), and in specific locations indicated on Drawings.
  2. Exterior Trim: Install in the following locations:
    - a. Cornerbead: Use at outside corners.
    - b. LC Bead: Use at exposed panel edges.
  3. Interior Trim: Install in the following locations:
    - a. Cornerbead: Use at outside corners, unless otherwise indicated.
    - b. Bullnose Bead: Use at outside corners.
    - c. LC Bead: Use at exposed panel edges.
    - d. L Bead: Use where indicated or necessary.
    - e. U Bead: Use at exposed panel edges.
- K. Gypsum Board Finishing: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
1. Pre-fill open joints, rounded or beveled edges, and damaged surface areas.
  2. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

3. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
    - a. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
    - b. Level 2: Panels that are substrate for tile.
    - c. Level 3: Where indicated on Drawings.
    - d. Level 4: For surfaces receiving flat paints.
    - e. Level 5: For surfaces receiving gloss or semi-gloss paint, subjected to severe lighting, or receiving wall covering.
  4. Glass Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
  5. Glass Mat Faced Panels: Finish according to manufacturer's written instructions.
- L. Installation Tolerances:
1. Suspension System: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
  2. Installation Tolerances, Suspension System: Install suspension systems level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
- M. Fire-Resistance-Rated and Smoke Partitions Markings
1. Each fire-resistance rated partition, smoke partition, or other wall requiring protected openings is to be marked as such as defined below.
    - a. Location: Mark walls in accessible concealed floor, floor-ceiling, and attic spaces.
    - b. Spacing: Markings shall be located within 15 feet of the end of each wall and at intervals not exceeding 30 feet measured horizontally along the wall or partition.
    - c. Lettering: Stenciled letters a minimum of 3 inches in height with a minimum 3/8 inch stroke in a color contrasting with the wall material (typically black) paint. Markings shall be one of the following, appropriate to the partition type, as indicated on plans.
      - 1) "SMOKE PARTITION – PROTECT ALL OPENINGS".
      - 2) "#-HR FIRE BARRIER – PROTECT ALL OPENINGS" where #-HR is as indicated on the Drawings.
      - 3) "#-HR FIRE WALL – PROTECT ALL OPENINGS" where #-HR is as indicated on the Drawings.

### 3.4 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

**END OF SECTION 09 21 16**

## **SECTION 09 30 00 - TILING**

### **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. Ceramic Tile.
- B. Related Sections:
  - 1. Section 07 92 00 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
  - 2. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

#### **1.3 REFERENCE STANDARDS**

- A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2017 (Reaffirmed 2022).
- B. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 2017.
- C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2021).
- D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2019.
- F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 2021.
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 1999 (Reaffirmed 2019).
- H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2019).
- I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (Reaffirmed 2019).
- J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).
- K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.
- L. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar; 1999 (Reaffirmed 2019).
- M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).
- N. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.

- O. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2021.
- P. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2019.
- Q. ANSI A118.5 - American National Standard Specifications for Chemical Resistant Furan Mortars and Grouts for Tile Installation; 1999 (Reaffirmed 2021).
- R. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation; 2019.
- S. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2019.
- T. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2019.
- U. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2014 (Reaffirmed 2019).
- V. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).
- W. ANSI A118.13 - American National Standard Specifications for Bonded Sound Reduction Membranes for Thin-Set Ceramic Tile Installation; 2014.
- X. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2019.
- Y. ANSI A136.1 - American National Standard Specifications for Organic Adhesives for Installation of Ceramic Tile; 2020.
- Z. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- AA. ASTM C847 - Standard Specification for Metal Lath; 2018.
- BB. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- CC. ASTM D4068 - Standard Specification for Chlorinated Polyethylene (CPE) Sheeting for Concealed Water-Containment Membrane; 2017 (Reapproved 2022).
- DD. ASTM E492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine; 2022.
- EE. ASTM E2179 - Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors; 2021.
- FF. ICC-ES AC380 - Acceptance Criteria for Termite Physical Barrier Systems; 2021, with Editorial Revision (2022).
- GG. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2024.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Pre-Installation Meeting: Convene a pre-installation meeting one week before starting work of this section; require attendance by affected installers.

#### **1.5 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and

setting details.

- D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches (457 by 457 mm) in size illustrating pattern, color variations, and grout joint size variations.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Master Grade Certificate: Submit for each type of tile, signed by the tile manufacturer and tile installer.
- G. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- H. Maintenance Materials: Furnish the following for School District's use in maintenance of project.
  - 1. Refer to Section 01 60 00 - Product Requirements for additional provisions.

## **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.

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

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

## **1.8 FIELD CONDITIONS**

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) and below 100 degrees F (38 degrees C) during installation and curing of setting materials.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
  - 1. Ceramic Tile:
  - 2. Tile Setting and Grout Materials: Those manufactured by tile manufacturers named above or any of the following as approved by tile manufacturer for use with their tile and to suit application.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

### **2.2 TILE SCHEDULE**

- A. Tile Type T-1 - Gray:
  - 1. Basis of Design:
    - a. Products manufactured by Daltile.
    - b. Line: Color Wheel Classic.
    - c. Color: X114 Desert GRay.
    - d. Finish: Glossy.
  - 2. Material: Ceramic.
  - 3. Size: 4 by 4 inches.
- B. Tile Type T-2 - Blue:
  - 1. Basis of Design:
    - a. Products manufactured by Daltile.
    - b. Line: Color Wheel Classic.
    - c. Color: DM14 Cobalt.
    - d. Finish: Glossy.
  - 2. Material: Ceramic.

3. Size: 4 by 4 inches.
- C. Tile Type T-3 - White:
  1. Basis of Design:
    - a. Products manufactured by Daltile.
    - b. Line: Color Wheel Classic.
    - c. Color: 0190 Arctic White.
    - d. Finish: Glossy.
  2. Material: Ceramic.
  3. Size: 4 by 4 inches.
- D. Tile Type T-4 - Red:
  1. Basis of Design:
    - a. Products manufactured by Daltile.
    - b. Line: Color Wheel Classic.
    - c. Color: SH17 Currant.
    - d. Finish: Glossy.
  2. Material: Ceramic.
  3. Size: 4 by 4 inches.

### **2.3 CERAMIC TILE**

- A. Composition: ANSI A137.1 standard grade.
- B. Size: As scheduled.
- C. Thickness: Refer to Basis of Design product.
- D. Shape: As scheduled.
- E. Surface Finish: As scheduled.
- F. Color(s): As scheduled.
- G. Trim Units: Matching bead, cove, and surface bullnose shapes in sizes coordinated with field tile.

### **2.4 TRIM AND ACCESSORIES**

- A. Ceramic Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
  1. Manufacturers: Same as for tile.
- B. Metal Trim: Refer to Section 05 75 00 - Decorative Formed Metal.

### **2.5 SETTING MATERIALS**

- A. Provide setting and grout materials from same manufacturer.
- B. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
  1. Applications: Use this type of bond coat where Large and Heavy Tile (LHT) mortar is indicated.
  2. Basis of Design Product(s):
- C. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.
  1. Applications: Use this type of bond coat where Large and Heavy Tile (LHT) mortar is indicated.
  2. Basis of Design Product(s):
- D. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.
  1. Applications: Where indicated on drawings.
  2. Basis of Design Product(s):
- E. Organic Adhesive: ANSI A136.1, thinset mastic type.
  1. Use Type I in areas subject to prolonged moisture exposure.
  2. Basis of Design Product(s):

- F. Water Based Adhesive: Multi-purpose type mastic.
  - 1. Basis of Design Product(s):
    - a. M420 Spot Tack manufactured by Stauf USA, LLC.
- G. Adhesive for Bonding Fleece-Backed Underlayments to Non-Cementitious Substrates: Water-based rubber resin.
  - 1. Basis of Design Product(s):
- H. Mortar Bed Materials: Pre-packaged mix of Portland cement, sand, latex additive, and water.
  - 1. Basis of Design Product(s):

## 2.6 GROUTS

- A. Provide setting and grout materials from same manufacturer.
- B. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
  - 1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
  - 2. Use sanded grout for joints 1/8 inch (3.2 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.2 mm) wide.
  - 3. Color(s): As selected by Architect from manufacturer's full line.
  - 4. Basis of Design Product(s):
    - a. ARDEX FL manufactured by ARDEX Engineered Cements.
    - b. Prism Color Consistent Grout manufactured by Custom Building Products.
    - c. TEC AccuColor Plus Grout manufactured by H.B. Fuller Construction Products, Inc.
    - d. LATICRETE PERMACOLOR Grout manufactured by LATICRETE International, Inc.
    - e. Merkrete Pro Grout manufactured by Merkrete, by Parex USA, Inc.
  - 5. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
  - 6. Use sanded grout for joints 1/8 inch (3.2 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.2 mm) wide.
  - 7. Color(s):As selected by Architect from manufacturer's full line.
  - 8. Basis of Design Product(s):
    - a. Polyblend Non-Sanded Grout manufactured by Custom Building Products.
    - b. LATICRETE 1500 Sanded Grout manufactured by LATICRETE International, Inc.
    - c. Merkrete Duracolor Non-Sanded Grout manufactured by Merkrete, by Parex USA, Inc.
- C. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
  - 1. Applications: As indicated on Drawings.
  - 2. Color(s): As selected by Architect from manufacturer's full line.
  - 3. Basis of Design Product(s):
    - a. ARDEX WA manufactured by ARDEX Engineered Cements.
    - b. CEG-IG 100% Solids Industrial Grade Epoxy Grout manufactured by Custom Building Products.
    - c. TEC AccuColor EFX Epoxy Special Effects Grout manufactured by H.B. Fuller Construction Products, Inc.
    - d. LATICRETE SPECTRALOCK PRO Premium Grout manufactured by LATICRETE International, Inc.
    - e. Merkrete Pro Epoxy manufactured by Merkrete, by Parex USA, Inc.
    - f. Marcoat GS manufactured by Stuart Dean Company, Inc.
- D. Furan Grout: ANSI A118.5 chemical resistant furan resin grout.
  - 1. Applications: As indicated on Drawings.
  - 2. Color(s): As selected by Architect from manufacturer's full line.
  - 3. Basis of Design Product(s):
- E. Premixed Polymer Modified Grout: Single component, stain resistant grout.

1. Applications: As indicated on Drawings.
  2. Use for joints 1/16 inch (1.6 mm) to 1/2 inch (12.7 mm) wide.
  3. Color(s): As indicated on Drawings.
  4. Basis of Design Product(s):
    - a. SPECTRALOCK 1 Pre-Mixed Grout manufactured by LATICRETE International, Inc.
- F. Stain Resistant Grout Additive: Liquid admixture for sanded and unsanded cement-based grouts; mix with dry grout material in place of water.
1. Applications: As indicated on Drawings..
  2. Basis of Design Product(s):
    - a. \_\_\_\_\_ manufactured by \_\_\_\_\_.

## 2.7 MAINTENANCE MATERIALS

## 2.8 ACCESSORY MATERIALS

- A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
1. Crack Resistance: No failure at 1/8 inch (3.2 mm) gap, minimum.
  2. Fluid or Trowel Applied Type:
    - a. Thickness: 20 mils (0.5 mm), maximum.
  3. Peel-and-Stick Sheet Type:
    - a. Thickness: 20 mils (0.5 mm), maximum.
- B. Waterproofing Membrane at Floors: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
- C. Waterproofing Membrane at Showers and Tiled Tubs: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
- D. Waterproofing Membrane Under Thick Mortar Bed at Showers and Tiled Tubs:
1. Material: Chlorinated polyethylene sheet, 40 mils (1.0 mm) thick, minimum; complying with ASTM D4068.
  2. Basis of Design Product(s):
- E. Cleavage Membrane Under Thick Mortar Bed:
1. Basis of Design Product(s):
- F. Membrane at Walls:
1. Basis of Design Product(s):
- G. Metal Lath: ASTM C847 Flat diamond mesh, of weight to suit application, galvanized finish.
- H. Underlayment at Floors: Specifically designed for bonding to thin-set setting mortar; not primarily a waterproofing material and having the following characteristics:
1. Sound Reduction: Comply with ANSI A118.13 bonded membrane, ASTM E492, and ASTM E2179.
  2. Crack Resistance: No failure at 1/16 inch (1.6 mm) gap, minimum; comply with ANSI A118.12.
  3. Water Resistance: Comply with ANSI A118.10, bonded waterproofing.
  4. Termite Resistance: 100 percent when tested in accordance with ICC-ES AC380.
  5. Uncoupling Function: Allow for separation between membrane and the mortar adhering tile to the membrane when subjected to excessive substrate movement.
  6. Suitable for installation over green concrete.
  7. Suitable for installation over wood-based substrates.
  8. Type: Peel-and-Stick Sheet.
    - a. Basis of Design Product(s):
- I. Sound Control Underlayment at Floors: Recycled rubber type, fully-adhered.
1. Sound Reduction: Comply with ASTM E492.
  2. Thickness: 1/8 inch (3.2 mm), nominal.



3. Basis of Design Product(s):
  - a. QuietSound Acoustical Underlayment manufactured by U.S. Rubber Recycling, Inc:  
[www.usrubber.com/#sle](http://www.usrubber.com/#sle).
- J. Sound Control Underlayment at Floors: Cork type, fully-adhered.
  1. Sound Reduction: Comply with ASTM E2179.
  2. Thickness: 15/64 inch (6 mm), nominal.
  3. Applications: Accepted for use as part of tile installation method F-135 on concrete floors in accordance with TCNA (HB).
  4. Basis of Design Product(s):
    - a. R60 Premium Cork Underlayment manufactured by Amorim Cork Composites S.A.
- K. Sound Control Underlayment at Floors: Cork and recycled rubber composite type, fully-adhered.
  1. Sound Reduction: Comply with ASTM E2179.
  2. Thickness: 13/64 inch (5 mm), nominal.
  3. Applications: Accepted for use as part of tile installation method F-135 on concrete floors in accordance with TCNA (HB).
  4. Basis of Design Product(s):
    - a. RCLT500 Rubber Cork Composite Underlayment manufactured by Amorim Cork Composites S.A.
- L. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 7/16 inch (11 mm) thick; 2 inch (51 mm) wide, alkali-resistant, coated glass fiber mesh tape for joints and corners.
  1. Basis of Design Product(s):
- M. Backer Board: Coated glass mat type complying with ASTM C1178/C1178M; inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder.
  1. Standard Type: Thickness 1/2 inch (12.7 mm).
  2. Fire Resistant Type: Type X core, thickness 5/8 inch (15.9 mm).
  3. Basis of Design Product(s):
- N. Backer Board: High density polystyrene with reinforced cementitious coating on both sides; with compatible alkaline resistant joint tape; to be covered with waterproofing prior to installation of tile.
  1. Thickness: 1/2 inch (12.7 mm).
  2. Basis of Design Product(s):
- O. Mesh Tape: 2 inch (50 mm) wide self-adhesive fiberglass mesh tape.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
  1. Test in accordance with Section 09 05 61 - Common Work Results for Flooring Preparation.
  2. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
  3. Follow moisture and alkalinity remediation procedures in Section 09 05 61 - Common Work Results for Flooring Preparation.

### **3.2 PREPARATION**

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

### **3.3 INSTALLATION - GENERAL**

- A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.19, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install non-ceramic trim in accordance with manufacturer's instructions.
- G. Sound tile after setting. Replace hollow sounding units.
- H. Keep control and expansion joints free of mortar, grout, and adhesive.
- I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- J. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

### **3.4 INSTALLATION - FLOORS - THIN-SET METHODS**

- A. Over exterior concrete substrates, install in accordance with TCNA (HB) Method F102, with standard grout.
- B. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
- C. Over wood substrates, install in accordance with TCNA (HB) Method F142, with standard grout, unless otherwise indicated.
- D. Over wood substrate with backer board underlayment, install in accordance with TCNA (HB) Method F144, for cementitious backer boards, with standard grout.

### **3.5 INSTALLATION - WALL TILE**

- A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.

### **3.6 CLEANING**

- A. Clean tile and grout surfaces.

### **3.7 PROTECTION**

- A. Do not permit traffic over finished floor surface for 4 days after installation.

**END OF SECTION 09 30 00**

## **SECTION 09 51 00 - ACOUSTICAL CEILINGS**

### **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. Suspended metal grid ceiling system.
  - 2. Suspended plastic grid ceiling system.
  - 3. Acoustical units.
  - 4. Supplementary acoustical insulation above ceiling.
- B. Related Sections:
  - 1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
  - 2. Section 03 10 00 - Concrete Forming and Accessories: Placement of special anchors or inserts for suspension system.
  - 3. Section 03 30 00 - Cast-in-Place Concrete: Placement of special anchors or inserts for suspension system.
  - 4. Section 07 21 00 - Thermal Insulation; Acoustical insulation.

#### **1.3 REFERENCE STANDARDS**

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- E. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2017.
- F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- G. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
- H. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.
- I. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- K. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- L. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.
- M. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2016.
- N. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

- O. ASTM E1414/E1414M - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum; 2021a.
- P. CHPS (HPPD) - High Performance Products Database; Current Edition at [www.chps.net/](http://www.chps.net/).
- Q. ISO 14644-1 - Cleanrooms and associated controlled environments - Part 1: Classification of air cleanliness by particle concentration; 2015.
- R. ITS (DIR) - Directory of Listed Products; Current Edition.
- S. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.
- T. UL (FRD) - Fire Resistance Directory; Current Edition.
- U. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.
- V. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

#### **1.5 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Evaluation Service Reports: Show compliance with specified requirements.
- E. Samples: Submit two samples 6 by 6 inch (150 by 150 mm) in size illustrating material and finish of acoustical units, including edge.
- F. Samples: Submit two samples each, 6 inches (150 mm) long, of suspension system main runner, cross runner, and perimeter molding.
- G. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- H. Designer's Qualification Statement.
- I. Manufacturer's Qualification Statement.
- J. Maintenance Materials: Furnish the following for School District's use in maintenance of project.
  - 1. Refer to Section 01 60 00 - Product Requirements, for additional provisions.
  - 2. Extra Acoustical Units: Quantity equal to 5 percent of each type installed, to a minimum of one box of each..

#### **1.6 QUALITY ASSURANCE**

- A. Designer Qualifications for Seismic Design: Perform under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.
- B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

#### **1.7 FIELD CONDITIONS**

- A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
  - 1. Acoustic Panels:
    - a. Armstrong World Industries, Inc.: [www.armstrongceilings.com](http://www.armstrongceilings.com).
    - b. Acoustic Ceiling Products, Inc.: [www.acpideas.com](http://www.acpideas.com).
    - c. Acoustics First Corporation: [www.acousticsfirst.com](http://www.acousticsfirst.com).
    - d. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
    - e. Hunter Douglas Architectural: [www.hunterdouglasarchitectural.com](http://www.hunterdouglasarchitectural.com).
    - f. Nelson Industrial, Inc: [www.nelsonii.com/arch](http://www.nelsonii.com/arch).
    - g. Rockfon, LLC: [www.rockfon.com](http://www.rockfon.com).
    - h. TECHLITE: [www.techlite.com](http://www.techlite.com).
    - i. USG Corporation: [www.usg.com/ceilings](http://www.usg.com/ceilings).
    - j. \_\_\_\_\_.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Fire-Resistance Rating: Determined in accordance with test procedures in ASTM E119 and complying with the following:
  - 1. UL (FRD) Assembly Design No. \_\_\_\_\_.
  - 2. ICC-ES Evaluation Report No. \_\_\_\_\_.
- B. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions determined according to ASCE 7 for Seismic Design Category D, E, or F and complying with the following:
  - 1. Local authorities having jurisdiction.
  - 2. ICC-ES Evaluation Report No. \_\_\_\_\_.

### **2.3 ACOUSTICAL UNITS**

- A. General Requirements: ASTM E1264, Class A.
  - 1. VOC Content: Refer to Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
  - 2. VOC Content: Certified as Low Emission by one of the following:
    - a. Product listing in UL (GGG).
    - b. Product listing in CHPS (HPPD).
- B. Acoustical Ceiling Panels (ACP-1): Mineral fiber with membrane-faced overlay, with the following characteristics:
  - 1. Basis of Design:
    - a. Ultima manufactured by Armstrong World Industries, Inc.
  - 2. Classification: ASTM E1264 Type IV.
    - a. Form: 2, water felted.
    - b. Pattern: "E" - lightly textured.
  - 3. Size: 24 x 24 inches.
  - 4. Thickness: 3/4 inch (19 mm).
  - 5. Minimum Noise Reduction Coefficient (NRC): 0.60, determined in accordance with ASTM E1264.
  - 6. Minimum Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
  - 7. Fire Performance: Class A determined in accordance with ASTM E84.

8. Panel Edge: 15/16 inch Beveled Tegalur.
  9. Color: As indicated on Drawings.
  10. Suspension System: Exposed.
- C. Acoustical Ceiling Panels (ACP-22): Mineral fiber with scrubbable finish, with the following characteristics:
1. Basis of Design:
    - a. Kitchen Zone manufactured by Armstrong World Industries, Inc.
  2. Classification: ASTM E1264 Type IX.
    - a. Form: 2, water felted.
    - b. Pattern: "G" - smooth.
  3. Size: 24 by 24 inches (610 by 610 mm).
  4. Thickness: 5/8 inch (16 mm).
  5. Minimum Ceiling Attenuation Class (CAC): 33, determined in accordance with ASTM E1264.
  6. Fire Performance: Class A determined in accordance with ASTM E84.
  7. Panel Edge: Square.
  8. Color: As indicated on Drawings.
  9. Suspension System: Exposed.

## 2.4 SUSPENSION SYSTEM(S)

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
1. Materials:
    - a. Aluminum Grid: Aluminum sheet, ASTM B209/B209M.
- B. Exposed Suspension System: Aluminum grid and cap; factory-applied closed-cell foam gaskets.
1. Structural Classification: Light-duty, when tested in accordance with ASTM C635/C635M.
  2. Profile: Tee; 15/16 inch (24 mm) face width.
  3. Finish: Baked enamel.
- C. Enclosure for Recessed Ceiling Fixtures: Mineral fiber insulation box enclosure with foil facing on exterior side for placement over recessed ceiling light fixture; flame spread index of 25 and smoke development index of 0 (zero) when tested in accordance with ASTM E84.
1. Light Fixture Size: As indicated on Drawings.
  2. Insulation Thickness: 1-1/4 inch (31.8 mm), nominal.
  3. Thermal Resistance: R-value (RSI-value) of 4.2 (degrees F hour square foot) per Btu (0.74 (K sq m)/W) per inch at 75 degrees F (24 degrees C), minimum, when tested according to ASTM C518.
  4. Provide enclosure with documented noise reduction coefficient (NRC) in accordance with ASTM C423 of at least 1.00 at 2 inches (51 mm) thick.
  5. Provide enclosure with documented ceiling attenuation class (CAC) in accordance with ASTM E1414/E1414M.

## 2.5 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12 gauge, 0.08 inch (2 mm) galvanized steel wire.
- C. Hold-Down Clips: Manufacturer's standard clips to suit application.
- D. Acoustical Insulation: Refer to Section 07 21 00 - Thermal Insulation.
- E. Touch-up Paint: Type and color to match acoustical and grid units.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

### **3.2 PREPARATION**

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.
- C. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

### **3.3 INSTALLATION - SUSPENSION SYSTEM**

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
- D. Locate system on room axis according to reflected plan.
- E. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
  - 1. Install in bed of acoustical sealant.
  - 2. Use longest practical lengths.
  - 3. Overlap and rivet corners.
- F. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- G. Seismic Suspension System, Seismic Design Category C: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Maintain a 3/8 inch (9 mm) clearance between grid ends and wall.
- H. Seismic Suspension System, Seismic Design Categories D, E, F: Hang suspension system with grid ends attached to the perimeter molding on two adjacent walls; on opposite walls, maintain a 3/4 inch (19 mm) clearance between grid ends and wall.
- I. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- J. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- K. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.
- L. Do not eccentrically load system or induce rotation of runners.
- M. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch (25 mm) movement. Maintain visual closure.
- N. Install light fixture boxes constructed of gypsum board above light fixtures in accordance with fire rated assembly requirements and light fixture ventilation requirements.

### **3.4 INSTALLATION - ACOUSTICAL UNITS**

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

- C. Lay directional patterned units with pattern parallel to longest room axis.
- D. Fit border trim neatly against abutting surfaces.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
  - 1. Cut to fit irregular grid and perimeter edge trim.
  - 2. Make field cut edges of same profile as factory edges.
  - 3. Double cut and field paint exposed reveal edges.
- G. Where round obstructions occur, provide preformed closures to match perimeter molding.
- H. Lay acoustical insulation for a distance of 48 inches (1219 mm) either side of acoustical partitions as indicated.
- I. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.
- J. Install hold-down clips on panels within 8 ft (2.5 m) of an exterior door.
- K. Install plastic lay-in panels at following minimum distance from conventional light sources:
  - 1. Halogen, 60 Watt: 14 inches (355 mm) minimum.
  - 2. Incandescent, 120 Watt: 15 inches (380 mm) minimum.
  - 3. Quartz Halogen, 500 Watt: 23 inches (584 mm) minimum.
  - 4. \_\_\_\_\_: \_\_\_\_\_ inch (\_\_\_\_\_ mm).
- L. Install safety clips on wood veneer panels 2 inches (51 mm) from outside edge of panel and at 24 inches (610 mm) on center.
  - 1. Use wire ties to attach safety clips.
- M. Install wood veneer trim using aluminum L angle to attach to suspended grid system as required for application.

### **3.5 TOLERANCES**

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

**END OF SECTION 09 51 00**



## **SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES**

### **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. Resilient base, adhesive attached, in locations shown on drawings.
  - 2. Resilient subfloor transitions.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.

#### **1.4 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's specifications and other data needed to demonstrate compliance with specified requirements.
  - 2. Manufacturer's installation instructions.
- B. Samples:
  - 1. Actual samples or color charts showing manufacturer's full range of colors, for Architect's selection (if selections are not already scheduled or otherwise indicated on the drawings).
  - 2. Actual 12-inch-long piece of base material in each color selected for approval.

### **PART 2 PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers listed, whose product meets or exceeds the specifications are approved for use on the Project with Architect's approval. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
  - 1. Burke Flooring.
  - 2. Flexco.
  - 3. Johnsonite.
  - 4. Mannington.
  - 5. Nora Rubber Products.
  - 6. Roppe Corp.
  - 7. Tarkett.

#### **2.2 MATERIALS**

- A. Standard Rubber Base (typical except where extended toe or other type of base is specifically indicated on drawings, e.g., at athletic flooring or elsewhere) (RB-1):
  - 1. Quality Standard: ASTM F1861.
  - 2. Material: Rubber, vulcanized, Type TS, Group I, Styles A and B. Vinyl base and Type TP are not acceptable.
  - 3. Manufacturing Method: Group I (solid, homogeneous)
  - 4. Style: Topset cove; rolls of greatest length available, cut to length required to minimize joints.
  - 5. Minimum Thickness: Full 1/8 inch (3.2 mm)
  - 6. Color(s): 193 Black Brown.
  - 7. Height: 4 inches, unless indicated otherwise
  - 8. Corners: Job-Formed.
  - 9. Basis of Design: Products as manufactured by Burke Flooring, Flexco, Johnsonite, Nora Rubber Products, or Roppe Corp.

- B. Adhesive: Rubber-based type; same brand as base or as recommended and approved by base manufacturer to suit application.
- C. Other Materials: Provide other materials, not specifically described but required for a complete and proper installation.

### **2.3 EXTRA STOCK**

- A. Deliver to School District:
  - 1. percent, or one (1) unopened carton of each color, type and size of base selected, whichever is greater.
  - 2. One (1) gallon container of each type adhesive used for base.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and conditions under which Work of this Section will be performed. Report unsatisfactory conditions to Architect in writing. Do not proceed until unsatisfactory conditions are corrected.

### **3.2 PREPARATION**

- A. Prepare substrates to receive base as recommended by base manufacturer.
- B. Verify substrates are smooth and ready to receive resilient base. Grind high spots and fill low spots with latex cementitious filler as required.
- C. Starting Work indicates acceptance of existing conditions.

### **3.3 INSTALLATION**

- A. General:
  - 1. Install materials only after finishing operations, including painting, have been completed and after permanent heating and cooling system is operating.
  - 2. Verify that moisture content of concrete slabs, building air temperature, and relative humidity are within the limits recommended by the manufacturers of the materials used.
- B. Installing Base:
  - 1. Install base where shown on the Drawings in accordance with manufacturer's instructions.
  - 2. Use factory-preformed exterior corners, and factory preformed or job-mitered interior corners, as indicated on the drawings or directed by Architect.

### **3.4 CLEANING AND PROTECTING**

- A. Remove excess adhesive and other blemishes from exposed surfaces, using neutral cleaner recommended by the manufacturer of the resilient materials.

**END OF SECTION 09 65 13**

## **SECTION 09 68 00 - CARPETING**

### **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 requirements including but not limited to:
  - 1. Accessories necessary for a complete installation.
- B. Related Sections:
  - 1. Section 03 30 00 - Cast-in-Place Concrete.
  - 2. Section 09 65 13 - Resilient Base and Accessories.

#### **1.3 REFERENCE STANDARDS**

- A. AATCC Test Method 134 - Test Method for Electrostatic Propensity of Carpets; 2019.
- B. AATCC Test Method 174 - Antimicrobial Activity Assessment of New Carpets; 2022, with Editorial Revision (2023).
- C. AATCC TM 165 - Test Method for Colorfastness to Crocking: Textile Floor Coverings—Crockmeter; 2021.
- D. AATCC TM16.1 - Test Method for Colorfastness to Light: Outdoor; 2023.
- E. AATCC TM16.2 - Test Method for Colorfastness to Light: Carbon-Arc; 2023.
- F. AATCC TM16.3 - Test Method for Colorfastness to Light: Xenon-Arc; 2020.
- G. ASTM D1335 - Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings; 2021.
- H. ASTM D2646 - Standard Guide for Backing Fabric Characteristics of Pile Yarn Floor Coverings; 2018.
- I. ASTM D3936 - Standard Test Method for Resistance to Delamination of the Secondary Backing of Pile Yarn Floor Covering; 2021.
- J. ASTM D7330 - Standard Test Method for Assessment of Surface Appearance Change in Pile Floor Coverings Using Standard Reference Scales; 2022.
- K. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.
- L. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- M. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- N. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- O. CRI 104 - Standard for Installation of Commercial Carpet; 2015.
- P. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.
- Q. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

#### **1.4 SUBMITTALS**

- A. Product Data - Technical data including installation recommendations for each type of substrate:
  - 1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
- B. Samples:

1. For each product, each color, and texture required, provide a sample as follows. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules:
  - a. Carpet: 12 inch (300 mm) square Sample from approved color and product of carpet.
  - b. Carpet Seam: 6 inch (150 mm) Sample.
  - c. Mitered Carpet Border Seam: 12 inch (300 mm) square Sample. Show carpet pattern alignment.
  - d. Carpet accessory samples.
- C. Product Test Reports: For carpet and carpet cushion, for tests performed by a qualified testing agency.
- D. Shop Drawings: Showing extent of product, seam direction, and location and type of carpet accessories. Submittal to indicate columns, doorways, enclosing walls or partitions, casework, and locations where cutouts are required.
- E. Maintenance Data: For carpet to include in maintenance manuals. Include the following:
  1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  2. Precautions for cleaning materials and methods that could be detrimental to carpet and carpet cushion.

## 1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
  1. Fire Test Response Characteristics: Provide products with the critical radiant flux classification determined by testing identical products in accordance with ASTM E648.
  2. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
  3. Accessibility Requirements: Comply with applicable requirements:
    - a. Texas Accessibility Standards (TAS).
  4. AQMD - Air Quality Management District, Local Regulations.
  5. SCAQMD – South Coast Air Quality Management District Regulations Rule 1168 Adhesive and Sealant Applications.
  6. CRI – Carpet and Rug Institute Green Label Plus.
- B. Installer Qualifications: Installer having minimum 5 years' documented experience as a commercial carpet installer, who is certified by the International Certified Floorcovering Installers Association at the Commercial II or higher certification level.
- C. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products.
- D. Pre-installation Conference:
  1. Refer to Section 01 31 00 - Project Management and Coordination.

## 1.6 WARRANTY

- A. Written warranty in which manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period:
  1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
  2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excessive surface wear, excess static discharge, and delamination.
  3. Warranty Period: 25 years from date of Substantial Completion.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.
- B. Store in a dry location between 65 degrees F and 90 degrees F and a relative humidity below 65%. Protect from damage and soiling. Stack carpet rolls horizontally, elevated above slab

level on a flat surface, stacked no higher than two rolls.

- C. Store materials in area of installation for minimum period of 48 hours prior to installation.
- D. Protect carpet from damage, dirt, stains, and moisture.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

### **2.2 CARPET, GENERAL**

- A. Performance:
  - 1. Appearance Retention Rating: Severe traffic, 3.5 minimum according to ASTM D7330.
  - 2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
  - 3. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D2646.
  - 4. Delamination: Not less than 4 lbf/in. (18 N/mm) per ASTM D3936.
  - 5. Tuft Bind: Not less than 5 lbf (22 N) according to ASTM D1335.
  - 6. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC TM 165.
  - 7. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) according to AATCC TM16.1, AATCC TM16.2, and AATCC TM16.3.
  - 8. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC Test Method 174.
  - 9. Electrostatic Propensity: Less than 3.5 kV according to AATCC Test Method 134.
  - 10. Emissions: Provide carpet that complies with testing and product requirements of CRI Green Label Plus.
  - 11. Backing: Standard with manufacturer.
- B. Face Construction:
  - 1. Size: Refer to carpet type.
  - 2. Construction: Refer to Basis of Design product for minimum criteria.
- C. Backing:
  - 1. As recommended by manufacturer.
  - 2. Adhesive System: As recommended by manufacturer.
  - 3. Applied Soil Resistance Treatment: Manufacturer's standard.
  - 4. Antimicrobial Treatment: Manufacturer's standard.

### **2.3 ACCESSORIES**

- A. Adhesives: Water resistant, mildew resistant, nonstaining, pressure sensitive type to suit products and subfloor conditions indicated, complying with flammability requirements for installed carpet and is recommended by carpet manufacturer for releasable installation.
- B. Trowelable Leveling and Patching Compounds: Latex modified, hydraulic cement based formulation provided or recommended by carpet cushion manufacturer.
- C. Adhesives: Water resistant, mildew resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet and carpet cushion manufacturers.
- D. Seam Adhesive: Hot melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

- E. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints and provide accessible transitions. (11B-302)
- F. Extra Carpet: After completion of the carpet installation, the carpet subcontractor shall provide an additional three (3) percent of total yards installed of each carpet specified to the Owner for future carpet replacement that may be required. This extra stock is to be unused rolls, tiles, and mats and does not include scraps.

### **PART 3 EXECUTION**

#### **3.1 FIELD CONDITIONS**

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet and carpet cushion until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet and carpet cushion over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

#### **3.2 COORDINATION**

- A. Contractor's responsibility to hire movers to move furniture as required for flooring installation. Coordinate with Owner and Architect regarding temporary furniture relocation.

#### **3.3 EXAMINATION**

- A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710 and the following:
  - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond.
  - 2. Prior to delivery of flooring materials, contractor shall conduct Calcium Chloride "dome" test to verify that concrete floors are dry with maximum moisture vapor emissions of 3 lbs. per 1000 square feet. in 24 hours, and exhibit negative alkalinity, carbonation or dusting. Apply moisture test in four different areas of each floor location with at least one test for each 1,000 square feet of floor area.
  - 3. Prior to delivery of carpeting, conduct Relative Humidity Test Method in accordance with ASTM F2170 using a Wagner Rapid RH probe to verify relative humidity and surface pH of concrete floor slabs, the method:
    - a. Requires drilling holes at diameter not to exceed outside diameter of probe by more than 0.04 inch to depth equal to 40 percent of slab's thickness (elevated structural slab shall be tested at depth equal to 20 percent of slab thickness).
    - b. Place probe to full depth of test hole, place cap over probe.
    - c. Permit test site to acclimate, or equilibrate, for 72 hours prior to taking relative humidity readings.
    - d. Remove cap and press button on the probe to obtain reading.
    - e. Relative humidity readings for substrates receiving non-permeable flooring are 75% or lower.
  - 4. Testing shall require 3 tests in first 1,000 square feet, with one additional test per each additional 1,000 square feet of concrete slab surface.
  - 5. Alkalinity Testing: Concrete floors shall be tested for alkalinity prior to installation of flooring. Levels of pH shall not exceed written recommendations of flooring manufacturer

- or adhesive manufacturer, or both.
- 6. Delivery of flooring materials and beginning of installation means acceptance of existing substrate and site conditions.
- 7. Subfloor finishes comply with requirements specified in Section 03 30 00 - Cast-In-Place Concrete for slabs receiving carpet.
- 8. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- 9. Install Vapor Emission Treatment Systems where tests reveal presence of more than acceptable moisture level in accordance with Test Method ASTM F1869 or ASTM F2170.

C. Proceed with installation after correcting unsatisfactory conditions.

### **3.4 PREPARATION**

- A. Comply with CRI 104, Section 7.3 Site Conditions; Floor Preparation and with carpet manufacturer's written installation instructions for preparing substrates.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet and cushion manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

### **3.5 INSTALLATION**

- A. Comply with CRI 104 and carpet and carpet cushion manufacturer written installation instructions for the following:
  - 1. Direct Glue Down Installation: Comply with CRI 104, Section 9 Direct Glue Down Installation.
  - 2. Stair Installation: Comply with CRI 104, Section 13 Carpet on Stairs for glue down installation.
- B. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position:
  - 1. Do not bridge building expansion joints with carpet.
  - 2. Cut and fit carpet 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 manufacturer.
  - 3. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- C. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- D. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, Patterned Carpet Installations and with carpet manufacturer's written recommendations.

### **3.6 CLEANING AND PROTECTING**

- A. Perform cleaning operations immediately after installing carpet:
  - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
  - 2. Remove yarns that protrude from carpet surface.
  - 3. Vacuum carpet using commercial machine with face beater element.
- B. Protect installed carpet to comply with CRI 104, Section 16, Protecting Indoor Installations.

- C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer and carpet cushion manufacturer

**END OF SECTION 09 68 00**



## **SECTION 09 81 00 - ACOUSTIC INSULATION**

### **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. Fiberglass batt acoustical insulation.
  - 2. Sprayed cellulose fiber acoustical insulation.
- B. Related Sections:
  - 1. Section 09 21 16 - Gypsum Board Assemblies: Acoustically-rated partitions.
  - 2. Section 09 90 00 - Painting and Coating: Painting of spray-applied acoustic insulation.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2017.
- B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- E. ASTM E605/E605M - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members; 2019 (Reapproved 2023).
- F. ASTM E736/E736M - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members; 2019 (Reapproved 2023).
- G. ASTM E759/E759M - Standard Test Method for Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members; 1992 (Reapproved 2023).

#### **1.4 SYSTEMS DESCRIPTION**

- A. Contractor must use a total system, encompassing equipment, fiber and adhesive as supplied and tested by the manufacturer. No substitution.
- B. Fibers supplied under this Section shall have each bag coded with the date and lot number of manufactures and retained samples shall be kept by the manufacturer for not less than 1 year.
- C. Contractor must be licensed and trained by the manufacturer.

#### **1.5 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
  - 2. Manufacturer's installation instructions.
- B. Certification:
  - 1. Manufacturer's certificate that the product meets or exceeds specified requirements.
  - 2. Manufacturer's written certification that product contains no asbestos, and that sprayed-cellulose fiber acoustical insulation contains no fiberglass or other man made mineral fibers.

#### **1.6 QUALITY ASSURANCE**

- A. Qualifications:
  - 1. Manufacturers.

2. Suppliers.
3. Installers/Applicators.

## 1.7 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered in original, unopened containers bearing name of manufacturer, product identification and reference to U.L. testing.
- B. Store materials off ground, under cover and away from damp surfaces and keep material dry at all times.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
  1. Batt Insulation:
    - a. CertainTeed, LLC: [www.certainteed.com](http://www.certainteed.com).
    - b. Johns Manville, a Berkshire Hathaway Company: [www.jm.com](http://www.jm.com).
    - c. Knauf: [knauf.com](http://knauf.com).
    - d. Owens Corning: [www.owenscorning.com](http://www.owenscorning.com).
  2. Spray-Applied Acoustic Insulation:
    - a. International Cellulose Corporation: [www.spray-on.com](http://www.spray-on.com).
    - b. Monoglass Incorporated: [www.monoglass.com](http://www.monoglass.com).
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

### 2.2 MATERIALS

- A. Acoustic Glass Batt Insulation for Use in Partitions and Over Acoustical Panel Ceilings:
  1. Basis of Design:
    - a. CertaPro AcoustaTherm manufactured by CertainTeed Corp.
    - b. Thermal & Sound Control Batts manufactured by Guardian Fiberglass, Inc.
    - c. Sound-SHIELD Sound Control Batts manufactured by Johns-Manville.
    - d. EcoBatt with ECOSE manufactured by Knauf.
    - e. Sonobatts (above ceiling) and Sound Batt (partitions) manufactured by Owens-Corning.
  2. Type: ASTM C665, Type I, unfaced.
  3. Surface Burning Characteristics per ASTM E84:
    - a. Flame Spread: 25 or less.
    - b. Smoke Developed: 50 or less.
  4. Thickness (minimum):
    - a. 3-1/2 inches where indicated on Drawings.
    - b. 6 inches above Acoustic Ceiling Systems as indicated on Drawings.
- B. Acoustic Glass Batt Insulation for Use over Open Ceiling Panels:
  1. Basis of Design: SelectSound Black Acoustic Blanket manufactured by Owens-Corning.
  2. Type: ASTM C553, Types I and II.
  3. Surface Burning Characteristics per ASTM E84:
    - a. Flame Spread: 25 or less.
    - b. Smoke Developed: 50 or less.
  4. Acoustical Performance:
    - a. ASTM C423; Mounting Type A: Material placed against solid backing.
    - b. Noise Reduction Coefficient (NRC): 0.90 or \_\_\_\_\_ as indicated in Drawings.
  5. Thickness (minimum):
    - a. 2 inches (NRC 0.90).

- C. Spray-Applied Acoustic Insulation:
1. Color: Black, unless noted otherwise.
  2. Field-tested bond strength report per ASTM E736/E736M: Tested at over 5 years / Not less than 400 psf / Not less than 600 times its weight at one (1) inch
  3. Fire Resistance per ASTM E84: Tested at a minimum of five (5) inch thickness, Class I
    - a. Flame Spread: Not To Exceed Five (5).
    - b. Smoke Development: Not To Exceed Five (5).
  4. Sprayed insulation shall meet appropriate Building Code Requirements.
  5. Thickness: 1-1/2 inch minimum typical. Thickness shall be determined in accordance with ASTM E605/E605M field test procedure.
  6. Bond Deflection per ASTM E759/E759M: 6 inch deflection in 10 foot span - no spalling or delamination.
  7. Cohesive Strength at time of application per Method WS-2000: >700 Grams.
  8. Basis of Design: "K-13 Spray-On-Systems" manufactured by International Cellulose Corporation.

### **PART 3 EXECUTION**

#### **3.1 INSPECTION**

- A. Examine all surfaces and report all unsatisfactory conditions in writing to Architect. The work shall not proceed until unsatisfactory conditions are corrected.

#### **3.2 PREPARATION**

- A. Provide masking, drop cloths or other satisfactory coverings for all materials/surfaces, which are not to receive insulation to prevent damage from over-spray.
- B. Surfaces to receive spray insulation shall be inspected prior to application to determine if priming/sealing is required to insure bonding and/or to prevent discoloration caused by migratory stains. Prime accordingly.
- C. Work shall be coordinated with other trades whose work may be affected or have an effect on the installation of the sprayed cellulose fiber.

#### **3.3 INSTALLATION**

- A. Installation, clean up and curing shall be accomplished according to the manufacturer's recommendations and common construction standards.
- B. Provide natural or mechanical ventilation continuously to properly cure the insulation.

#### **3.4 PROTECTION**

- A. Protect finished installation from damage caused by work of other trades.

**END OF SECTION 09 81 00**

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## **SECTION 09 90 00 - PAINTING AND COATING**

### **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. Surface preparation and field painting of exposed items and surfaces.
  - 2. Field preparation and painting of factory primed metal products and fabrications.
  - 3. Accessories necessary for a complete installation.
- B. Related Sections:
  - 1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
  - 2. Section 05 50 00 - Metal Fabrications: Shop-Primed items.

#### **1.3 REFERENCE STANDARDS**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2019.
- C. ASTM D2486 - Standard Test Methods for Scrub Resistance of Wall Paints; 2017.
- D. ASTM D2805 - Standard Test Method for Hiding Power of Paints by Reflectometry; 2011 (Reapproved 2018).
- E. ASTM D4828 - Standard Test Methods for Practical Washability of Organic Coatings; 1994.
- F. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- G. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- H. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).

#### **1.4 DEFINITIONS**

- A. Standard coating terms defined in ASTM D16 apply.
  - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85 degree meter.
  - 2. Eggshell refers to low sheen finish with a gloss range between 20 and 35 when measured at a 60 degree meter.
  - 3. Semi-gloss refers to medium sheen finish with a gloss range between 35 and 70 when measured at a 60 degree meter.
  - 4. Gloss refers to high sheen finish with a gloss range more than 70 when measured at a 60 degree meter.

#### **1.5 SUBMITTALS**

- A. Product Data: Submit technical data and information for block fillers, primers, paints, and coatings, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
  - 1. Indicate manufacturer's instructions for special surface preparation procedures, substrate conditions requiring special attention.
  - 2. Material List: Provide inclusive list of required coating materials. Indicate each material and cross reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number, series, and general classification.
- B. Samples: Submit for each type of paint system and in each color and gloss of topcoat.

1. Provide stepped samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.
  2. Provide list of material and application for each coat of each sample. Label each sample as to location and application.
  3. Submit samples on following substrates for review of color and texture only:
    - a. Concrete: Provide two 4 inch square samples for each color and finish.
    - b. Concrete Masonry: Provide two 4 inch x 8 inch samples of masonry, with mortar joint in the center, for each finish and color.
    - c. Painted Wood: Provide two 12 inch square samples of each color and material on hardboard.
    - d. Ferrous and Nonferrous Metals: Provide two 4 inch square samples of flat metal and two 8 inch long samples of solid metal for each color and finish.
- C. Product List: Submit list of including each paint system, color, and location of application. Use same product and location designations indicated in Finish Schedule.

## 1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Comply with Federal and local toxicity and air quality regulations and with Federal requirements on content of for heavy metals including but not limited to: lead and mercury. Do not use solvents in paint products that contribute to air pollution.
  2. Performance and Durability:
    - a. ASTM D16 Standard Terminology for Paint, Related Coatings, Materials, and Applications.
    - b. ASTM D2486 Standard Test Method for Scrub Resistance of Interior Wall Paint.
    - c. ASTM D2805 Standard Test Method for Hiding Power of Paints by Reflectometry.
    - d. ASTM D4828 Standard Test Method for Practical Washability of Organic Coatings.
- B. Applicator Qualifications: A firm or individual having minimum 5 years documented experience in applying paints and coatings similar in material, design, and extent to those indicated.
- C. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, product name, product code, color designation, VOC content, batch date, environmental handling, surface preparation, application, and use instructions.
- C. Paint Materials: Store at a minimum of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.
- D. Handling: Maintain a clean, dry storage area to prevent contamination or damage to materials.

## 1.8 FIELD CONDITIONS

- A. Apply waterborne paints when temperatures of surfaces to be painted and surrounding air are between 50 degrees F and 90 degrees F (10 degrees and 32 degrees C).
- B. Do not thin or add water to waterbased paints, including waterbased alkyds.
- C. Weather Conditions:
1. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
  2. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 degrees F (3 degrees C) above dew point; or to damp or wet surfaces.

3. Minimum Application Temperatures for Water based Paints: Between 50 degrees F (10 degrees C) and 90 degrees F (32 degrees C).
- D. Apply solvent thinned paints when temperatures of surfaces to be painted and surrounding air are between 45 degrees F. and 95 degrees F (7 degrees F and 35 degrees C).
  1. Minimum Application Temperature for Varnish Finishes: 65 degrees F (18 degrees C) for interior or exterior, unless required otherwise by manufacturer's instructions.
  2. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.
- E. Provide lighting level of 80 foot candles (860 lux) measured midheight at substrate surface.
- F. Labels: Do not paint over Underwriters Laboratories, Factory Mutual, other code required labels, or equipment name, identification, performance rating, or nomenclature plates.

### **1.9 WARRANTY**

- A. Written warranty signed by the manufacturer and the installer in which the manufacture and installer agree to repair or replace paint and primers that fail within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Flaking or delamination of paint with the substrate.
    - b. Rust, scale, similar imperfections due to improper surface preparation.
    - c. Thinning or watering of paint beyond that considered acceptable of paint manufacturer.
    - d. Failure to achieve dry film thickness (DFT) recommended by manufacturer for each coat in a paint system.
    - e. Deterioration or loss of color of paint beyond normal weathering.
  2. Warranty Period: One year from date of Substantial Completion.

### **1.10 EXTRA MATERIALS**

- 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: 2 percent, but not less than 1 gallon (3.8 L) of each material and color applied.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
  1. Benjamin Moore & Co.: [www.benjaminmoore.com](http://www.benjaminmoore.com).
  2. Dunn-Edwards Corporation: [www.dunnedwards.com](http://www.dunnedwards.com).
  3. PPG Industries, Inc.: [www.ppgpaints.com](http://www.ppgpaints.com).
  4. The Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

### **2.2 MATERIALS**

- A. Basis of Specifications: PPG Industries, Inc..
- B. Subject to compliance with requirements, provide first quality, 100% acrylic, commercial or industrial products of one of the specified manufacturers. Residential products are not permitted.
- C. Proprietary Names: Paint Schedule is based on a single manufacturer for convenience. Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that named products are required to the exclusion of comparable products of specified manufacturers. Furnish product technical data, including percent solids by weight and volume;

VOC content limits and emissions data; and certificates of performance for comparable paint products of specified manufacturer.

- D. Subject to compliance with requirements, provide first quality, 100% acrylic, commercial or industrial products of one of the specified manufacturers. Residential products are not permitted.
- E. Material Compatibility: Provide each paint system including block fillers, primers, and finish coats, that are compatible with one another and with substrates indicated under conditions of service and application, demonstrated by manufacturer based on testing and field experience.
- F. Material Quality: Provide manufacturer's best quality commercial 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. Residential quality paint products are not permitted.
- G. Chemical Components of Interior Paints and Coatings: Provide products complying with limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and SCAQMD 1113.
  - 1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
  - 2. Restricted Components: Paints and coatings shall not contain components restricted by the EPA and SCAQMD 1113.
- H. Materials not specifically indicated but required to achieve the finishes specified, of commercial quality.
- I. Patching Materials: Latex filler compatible with paint systems.
- J. Fastener Head Cover Materials: Latex filler.

### **2.3 SOURCE QUALITY CONTROL**

- A. Testing of Paint Materials: School District reserves the right to invoke to engage the services of a qualified testing agency to sample paint materials.
  - 1. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to site, samples may be taken at the site. Samples will be identified, sealed, and certified by testing agency.
  - 2. Testing agency will perform tests for compliance with product requirements.
  - 3. School District may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

### **2.4 PAINT COLOR SCHEDULE**

- A. Colors (P-#):
  - 1. P-1 - Field:
    - a. Manufacturer: PPG Industries, Inc.
    - b. Color: PPG1010-2 Fog.
    - c. Sheen: Eggshell.
    - d. Locations: As indicated on Drawings.
  - 2. P-2 - Accent 1:
    - a. Manufacturer: PPG Industries, Inc.
    - b. Color: PPG1010-4 Stepping Stone.
    - c. Sheen: Eggshell.
    - d. Locations: As indicated on Drawings.
  - 3. P-3 - Accent 2:
    - a. Manufacturer: PPG Industries, Inc.



- b. Color: PPG1188-7 Burnt Red.
- c. Sheen: Eggshell.
- d. Locations: As indicated on Drawings.
- 4. P-4 - Door and Window Trim:
  - a. Manufacturer: PPG Industries, Inc.
  - b. Color: PPG1010-4 Stepping Stone.
  - c. Sheen: Semi-Gloss.
  - d. Locations: As indicated on Drawings.
- 5. P-5 - Exterior Wall:
  - a. Manufacturer: PPG Industries, Inc.
  - b. Color: As selected by Architect.
  - c. Sheen: Flat.
  - d. Locations: As indicated on Drawings.
- 6. P-6 - Exterior Column:
  - a. Manufacturer: PPG Industries, Inc.
  - b. Color: PPG1244-5 Blueberry Popover.
  - c. Sheen: Semi-Gloss.
  - d. Locations: As indicated on Drawings.
- 7. P-7 - Exterior Canopy Soffit:
  - a. Manufacturer: PPG Industries, Inc.
  - b. Color: PPG1010-2 Fog.
  - c. Sheen: Flat.
  - d. Locations: As indicated on Drawings.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for maximum moisture content and conditions affecting performance of the work.
- B. Test substrates after repairing and cleaning substrates but prior to application of paint and coatings.
  - 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
    - a. Concrete: 12 percent.
    - b. Fiber Cement Board: 12 percent.
    - c. Masonry (Clay and CMUs): 12 percent.
    - d. Wood: 15 percent.
    - e. Gypsum Board: 12 percent.
    - f. Plaster: 12 percent.
  - 2. Test cementitious and plaster cement/stucco for alkalinity (pH).
- C. Gypsum Board Substrates: Verify taped joints are tapes and finishing compound is sanded smooth.
- D. Plaster Substrates: Verify plaster has fully cured. Verify existing plaster is in good condition and can receive new paint coating.
- E. Spray Textured Ceiling Substrates: Verify surfaces are dry.
- F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
  - 1. Verify previously painted surfaces can be stripped to bare substrate, repaired if necessary, and prepared to receive new paint system consisting of primer and two top coats at a minimum.
    - a. Note: Previously painted surfaces have failed to accept new paint systems. Determined cause of failure and take corrective measures to ensure each surface accepts new paint system. Failure of new paint system is not permitted.

- G. Commence paint and coating application after correcting unsatisfactory conditions and surfaces are dry. Application of coating indicates applicator's acceptance of surfaces and conditions.

### **3.2 ITEMS TO RECEIVE PAINT**

- A. Generally, all new items that are normally painted in any typical building, including but not limited to the following list:
1. All ferrous metal.
  2. All exterior galvanized metal.
  3. All exterior wood.
  4. All interior wood.
  5. All prime coated hardware.
  6. All exposed pipe, plumbing, ductwork, conduit, outlet boxes and electrical cabinets, excluding those located in mechanical rooms.
  7. All metal grilles, except aluminum, unless otherwise indicated.
  8. All exposed gypsum board surfaces, including all mechanical rooms.
  9. Miscellaneous other items which normally require painting or are scheduled to be painted.
  10. Consult plans, finish schedule, details and specifications for other trades as all items usually field painted or finish will be considered as part of the Contract.
  11. All exposed mechanical equipment and electrical equipment.
  12. Traffic lanes and parking spaces including fire lanes and crosswalks.
  13. Rolling doors.
  14. Bollards.
  15. Loose lintels.
  16. Refer to MEP specifications for additional items to receive paint.
- B. All work where a coat of material has been applied must be inspected and approved by Architect before application of succeeding specified coat, otherwise no credit for coat applied will be given. Notify Architect when a particular coat has been completed for inspection and approval. Apply coats of material in strict accordance with manufacturer's specifications except where requirements of these specifications are in excess of manufacturer's requirements. Paint all sight exposed pipe and plumbing only after all mechanical work and tests have been completed.

### **3.3 PREPARATION**

- A. Coordination of Work: Review work in which primers are provided to ensure compatibility of the total system for various substrates. Notify Architect of anticipated problems when using materials specified over substrates primed by others.
1. Pre-Primed Substrates: Inspect existing conditions in which primers are factory applied to ensure compatibility of the total system for each substrate. Notify Architect of anticipated problems when using the materials specified over factory primed or pre-primed substrates.
  2. Existing Painted Surfaces: Inspect previously painted surfaces to ensure compatibility of the existing paints with new paint system for each substrate. Notify Architect of anticipated problems.
  3. Correct defects and clean surfaces affecting bond with paint system. Remove existing paints exhibiting loose surface defects showing signs of rust, scale, or delamination.
  4. Seal marks which may bleed through surface finishes.
- B. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified. Provide barrier coats over incompatible primers or remove and reprime. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting.
1. Remove hardware and hardware accessories, plates, lighting fixtures, and similar items that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting. After completing painting operations in each space or area, reinstall items removed using

- workers skilled in the trades involved.
2. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface applied protection if any.
  3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  4. Clean and prepare surfaces to receive paint according to manufacturer's written instructions for each substrate condition and as specified. Provide barrier coats over incompatible primers, existing paint or coating, or remove and reprime.
  5. Correct defects and clean surfaces affecting bond with paint or coating system. Remove existing coatings exhibiting loose surface defects. Seal marks which may bleed through surface finishes.
- C. **Cleaning:** Before applying paint or surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning. Schedule cleaning and painting so dust and contaminants from the cleaning process will not fall on wet, newly painted surfaces.
1. Remove incompatible primers, including factory applied primers, and reprime substrate with compatible primers or apply barrier coat as necessary to produce paint systems indicated.
  2. **Concrete Substrates:** Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
  3. **Steel Substrates:** Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
  4. **Galvanized Metal Substrates:** Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
  5. **Aluminum Substrates:** Remove surface oxidation.
- D. **Mildew and Mold Removal:** Remove mildew and mold by high power washing (pressure range of 1500 to 4000 psi) with solution of trisodium phosphate and bleach. If substrate is too soft for high power washing, scrub substrate with solution. Rinse with clean water and allow surface to dry.
- E. **Protective Coverings:** Provide protections for duration of the work, including covering furnishings and decorative items. Protect and mask adjacent finishes and components against damage, marking, overpainting, and injury. Clean and repair or replace damage caused by painting.
- F. **Renovated Surfaces:** Clean surface free of loose dirt and dust. Except at gypsum board surfaces, remove existing paint and coatings to bare substrate and prepare substrates to receive new paint system. Test substrate to verify it will bond with primer and receive new paint system without failure. If test fails, clean surface to base substrate and apply barrier coat. Retest to verify surface will accept new paint system.
1. Remove surface film preventing proper adhesion and bond.
  2. Wash glossy paint with a solution of sal soda and rinse thoroughly.
  3. Remove loose, blistered, and defective paint and varnish; smooth edges with sandpaper.
  4. Clean corroded iron and steel surfaces.
  5. Repair and blend into portland cement plaster.
  6. Prime bare surfaces.
  7. Tone varnished surfaces with stain bringing to uniform color.
  8. If existing surfaces cannot be put in acceptable condition for finishing by customary cleaning, sanding, and puttying operations, notify School District and do not proceed until correcting unsatisfactory conditions.
- G. **Cementitious Substrates:** Prepare concrete surfaces to receive paint. Remove efflorescence, chalk, dust, dirt, grease, oils, release agents, mold, mildew, and existing paint. Roughen as necessary to remove glaze. If hardeners or sealers have been used to improve curing, use

mechanical methods of surface preparation.

1. Use abrasive blast cleaning methods if recommended by paint manufacturer.
  2. Do not paint surfaces if moisture content or alkalinity of surfaces exceeds that permitted in manufacturer's written instructions.
    - a. Determine alkalinity and moisture content of surfaces by performing appropriate pH testing. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct condition prior to application of paint.
    - b. Anhydrous Calcium Chloride Test: ASTM F1869 . Proceed with installation after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.3 kg of water/92.9 sq. m).
    - c. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation after substrates have obtained percent relative humidity level recommended by paint manufacturer.
    - d. Perform additional moisture tests when recommended by manufacturer. Proceed with installation when moisture content complies with that permitted in manufacturer's written instructions.
    - e. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to thoroughly dry.
  3. Clean concrete floors to receive paint or coating with a 5 percent solution of muriatic acid or etching cleaner. Flush floors with clean water to remove acid; neutralize with ammonia, rinse, allow to dry; vacuum before painting.
- H. Ferrous Metals: Clean ungalvanized ferrous metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC recommendations.
1. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
  2. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
  3. Touch up bare areas and shop-applied prime coats that have been damaged. Wire brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
- I. Galvanized Ferrous Metal Substrates: Clean galvanized surfaces with nonpetroleum based solvents leaving surface free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- J. Shop Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop primed surfaces.
- K. Aluminum Substrates: Clean surfaces to remove oil, grease, surface oxidation, and contaminants in accordance with SSPC SP-1 Solvent Cleaning. Lightly abrade surface with a nonmetallic pad.
- L. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- M. Plaster/Stucco Substrates: Remove contaminants, release agents, curing compounds, efflorescence, chalk, mold, mildew, and similar deterrents. Spot patch existing plaster to eliminate blisters, buckles, excessive crazing, and to check cracking, dryouts, efflorescence, sweat outs, and similar defects the prevent plaster from bonding with paint or coatings. Sand or texture repair or patch to match adjacent finish and to remove trowel marks and arrises.
1. Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
  2. Deep Cracks: Clean out and fill deep cracks with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

3. Do not paint surfaces if moisture content or alkalinity of surfaces exceeds that permitted in manufacturer's written instructions. Test for alkali using litmus paper.
  4. Allow patching and repair compounds to set and cure before painting.
- N. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
- O. Wood Substrates:
1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
  2. Sand surfaces that will be exposed to view, and dust off.
  3. Prime, stain, or seal wood to be painted. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
  4. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
  5. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- P. Pipe Covering and Insulation: Clean to remove loose, foreign, and objectionable material before applying sealing coat.
- Q. Preparation of Substrates for Wallcovering: Prime and seal substrate with release coat in accordance with wallcovering manufacturer's recommendations for substrate.
1. Assure compatibility with product of wall covering manufacturer.
  2. Fill indentations in substrate and prime with opaque white primer before applying release coat.
  3. Apply release coat in accordance with manufacturer's recommendations.
- R. Barrier Coat: Provide barrier coats over incompatible primers or remove and reprime. Notify Owner in writing of anticipated problems using specified finish coat material over previously coated substrates.
- S. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
  2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
  3. Do not use thinners for water based paints.
  4. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

### **3.4 APPLICATION**

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
1. The term exposed surfaces includes areas visible when permanent or built in fixtures, grilles, convactor covers, covers for finned tube radiation, and similar components are in place. Extend coatings in these areas to maintain system integrity and provide desired protection.
  2. Use applicators and techniques suited for paint and substrate indicated.
  3. Provide finish coats compatible with primers.
  4. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

5. Paint exposed surfaces. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces.
    - a. Field painting of exposed surfaces include bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory applied final finish.
    - b. Areas visible when permanent or built in fixtures, grilles, convactor covers, covers for finned tube radiation, and similar components are in place.
    - c. Extend coatings in areas, as required, to maintain system integrity and provide desired protection.
  6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
  7. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  8. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  9. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  10. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or surface imperfections. Cut in sharp lines and color breaks.
  11. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
  12. Provide finish coats compatible with primers used.
  13. Sand lightly between each succeeding enamel or varnish coat.
- B. Items not to Receive Paint: Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
- C. Applicators: Apply paints and coatings by brush, roller, spray, or applicators recommended by manufacturer.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
  2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool recommended by manufacturer for material and texture required.
  3. Spray Equipment: Use airless spray equipment with orifice size recommended by manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
1. Measure film thickness on magnetic surfaces by use of Elcometer thickness gauge and on nonmagnetic surfaces by pit gauge or Tooke Gauge.
- E. Application: Apply first coat to surfaces that have been cleaned, pretreated, or prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
  2. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished after removing rust and scale and priming or touching up surface sand if acceptable to topcoat manufacturers.
  3. If undercoats, stains, or conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive dry film thickness

- equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried and cured to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- F. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
1. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
  2. Prime and paint uninsulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, heat exchangers, tanks, ductwork, conduit, switchgear, and paintable insulation except where items are prefinished.
  3. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
  4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
  5. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
  6. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
  7. Concealed Members: Wherever steel and metal parts to receive paint are built into and concealed by construction, paint as specified for exposed parts so finish painting is complete before members are concealed.
- G. Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work: Painting is limited to items exposed in equipment rooms and occupied spaces.
1. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
  2. Prime and paint uninsulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, heat exchangers, tanks, ductwork, conduit, switchgear, and paintable insulation except where items are prefinished.
  3. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
  4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
  5. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
  6. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
- H. Electrostatic Spray Painting: Apply coating electrostatically to finished surfaces, free from runs, sags, visible overlaps, holidays, craters, pinholes and other defects detrimental to protective and decorative qualities of coating.
1. Thickness of Coatings: 1.5 to 2.0 mils dry film thickness. Measure dry film thickness with magnetic gauge.
  2. Use application techniques, equipment, materials, and preparation procedures recommended by manufacturer.
- I. Block Fillers: Apply block fillers to concrete masonry block at rate to ensure complete coverage with pores filled.
- J. Prime Coats: Before applying finish coats, apply prime coat, recommended by manufacturer, to material required to be painted or finished and that has not been prime coated by others.

- Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or defects due to insufficient sealing.
- K. Finish Coats: Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance without bleed through.
    - 1. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or surface imperfections is not acceptable.
    - 2. Transparent (Clear) Finishes: Use multiple coats to produce glass smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats.
  - L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
  - M. Touch Up: Touch up marred, scraped, and blemished areas of surfaces which were factory primed or previously coated.
    - 1. Prepare and touch up scratches, abrasions, and blemishes and remove foreign matter before proceeding with succeeding coats.
    - 2. Touch up marred, scraped, and blemished areas of factory primed or previously coated surfaces.
    - 3. Feather touch up coating overlapping minimum 2 inches onto adjacent unblemished areas producing smooth, uniform surface.
    - 4. As soon after erection and installation as possible, touch up fasteners, welded surfaces and surroundings, field connections, and areas on which shop coat has been abraded or damaged with specified primer before corrosion and other damage occurs from exposure.

### 3.5 FIELD QUALITY CONTROL

- A. Dry Film Thickness (DFT) Testing: Tests for dry film thickness may be determined by using a Tooke Scale and microgroover, an electronic scanner, or the Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
  - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
  - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

### 3.6 CLEANING AND PROTECTION

- A. It is of the utmost important to the School District that the sites remain in a safe, clean, and well maintained condition. At the end of each day, leave the site ready to use by staff and students. Protect staff and students and the learning environment throughout the work.
- B. Cleanup: At the end of each day, remove empty cans, rags, rubbish, and discarded paint materials from site. After completion of painting work, clean glass and paint splattered surfaces. Remove splattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work. After related work is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.
- E. At completion of painting activities, touch up and restore damaged or defaced painted surfaces.



- F. Waste Management: Legally dispose of unused paint and paint containers in accordance with manufacturer's recommendations and environmental regulations.

## **PART 4 SCHEDULES**

### **4.1 GENERAL**

- A. The following is a schedule of typical painted items and does not specifically include every item that is to receive paint but should establish type and quality of finish for all items normally included in a complete paint job.
- B. Overhead Painting (Ceilings, Exposed to Structure Above, etc.)
1. Use a dryfall system comparable to system defined below for substrate.

### **4.2 DUNN EDWARDS APPLICATION SCHEDULES**

- A. Exterior Surfaces (Note: Exterior surfaces are divided into two (2) different categories, based upon color and level of graffiti resistance required. System 1 shall be used when standard earthtone colors or neutral colors are specified, and System 2 shall be used when bright colors [primary reds, yellows, and oranges] are specified and/or when a graffiti resistant coating is required):
1. Galvanized Metal:
    - a. Surface Preparation: Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations. Krud Kutter Metal Clean and Etch.
    - b. Primer: One (1) coat Ultrashield ULDM00 DTM Gray Primer.
    - c. Finish: Two (2) coats Ultrashield ULSH40 Low Sheen High Performance Acrylic Urethane.
    - d. Finish: Two (2) coats US Coatings RustGrip 2300 1-2 Mils DFT.
  2. Un-galvanized Metal:
    - a. Primer: One (1) coat Ultrashield ULDM00 DTM Gray Primer.
    - b. Finish: Two (2) coats Ultrashield ULSH40 Low Sheen High Performance Acrylic Urethane.
  3. Concrete and CMU:
    - a. Primer/Finish: (2) coats Eff-Stop Premium ESPR00 Masonry Primer / (2) coats US Coatings AquaGrip 2600 3-5 Mils DFT.
  4. Wood (Includes plywood siding and wooden trim):
    - a. Primer: One (1) coat EZ-Prime EZPR00 Exterior Wood Primer.
    - b. Finish: Two (2) coats Spartashield SSSL60 100% Acrylic Gloss.
  5. Fiber-Cement Materials:
    - a. Primer: One (1) coat Eff-Stop Premium ESPR00 Masonry Primer.
    - b. Finish: Spartashield SSSL60 100% Acrylic Gloss.
  6. Parking Line and Driveway Paint: Vin-L-Stripe VSZM10 Zone Marking Paint Yellow.
  7. All piping in mechanical rooms shall be painted in their entirety, in the following colors: Aristoshield ASHL70 High-Gloss Enamel:
    - a. Gas lines: Orange
  8. Domestic cold water: White
    - a. Domestic hot water: Pink
    - b. Heating hot water: Red
  9. Condenser water: Green
    - a. Chilled water: Blue
- B. Interior Surfaces:
1. Galvanized Metal:
    - a. Primer: One (1) coat Ultrashield Galvanized Metal Primer ULGM00.
    - b. Finish: Two (2) coats Aristoshield ASHL50 Semi-Gloss Enamel.
  2. Shop-Primed Ferrous Metals (Use for metal doors and frames and miscellaneous metal items):

3. Shop coat by others.
  - a. One (1) coat over Steel: Bloc-Rust Premium BRPR00 Rust Preventative Primer; Aluminum: Ultrashield Galvanized Metal Primer ULGM00.
  - b. Two (2) coats Aristoshield ASHL50 Semi-Gloss Enamel.
4. Gypsum Wallboard:
  - a. Primer: One (1) coat Vinylastic Premium VNPR00 Acrylic Wall Sealer.
  - b. Finish: Two (2) coats Spartawall Premium SWLL30 Acrylic Latex Eggshell.
5. Primer Concrete and CMU (Enamel):
  - a. One (1) coat Smooth Blocfil Premium SBPR00 100% Acrylic Block Filler.
  - b. Finish: Two (2) coats Premium SWLL50 Acrylic Latex Semi-Gloss.
6. Wood (Painted):
  - a. Primer: Interkote Premium IKPR00 100% Acrylic Enamel Undercoater.
  - b. Finish: Aristoshield ASHL50 Semi-Gloss Enamel.
7. Wood (Stained):
  - a. Stain: Gemini Craftsman Collection Wiping Stain CCW Water-Based Series.
  - b. Finish (First Coat): WB-0230 Gemini Titanium Clear Urethane Satin
  - c. Finish (Second Coat): Gemini WB-0230 Gemini Titanium Clear Urethane Satin.
8. Gypsum Wallboard (Epoxy) – Kitchens, bathrooms, laboratories, etc.:
  - a. Primer: One (1) coat US Coatings AquaGrip 2600 2-3 Mils DFT.
  - b. Finish: Two (2) coats US Coatings AquaGrip 2600 3-5 Mils DFT per coat.
9. CMU (Epoxy) - Kitchens, bathrooms, laboratories, etc.:
  - a. Primer: Two (2) coats Smooth Blocfil Premium SBPR00 100% Acrylic Block Filler.
  - b. Finish: Two (2) coats US Coatings AquaGrip 2600 3-5 Mils DFT.
10. Pipe and fittings, including but not limited to copper and brass, at kitchen areas (but excluding aluminum, stainless steel, nickel and chrome plated pipe and fittings):
  - a. Primer: One (1) coat; US Coatings RustGrip 2300 1-2 Mils DFT.
  - b. Finish: Two (2) coats bright aluminum paint, US Coatings UreGrip 3000 VOC 2-3 Mils DFT per coat.

C. Paint Types: Refer to the Finish Schedule in the Drawings.

#### 4.3 PPG APPLICATION SCHEDULES

##### A. Exterior:

1. Galvanized Metal:
  - a. Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations.
  - b. Better: One (1) coat Speedhide Int/Ext Galvanized Steel Primer, 6-209 Series.
2. Field Weld Touch-Up on Galvanized Metal:
  - a. Two (2) coats Speedhide Int/Ext Galvanized Steel Primer, 6-209 Series.
3. Shop-Primed Ferrous Metals:
  - a. Clean all bare and abraded areas to bright, bare metal and touch up with either:
  - b. One (1) coat Speedhide Int/Ext Rust Inhibitive Steel Primer, 6-208 Series.
4. Wood (Painted Finish):
  - a. One (1) coat Seal Grip Int/Ext Acrylic universal Primer/Sealer 17-921
  - b. Two (2) coats Sun Proof Exterior House & Trim Flat 100% Acrylic 72-45.
5. Concrete Block (Flat, smooth finish CMU):
  - a. One (1) coat Speedhide Int/Ext Masonry Hi Fill Block Filler Latex, 6-15 Series
  - b. Two (2) coats Sun Proof Exterior House & Trim Flat 100% Acrylic 72-45.

##### B. Interior:

1. Gypsum Board Walls:
  - a. Ceilings and locations not scheduled to receive enamel finish.
    - 1) One (1) coat Speedhide Interior Latex Sealer Quick Drying, with texture added, 6-2 Series.
    - 2) Two (2) coats Speedhide Interior Paint Flat Latex, 6-70 Series.

- b. Walls scheduled to receive enamel paint.
  - 1) One (1) coat Speedhide Interior Latex Sealer Quick Drying, with texture added, 6-2 Series.
  - 2) Two (2) coats Speedhide Interior Enamel Eggshell Latex, 6-411 Series.
- 2. Wood (Painted):
  - a. One (1) coat Seal Grip Interior/Ext Acrylic Universal Primer/Sealer 17-921
  - b. Two (2) coats Speedhide Interior Enamel Wall and Trim Semi-gloss, 6-1110 Series.
- 3. Wood (Stained):
  - a. Two (2) coats Deft Interior Water-Based Gloss Polyurethane DFT158.
- 4. Shop-Primed Ferrous Metals (Use for metal doors and frames and miscellaneous metal items):
  - a. Shop coat by others.
  - b. Touch up bare areas with Pitt Tech Plus Int/Ext DTM Primer, 90-912 Series.
  - c. One (1) coat Pitt Tech Plus Int/Ext DTM Primer 90-912.
  - d. Two (2) coats Pitt Tech Plus Int/Ext DTM Semi-Gloss Industrial 90-1210.
- 5. Galvanized Metals (Use for all exposed interior galvanized metal):
  - a. Clean and acid etch as necessary.
  - b. One (1) coat Pitt Tech Plus Int/Ext Industrial Primer, 90-912 Series.
  - c. Two (2) coats Pitt Tech Plus Int/Ext Industrial Semi-Gloss 90-1210.
- 6. Concrete Block (CMU):
  - a. General: Stop block filler and paint 1/2 inch below top of floor base material at all wall surfaces.
  - b. Latex Enamel (Corridors, Classrooms, Offices, and where shown on drawings):
    - 1) One (1) coat One (1) coat Speedhide Int/Ext Masonry Hi Fill Block Filler Latex, 6-15 Series.
    - 2) Two (2) coats Speedhide zero interior Zero-Voc Semi-Gloss 6-4510.
- 7. Epoxy (Kitchen, and where shown on drawings):
  - a. One (1) coat Pitt-Glaze Int/Ext Block Filler Latex, 16-90 series.
  - b. Two (2) coats Pitt-Glaze WB1 Acrylic Epoxy Semi-Gloss 16-310 Series.

#### 4.4 SHERWIN-WILLIAMS APPLICATION SCHEDULES

- A. Exterior Surfaces: Note: Exterior surfaces are divided into two (2) different categories, based upon color and level of graffiti resistance required. System 1 will be used when standard earthtone colors or neutral colors are specified, and System 2 will be used when bright colors (primary reds, yellows, and oranges) are specified and/or when a graffiti resistant coating is required.
  - 1. Galvanized Metal:
    - a. Surface Preparation: Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations.
    - b. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
    - c. Finish: Two (2) coats Sher-Cryl HPA High Performance Acrylic (B66W300).
  - 2. Galvanized Metal: Chloramine environment.
    - a. Surface Preparation: Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations.
    - b. Primer: One (1) coats Macropoxy 646 (B58-600).
    - c. Finish: Two (2) coats Acrolon 218 HS Acrylic Polyurethane (B65-600).
  - 3. Un-galvanized Metal:
    - a. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310).
    - b. Finish: Two (2) coats Sher-Cryl HPA High Performance Acrylic (B66W300).
  - 4. Pre-Finished Metal Surfaces:
    - a. Surface Preparation: As recommended by primer manufacturer.
    - b. Primer: One (1) coat Bond-Plex Waterbased Acrylic.
      - 1) OR

- 2) Primer: One (1) coat DTM Bonding Primer.
  - c. Finish: Two (2) coats Bond-Plex Waterbased Acrylic.
  5. Concrete and CMU:
    - a. Primer/Finish: (2) coats Loxon XP Exterior Waterproofing System, 14-18 mils wet, 6.4 – 8.3 mils dry per coat.
  6. Tilt-Up Concrete:
    - a. Primer: One (1) coat Loxon Concrete and Masonry Primer Sealer (LX02W50), 5.3-8.0 mils wet, 2.1-3.2 mils dry.
    - b. Finish: One (1) coat Conflex UltraCrete Acrylic Textured Finish, Texture: Fine, Base Color: CF17W0811 Medium Extra White.
  7. Wood (Includes plywood siding and wooden trim):
    - a. Primer: One (1) coat A-100 Latex Wood Primer (B42W41).
    - b. Finish: Two (2) coats A-100 Acrylic Gloss (A8 ser.).
  8. Fiber-Cement Materials:
    - a. Primer: One (1) coat Loxon Masonry Primer (A24W300).
    - b. Finish: Two (2) coats A-100 Acrylic Gloss (A8 Series).
  9. Parking Line and Driveway Paint: Setfast Waterborne Yellow (TM225) (meets Federal Specification (FS) TTP-1952-B)
- B. Interior Surfaces:
1. Concrete Substrates, Non-Traffic Surfaces and Clay Masonry:
    - a. Latex System:
      - 1) Prime Coat: Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils (0.203 mm) wet, 3.2 mils (0.081 mm) dry.
      - 2) Intermediate Coat: Latex, interior, matching topcoat.
      - 3) Topcoat:
        - (a) Flat: ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
        - (b) Low Sheen: ProMar 200 Zero VOC Latex Low Sheen Eg-Shel, B24-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
        - (c) Eggshell: ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.
        - (d) Semi-Gloss: ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
        - (e) Gloss: ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.
    - b. Water-Based Light Industrial Coating System:
      - 1) Prime Coat: Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils (0.203 mm) wet, 3.2 mils (0.081 mm) dry.
      - 2) Intermediate Coat: Latex, interior, matching topcoat.
      - 3) Topcoat:
        - (a) Eggshell: Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
        - (b) Semi-Gloss: Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
  2. Concrete Substrates, Pedestrian Traffic Surfaces:
    - a. Latex Floor Enamel System:
      - 1) First Coat: Floor paint, latex, slip-resistant, matching topcoat.
      - 2) Topcoat: Floor paint, latex, slip-resistant, low gloss: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils (0.038 to 0.051 mm) dry per coat.
  3. Flat: Galvanized Metal:
    - a. Latex System:
      - 1) Prime Coat: One (1) coat Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) wet, 2.0 to 4.0 mils (0.051 to 0.102

- mm) dry.
- 2) Intermediate Coat: Water-based acrylic, interior, matching topcoat.
- 3) Topcoat:
  - (a) Semi-Gloss: Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils (0.064 to 0.102 mm) dry, per coat.
  - (b) Gloss: Pro Industrial Acrylic Gloss Coating, B66-660 Series, at 2.5 to 4.0 mils (0.064 to 0.102 mm) dry, per coat.
- b. Water-Based Dry-Fall System:
  - 1) Top Coat:
    - (a) Flat: S-W Pro Industrial Waterborne Acrylic Dryfall Flat, B42-181 Series, at 6.0 mils (0.152 mm) wet, 1.5 mils (0.038 mm) dry.
    - (b) Eggshell: Pro Industrial Waterborne Acrylic DryFall Eg-Shel, B42-82, at 6.0 mils (0.152 mm) wet, 1.9 mils (0.048 mm) dry.
    - (c) Semi-Gloss: Pro Industrial Waterborne Acrylic DryFall Semi-Gloss, B42-83, at 5.8 mils (0.147 mm) wet, 2.3 mils (0.058 mm) dry.
- c. Water-Based Light Industrial Coating System:
  - 1) Prime Coat: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) wet, 2.0 to 4.0 mils (0.051 to 0.102 mm) dry.
  - 2) Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
  - 3) Top Coat:
    - (a) Eggshell: Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
    - (b) Semi-Gloss: Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
- 4. Shop-Primed Ferrous Metals (Use for metal doors and frames and miscellaneous metal items):
  - a. Shop coat by others.
  - b. One (1) coat over Steel Kem Kromik Primer B50series.
  - c. One (1) coat over Aluminum Metal Procryl Primer B60series.
  - d. Two (2) coats PM200 Alkyd Semi-Gloss B34series.
- 5. Wood: (Painted)
  - a. Latex System:
    - 1) Prime Coat: PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry.
    - 2) Intermediate Coat: Latex, interior, matching topcoat.
    - 3) Topcoat:
      - (a) Eggshell: ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.
      - (b) Semi-Gloss: ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
      - (c) Gloss: ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
  - b. Water/Alkyd Urethane System:
    - 1) Prime Coat: Premium Wall & Wood Primer, B28W8111, at 4.0 mils (0.102 mm) wet, 1.8 mils (0.046 mm) dry.
    - 2) Intermediate Coat: Water-based alkyd-urethane, interior, matching topcoat.
    - 3) Topcoat:
      - (a) Semi-Gloss: Pro Industrial Waterbased Alkyd Urethane Semi-Gloss, B53-1150 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.
      - (b) Gloss: Pro Industrial Waterbased Alkyd Urethane Gloss, B53-1050 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.
  - c. Water-Based Light Industrial Coating:

- 1) Prime Coat: PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry.
- 2) Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
- 3) Topcoat:
  - (a) Eggshell: Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
  - (b) Semi-Gloss: Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
6. Wood: (Stained)
  - a. Stain: SherWood BAC Wiping Stain (S64 Series).
  - b. Finish (First Coat): Wood Classics Polyurethane Varnish (A67 Series).
  - c. Finish (Second Coat): Wood Classics Polyurethane Varnish (A67 Series).
7. Gypsum Board and Plaster:
  - a. Latex System:
    - 1) Prime Coat: ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils (0.102 mm) wet, 1.0 mils (0.025 mm) dry.
    - 2) Intermediate Coat: Latex, interior, matching topcoat.
    - 3) Topcoat:
      - (a) Flat: ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
      - (b) Low Sheen: ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
      - (c) Eggshell: ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.
      - (d) Semi-Gloss: ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
      - (e) Gloss: ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
  - b. Water-Based Light Industrial Coating System:
    - 1) Prime Coat: ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils (0.102 mm) wet, 1.0 mils (0.025 mm) dry.
    - 2) Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
    - 3) Topcoat:
      - (a) Eggshell: Pro Industrial Pre-Catalyzed Waterbased Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
      - (b) Semi-Gloss: Pro Industrial Pre-Catalyzed Waterbased Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
8. CMU: (Epoxy) - Kitchens, bathrooms, laboratories, etc.
  - a. Primer: Two (2) coats Heavy Duty Block Filler (B42W46).
  - b. Finish: Two (2) coats Water-Based Catalyzed Epoxy (B70/B60).
9. Pipe and fittings, including but not limited to copper and brass, at kitchen areas (but excluding aluminum, stainless steel, nickel and chrome plated pipe and fittings):
  - a. Primer: One (1) coat; product recommended for the substrate by the finish coat manufacturer.
  - b. Finish: Two (2) coats bright aluminum paint.

**END OF SECTION 09 90 00**

## **SECTION 10 11 00 - VISUAL DISPLAY UNITS**

### **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. Porcelain enamel steel markerboards.
  - 2. Tackboards.
- B. Related Sections:
  - 1. Section 06 10 00 - Rough Carpentry: Blocking and supports.
  - 2. Section 06 20 00 - Finish Carpentry: Wood frame and marker rails.
  - 3. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports in metal stud walls.
  - 4. Section 09 90 00 - Painting and Coating: Finishing of wood frame and marker rail.
  - 5. Section 10 22 39 - Folding Panel Partitions: Installation of visual display boards on operable partitions.

#### **1.3 REFERENCE STANDARDS**

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).
- C. ANSI A208.1 - American National Standard for Particleboard; 2022.
- D. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- E. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.
- F. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2012, with Editorial Revision (2019).
- G. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- H. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- I. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
- J. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- L. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics; 2020.
- M. PS 1 - Structural Plywood; 2023.

#### **1.4 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide manufacturer's data on chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surface covering, trim, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.
- D. Samples: Color charts for selection of color and texture of chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surface covering, and trim.
- E. Samples: Two, 2 by 2 inches (50 by 50 mm) in size illustrating materials and finish, color and texture of chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surfacing, and trim.

- F. Test Reports: Show compliance to specified surface burning characteristics requirements.
- G. Manufacturer's printed installation instructions.
- H. Manufacturer's Qualification Statement.
- I. Maintenance Data: Include data on regular cleaning, stain removal, and \_\_\_\_\_.

### **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

### **1.6 WARRANTY**

- A. Refer to Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Provide five year warranty for chalkboard and markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

## **PART 2 PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

### **2.2 VISUAL DISPLAY UNITS**

- A. Porcelain Enamel Steel Markerboards:
  - 1. Color: White.
  - 2. Steel Face Sheet Thickness: 24 gauge, 0.0239 inch (0.61 mm).
  - 3. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
  - 4. Backing: Aluminum foil, laminated to core.
  - 5. Size: As indicated on drawings.
  - 6. Frame: Same as for chalkboards.
  - 7. Frame: Extruded aluminum , with concealed fasteners.
  - 8. Frame Profile: As indicated on drawings.
  - 9. Frame Finish: Anodized, natural.
  - 10. Accessories: Provide marker tray and map rail.
  - 11. Basis of Design Products:
    - a. Egan Visual WhiteBoards manufactured by Egan Visual Corporation.
    - b. LSC3 manufactured by Claridge Products and Equipment, Inc.
- B. Tackboards: Fine-grained, homogeneous natural cork.
  - 1. Cork Thickness: 1/8 inch (3 mm).
  - 2. Fabric: Vinyl coated fabric.
  - 3. Color: As selected by Architect from manufacturer's full range.
  - 4. Backing: Hardboard, 1/4 inch (6 mm) thick, laminated to tack surface.
  - 5. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
  - 6. Size: As indicated on drawings.
  - 7. Height: 48 inches (1220 mm).
  - 8. Length: As indicated on drawings.
  - 9. Length: 6 feet (1830 mm) , in one piece.
  - 10. Frame: Same type and finish as for chalkboard.
  - 11. Frame: Extruded aluminum , with concealed fasteners.
  - 12. Frame Profile: As indicated on drawings.



13. Frame Finish: Anodized, natural.
14. Accessories: Provide map rail.
15. Basis of Design Products:
  - a. Products manufactured by Claridge Products and Equipment, Inc.
  - b. Egan Visual TackBoards manufactured by Egan Visual Corporation.

## **2.3 MATERIALS**

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Hardboard for Chalk Surface: ANSI A135.4 Tempered type.
- C. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
  1. Laminated Safety Glass: Comply with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.
  2. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch (0.762 mm) thick, minimum.
  3. Ionoplast Interlayer: 0.035 inch (0.889 mm) thick, minimum.
- D. Plywood: PS 1 Grade C-D , softwood.
- E. Hardboard for Cores: ANSI A135.4, Class 1 - Tempered, S2S (smooth two sides).
- F. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
- G. Gypsum Board: ASTM C1396/C1396M, paper/foil faced, plain type.
- H. Fiber Board: ASTM C208, cellulosic fiber board.
- I. Foil Backing: Aluminum foil sheet, 0.005 inch thick (0.13 mm thick).
- J. Aluminum Sheet Backing: 27 gauge, 0.014 inch (0.36 mm) thick.
- K. Steel Sheet Backing: 28 gauge, 0.0149 inch (0.38 mm), galvanized.
- L. Adhesives: Type used by manufacturer.

## **2.4 ACCESSORIES**

- A. Temporary Protective Cover: Sheet polyethylene, 8 mil (0.2 mm) thick.
- B. Cleaning Instruction Plate: Provide instructions for chalkboard cleaning on a metal plate fastened to perimeter frame near chalkrail.
- C. Marker Tray: Aluminum, manufacturer's standard profile, one piece full length of markerboard, molded ends, concealed fasteners, same finish as frame.
- D. Mounting Brackets: Concealed.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.
- C. Verify flat wall surface for frameless adhesive-applied boards.

### **3.2 PREPARATION**

- A. Acclimatize tackable wall panels by removing from packaging in installation area not less than 24 hours before application.
- B. Remove switchplates, wall plates, and surface-mounted fixtures where tackable wall paneling is applied. Reinstall items on completion of installation.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### **3.3 INSTALLATION**

- A. Install boards in accordance with manufacturer's instructions.
- B. Install with top of marker tray at 30 inches (760 mm) above finished floor.
- C. Secure units level and plumb.
- D. Carefully cut holes in boards for thermostats.
- E. Install tackable wall panels in accordance with manufacturer's recommendations on specified substrates with concealed attachments.
  - 1. Fabricate re-wrapped edges where partial panels about each other, or adjacent surfaces or trim.
  - 2. Re-wrap top, bottom or side edges for cutting panels around door or window openings, abutting trim, protruding objects, and at other openings, including x-cut at receptacles, light switches, and other openings.
    - a. Wrap minimum 2 inches (51 mm) around back of panel.
    - b. Carefully cut fiber board, leaving vinyl wallcovering intact. Wrap wallcovering tightly around edge of board and adhere continuously around back of panel with manufacturer's recommended vinyl wallcovering adhesive.

### **3.4 CLEANING**

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at Date of Substantial Completion.
- D. Break-in slate chalkboards with a chalk and clean treatment.

**END OF SECTION 10 11 00**

## **SECTION 10 14 00 - SIGNAGE**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Room and door signs.
  - 2. Interior directional and informational signs.
  - 3. Luminous egress path marking and other "glow-in-the-dark" signs.
  - 4. Emergency evacuation maps.
  - 5. Building identification signs.
  - 6. Plaque.
  - 7. Traffic signs.
- B. Related Sections:
  - 1. Section 05 51 00 - Metal Stairs: Photoluminescent stair nosings.
  - 2. Section 05 52 00 - Metal Railings: Photoluminescent handrail strips.
  - 3. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
  - 4. Section 26 05 53 - Identification for Electrical Systems.
  - 5. Section 26 51 00 - Interior Lighting: Exit signs required by code.

#### **1.2 REFERENCE STANDARDS**

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. ASTM E2072 - Standard Specification for Photoluminescent (Phosphorescent) Safety Markings; 2014.
- D. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- E. NFPA 170 - Standard for Fire Safety and Emergency Symbols; 2021.
- F. UL 1994 - Luminous Egress Path Marking Systems; Current Edition, Including All Revisions.

#### **1.3 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
  - 1. When room numbers to appear on signs differ from those on Drawings, include the drawing room number on schedule.
  - 2. When content of signs is indicated to be determined later, request such information from School District through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
  - 3. Submit for approval by School District through Architect prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- F. Verification Samples: Submit samples showing colors specified.
- G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- H. Manufacturer's Qualification Statement.

- I. Maintenance Materials: Furnish the following for School District's use in maintenance of project.
  1. Refer to Section 01 60 00 - Product Requirements, for additional provisions.
  2. Curved Sign Media Suction Cups: One for each 100 signs; for removing media.

#### **1.4 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

#### **1.6 FIELD CONDITIONS**

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

### **PART 2 PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
  1. Flat Signs:
    - a. Best Sign Systems, Inc: [www.bestsigns.com](http://www.bestsigns.com).
    - b. Cosco Industries: [www.coscoarchitecturalsigns.com](http://www.coscoarchitecturalsigns.com).
    - c. FASTSIGNS: [www.fastsigns.com](http://www.fastsigns.com).
    - d. Inpro: [www.inprocorp.com](http://www.inprocorp.com).
    - e. Mohawk Sign Systems, Inc: [www.mohawksign.com](http://www.mohawksign.com).
    - f. Seton Identification Products: [www.seton.com/aec](http://www.seton.com/aec).
  2. Curved Signs:
    - a. FASTSIGNS: [www.fastsigns.com](http://www.fastsigns.com).
    - b. Vista System: [www.vistasystem.com](http://www.vistasystem.com).
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

#### **2.2 SIGNAGE APPLICATIONS**

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 \_\_\_\_\_, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
  1. Sign Type: Flat signs with engraved panel media as specified.
  2. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.
  3. Character Height: 1 inch (25 mm).
  4. Sign Height: 2 inches (50 mm), unless otherwise indicated.
  5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
  6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section with sliding "In

- Use/Vacant" indicator.
7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
  8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
- C. Interior Directional and Informational Signs:
1. Sign Type: Same as room and door signs.
  2. Sign Type: Curved signs with engraved panel media as specified.
  3. Sizes: As indicated on Drawings.
  4. Allow for 20 signs 4 inches high by 16 inches long.
  5. Wording of signs is scheduled on Drawings.
  6. Where suspended, ceiling mounted, or projecting from wall signs are indicated, provide two-sided signs with same information on both sides.
- D. Luminous Egress Path Marking and Other "Glow-in-the-Dark" Signs: Photoluminescent media.
1. Provide luminous egress path marking as required by local authority having jurisdiction.
  2. Allow for total of 100 directional signs, approximately 6 inches (150 mm) square.
  3. Allow for 1000 linear feet (305 linear meters) of guidance strips.
  4. Provide one numbered seat marker for each seat in auditorium and one numbered row marker for each row, each side of aisles.
- E. Emergency Evacuation Maps:
1. Provide maps where indicated on Drawings or as directed by the Architect or the School District.
  2. Allow for one map per elevator lobby.
  3. Map content to be provided by the Architect.
  4. Use clear plastic panel silk-screened on reverse, in brushed aluminum frame, screw-mounted.
- F. Recognition/Donor Panels: Engraved panel media; individual name signs attached with magnetic tape to fixed panel.
1. Dimensions and Number of Name Signs: As indicated on Drawings.
  2. Provide all name signs whether engraved or not, for uniform overall appearance.
  3. Color: Color as selected.
- G. Building Identification Signs:
1. Use individual metal letters.
  2. Mount on outside wall in location indicated on drawings.
- H. Other Dimensional Letter Signs: Wall-mounted.
1. Exterior: Allow for total of 50 letters, 6 inches (150 mm) high, metal.
  2. Interior: Allow for total of 50 letters, 6 inches (150 mm) high, metal.
- I. Plaque: See Allowance for details.
- J. Traffic Signs: Match campus standards; locate where indicated on Drawings.

### 2.3 SIGN TYPES

- A. Flat Signs: Signage media without frame.
1. Edges: Square.
  2. Corners: Square.
  3. Frame Finish: Natural (clear) anodized.
  4. Clear Cover: For customer produced sign media, provide clear cover of polycarbonate plastic, glossy on back, non-glare on front.
  5. Wall Mounting of One-Sided Signs: Tape adhesive.
  6. Wall and Ceiling Mounting of Two-Sided Signs: Aluminum wall bracket, powder coated, color selected from manufacturer's standard colors, attached with screws in predrilled mounting holes, set in clear silicone sealant.

7. Suspended Mounting: Stainless steel suspension cables, cable clamps, and ceiling fastener suitable for attachment to ceiling construction indicated.
- B. Radius / Curved Signs: One-piece, curved extruded aluminum media holder securing flat, flexible sign media by curved lip on two sides; other two sides closed by end caps; concealed mounting attachment.
  1. Sizes: As indicated on Drawings.
  2. Finish: Natural (clear) anodized.
  3. Sign Orientation: Curved in horizontal section.
  4. End Caps: Aluminum with finish matching frame and stainless steel screw attachment.
  5. End Caps: Plastic, color selected from manufacturer's standard colors, paintable.
  6. Clear Cover: For customer produced sign media, provide clear cover of polycarbonate plastic, glossy on back, non-glare on front.
  7. Wall Mounting of One-Sided Signs: Mechanical anchorage, with predrilled holes, and set in clear silicone sealant.
  8. Wall and Ceiling Mounting of Two-Sided Signs: Aluminum wall bracket, powder coated, color selected from manufacturer's standard colors, attached with screws in predrilled mounting holes, set in clear silicone sealant.
  9. Mounting of Floor Mounted Pylon Signs: Oval shaped steel base anchored to floor.
  10. Suspended Mounting: Stainless steel suspension cables, cable clamps, and ceiling fastener suitable for attachment to ceiling construction indicated.
  11. Directories: For customer-produced media; provide divider strips.
- C. Color and Font: Unless otherwise indicated:
  1. Character Font: Helvetica, Arial, or other sans serif font.
  2. Character Case: Upper case only.
  3. Background Color: Clear.
  4. Character Color: Contrasting color.

## 2.4 TACTILE SIGNAGE MEDIA

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
  1. Total Thickness: 1/16 inch (1.6 mm).
- B. Injection Molded Panels: One-piece acrylic plastic, with raised letters and braille.
  1. Total Thickness: 1/8 inch (3 mm).
- C. Applied Character Panels: Acrylic plastic base, with applied acrylic plastic letters and braille.
  1. Total Thickness: 1/8 inch (3 mm).
  2. Letter Thickness: 1/8 inch (3 mm).
  3. Letter Edges: Square.

## 2.5 NON-TACTILE SIGNAGE MEDIA

- A. Silk Screened Plastic Panels: Letters and graphics silk screened onto reverse side of plastic surface:
  1. Sign Color: Clear.
  2. Total Thickness: 1/8 inch (3 mm).
- B. Sand Blasted Plastic Panels: High gloss acrylic plastic; letters sand blasted to dull sheen:
  1. Total Thickness: 1/8 inch (3 mm).

## 2.6 PHOTOLUMINESCENT MEDIA

- A. Stair Identification Signs: Nonflexible photoluminescent sign with tactile raised numbers and Braille markings.
  1. Comply with UL 1994 and ASTM E2072.
  2. Size: 12 inches by 18 inches (305 mm by 457 mm).
  3. Mounting: As recommended by manufacturer for material selected.
  4. Products:

- a. Safe-T-Nose, LLC; Photoluminescent Stair Identification Sign (ISID):  
[www.safetnose.com/#sle](http://www.safetnose.com/#sle).
  - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- B. Directional Signs: Acrylic photoluminescent square.
1. Comply with NFPA 170, UL 1994, and ASTM E2072.
  2. Symbol: Running man right.
  3. Size: 5 inches by 5 inches (127 mm by 127 mm).
  4. Mounting: Peel-and-stick.
  5. Products:
    - a. Safe-T-Nose, LLC; Photoluminescent Directional Sign (DRMR):  
[www.safetnose.com/#sle](http://www.safetnose.com/#sle).
    - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- C. Extruded Aluminum Guidance Strips:
1. Comply with UL 1994 and ASTM E2072.
  2. Width: 1/2 inch (12.5 mm).
  3. Mounting: As recommended by manufacturer for material selected.
- D. Sheet Aluminum Guidance Strips:
1. Comply with UL 1994 and ASTM E2072.
  2. Width: 1/2 inch (12.5 mm).
  3. Mounting: As recommended by manufacturer for material selected.
- E. High-Impact Plastic Guidance Strips:
1. Comply with UL 1994 and ASTM E2072.
  2. Width: 1 inch (26 mm).
  3. Mounting: As recommended by manufacturer for material selected.
  4. Products:
    - a. Safe-T-Nose, LLC; Photoluminescent Perimeter Strips (STNF):  
[www.safetnose.com/#sle](http://www.safetnose.com/#sle).
    - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- F. Polyester Tape Guidance Strips:
1. Comply with UL 1994 and ASTM E2072.
  2. Width: 1/2 inch (12.5 mm).
  3. Protection: Temporary protective cover.
  4. Products:
    - a. Safe-T-Nose, LLC; Photoluminescent Exit Path/Perimeter Markings (S9203P):  
[www.safetnose.com/#sle](http://www.safetnose.com/#sle).
    - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- G. Obstruction Strips: Black/luminous stripe marking on sheet aluminum.
1. Comply with UL 1994 and ASTM E2072.
  2. Width: 1/2 inch (12.5 mm).
  3. Mounting: As recommended by manufacturer for material selected.
  4. Products:
    - a. Safe-T-Nose, LLC; Photoluminescent Obstruction Markings (0150):  
[www.safetnose.com/#sle](http://www.safetnose.com/#sle).
    - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- H. Photoluminescent Stair Nosings: Factory fabricated aluminum extrusion with replaceable embedded photoluminescent and slip-resistant strip.
1. Comply with UL 1994 and ASTM E2072.
  2. Finish: Anodized.
  3. Color: As selected by Architect from manufacturer's standard range.
  4. Mounting: Provide manufacturer approved field applied adhesive, factory applied adhesive, and mechanical fasteners.

## **2.7 ACCESSORIES**

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Exposed Screws: Chrome plated.
- C. Tape Adhesive: Double sided tape, permanent adhesive.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that substrate surfaces are ready to receive work.

### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- D. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

**END OF SECTION 10 14 00**



## **SECTION 10 21 13.16 - PLASTIC-LAMINATE-CLAD TOILET COMPARTMENTS**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Plastic laminate toilet compartments.
- B. Plastic laminate urinal screens.
- C. Plastic laminate vestibule screens.
- D. Accessories as required for a complete installation.

#### **1.2 RELATED REQUIREMENTS**

- A. Section 05 12 00 - Structural Steel Framing: Concealed steel support members.
- B. Section 05 50 00 - Metal Fabrications: Concealed steel support members.
- C. Section 06 10 00 - Rough Carpentry: Blocking and supports.
- D. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.
- E. Section 10 28 19 - Tub and Shower Enclosures: Shower compartment construction.

#### **1.3 REFERENCE STANDARDS**

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- C. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- D. PS 1 - Structural Plywood; 2023.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

#### **1.5 SUBMITTALS**

- A. Refer to Section 01 25 13 - Product Substitution Procedures, for submittal procedures.
- B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- C. Product Data: Provide data on panel construction, hardware, and accessories.
- D. Samples: Submit two samples of partition panels, 6 by 6 inches (150 by 150 mm) in size illustrating panel finish, color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

### **PART 2 PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
  - 1. ASI Accurate Partitions: [www.asi-accuratepartitions.com/#sle](http://www.asi-accuratepartitions.com/#sle).
  - 2. ASI Global Partitions: [www.asi-globalpartitions.com/#sle](http://www.asi-globalpartitions.com/#sle).
  - 3. General Partitions Mfg. Corp: [www.generalpartitions.com/#sle](http://www.generalpartitions.com/#sle).
  - 4. Thrislington Cubicles, Ltd.: [www.thrislingtoncubicles.com](http://www.thrislingtoncubicles.com).
  - 5. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

#### **2.2 BASIS OF DESIGN**

- A. Plastic Laminate Moisture Guard manufactured by ASI Accurate Partitions.

### 2.3 MATERIALS

- A. Core: Manufacturer's standard.
- B. Plastic Laminate: NEMA LD 3, HGS.
  - 1. Color: As indicated on Drawings.
- C. Adhesive: Contact type.

### 2.4 COMPARTMENTS AND SCREENS

- A. General: Plastic-laminate faced.
- B. Toilet Compartments: Floor-to-ceiling.
- C. Urinal Screens: Wall-mounted with two panel brackets, and floor-to-ceiling vertical upright consisting of pilaster anchored to floor and ceiling.

### 2.5 COMPONENTS

- A. Doors, Panels, and Pilasters: Plastic laminate adhesive and pressure bonded to faces and edges of core, with beveled corners and edges; edges of cut-outs sealed.
  - 1. Reinforce pilasters and panels with steel plate sandwiched in core at attachment points. Router cut openings as required.
  - 2. Plastic Laminate Color: Refer to Interior Finish Schedule and Interior Elevations.
- B. Door and Panel Dimensions:
  - 1. Thickness: 1 inch (25 mm).
  - 2. Door Width: 24 inch (610 mm).
  - 3. Door Width for Accessible Stalls: 36 inch (915 mm), out-swinging.
  - 4. Height: 58 inch (1 473 mm).
- C. Pilasters Dimensions:
  - 1. Width: As indicated on Drawings.
  - 2. Thickness: 1-1/4 inch (32 mm).

### 2.6 ACCESSORIES

- A. Pilaster Shoes: Formed chromed steel with polished finish, 3 inches (75 mm) high, concealing floor fastenings.
  - 1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
  - 2. Provide ceiling attachment using two adjustable hanging studs, attached to above-ceiling framing.
- B. Head Rails: Hollow chrome plated steel tube, 1 x 1-5/8 inch (25 x 41 mm) size, with anti-grip strips and cast socket wall brackets.
- C. Wall and Pilaster Brackets: Polished stainless steel.
- D. Wall Brackets: Continuous type, polished stainless steel.
- E. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
  - 1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.
- F. Steel Plate Reinforcement: Carbon steel, prepared for fasteners, 1/8 inch (3 mm) thick.
- G. Hardware: Polished stainless steel:
  - 1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
  - 2. Nylon bearings.
  - 3. Thumb turn door latch with exterior emergency access feature.
  - 4. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
  - 5. Coat hook with rubber bumper; one per compartment, mounted on door.
  - 6. Provide door pull for outswinging doors.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

#### **3.2 INSTALLATION**

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 to 1/2 inch (9 to 13 mm) space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

#### **3.3 TOLERANCES**

- A. Maximum Variation From True Position: 1/4 inch (6 mm).
- B. Maximum Variation From Plumb: 1/8 inch (3 mm).

#### **3.4 ADJUSTING**

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

**END OF SECTION 10 21 13.16**

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## **SECTION 10 21 23 - CUBICLE CURTAINS AND TRACK**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Suspended, overhead curtain track and guides.
- B. Surface-mounted, overhead curtain track and guides.
- C. Cubicle curtains.
- D. Blackout curtains.

#### **1.2 RELATED REQUIREMENTS**

- A. Section 05 50 00 - Metal Fabrications: Above ceiling track supports.
- B. Section 06 10 00 - Rough Carpentry: Above ceiling blocking and track supports for track.
- C. Section 09 51 00 - Acoustical Ceilings: Suspended ceiling system to support track.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

#### **1.4 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data for curtain fabric characteristics and \_\_\_\_\_.
- C. Shop Drawings: Indicate a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes.
- D. Samples: Submit 12 by 12 inch (300 by 300 mm) sample patch of curtain cloth with representative top, bottom, and edge hem stitch detail, heading with reinforcement and carrier attachment to curtain header.
- E. Samples: Submit 12 inch (300 mm) sample length of curtain track including typical splice, wall and ceiling hanger, and escutcheon.
- F. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- G. Maintenance Data: Include recommended cleaning methods and materials and stain removal methods.
- H. Maintenance Materials: Furnish the following for School District's use in maintenance of project.
  - 1. Refer to Section 01 60 00 - Product Requirements, for additional provisions.
  - 2. Extra Curtains: Two of each type and size.
  - 3. Extra Carriers: Ten.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Accept curtain materials on site and inspect for damage.
- B. Store curtain materials on site and deliver to School District for installation when requested.

### **PART 2 PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.

1. ArcCom.
2. A. R. Nelson Co: [www.arnelson.com/#sle](http://www.arnelson.com/#sle).
3. Construction Specialties, Inc: [www.c-sgroup.com/#sle](http://www.c-sgroup.com/#sle).
4. Imperial Fastener Co., Inc: [www.imperialfastener.com/#sle](http://www.imperialfastener.com/#sle).
5. Inpro: [www.inprocorp.com/#sle](http://www.inprocorp.com/#sle).

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

## 2.2 TRACKS AND TRACK COMPONENTS

- A. Tracks: Extruded aluminum sections; one piece per track run.
1. Profile: Channel.
  2. Mounting: Surface.
  3. Structural Performance: Capable of supporting vertical test load of 50 lbs (23 kg) without visible deflection of track or damage to supports, safely supporting moving loads, and sufficiently rigid to resist visible deflection and without permanent set.
  4. Track End Stop: To fit track section.
  5. Track Bends: Minimum 12 inch (300 mm) radius; fabricated without deformation of track section or impeding movement of carriers.
  6. Suspension Rods: Tubular aluminum sections, sized to support design loads and designed to receive attachment from track and ceiling support.
  7. Escutcheons: Where suspension rod meets finished ceiling or structure, provide escutcheons to match rod finish.
  8. Finish on Exposed Surfaces: Clear anodized.
  9. Basis of Design Products:
    - a. Products manufactured by Construction Specialties, Inc..
    - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- B. Curtain Carriers: Nylon rollers, size and type compatible with track; designed to eliminate bind when curtain is pulled; fitted to curtain to prevent accidental curtain removal.
1. Provide 2 carriers per foot of track length (6 carriers per meter of track length)
- C. Wand: Plastic, attached to lead carrier, for pull-to-close action.
- D. Installation Accessories: Types required for specified mounting method and substrate conditions.

## 2.3 CURTAINS

- A. Cubicle Curtains:
1. Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
  2. Inherently flame resistant or flameproofed; capable of passing NFPA 701 test.
  3. Material: Close weave polyester; anti-bacterial, self deodorizing, sanitized, and preshrunk.
  4. Color/Pattern: \_\_\_\_\_.
  5. Open Mesh Cloth: Open weave to permit air circulation; flameproof material, manufacturer's standard color.
  6. Attachment of Curtain Fabric to Open Mesh Cloth: Manufacturer's standard sewn seam.
- B. Curtain Fabrication:
1. Width of curtain to be 10 percent wider than track length.
  2. Length of curtain to end 15 inches (380 mm) above finished floor.
  3. Railroad fabric without vertical seams.
  4. Pattern match fabric with vertical seams.
  5. Include open mesh cloth at top 20 inches (508 mm) of curtain for room air circulation, attached to curtain as specified above.
  6. Curtain Heading: Fabric band matching curtain panel with metal grommet holes for carriers spaced 6 inches (150 mm) on center.

7. Seams and Hems: Manufacturer's standard fabrication method for securely sewn and finished seams and hems.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that surfaces and supports above ceiling are ready to receive work of this Section.
- B. Verify that field measurements are as indicated.

#### **3.2 INSTALLATION**

- A. Install curtain track to be secure, rigid, and true.
- B. Refer to Section 05 50 00 - Metal Fabrications for track supports above ceiling.
- C. Refer to Section 06 10 00 - Rough Carpentry for blocking and track supports above ceiling.
- D. Secure track to ceiling system.
- E. Install end cap and stop device.
- F. Install curtains on carriers ensuring smooth operation.

**END OF SECTION 10 21 23**

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## **SECTION 10 26 00 - WALL AND DOOR PROTECTION**

### **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. Corner guards.
  - 2. Protective wall covering.
- B. Related Requirements:
  - 1. Section 05 50 00 - Metal Fabrications: Anchors for attachment of work of this section, concealed in wall.
  - 2. Section 06 10 00 - Rough Carpentry: Blocking for wall and corner guard anchors.
  - 3. Section 08 71 00 - Door Hardware: Standard protection plates and trim.
  - 4. Section 09 21 16 - Gypsum Board Assemblies: Placement of supports in stud wall construction.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

#### **1.4 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
- C. Shop Drawings: Include plans, elevation, sections, and attachment details. Show design and spacing of supports for protective corridor handrails, required to withstand structural loads.
- D. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
  - 1. Submit two samples of protective wall covering and door surface protection, 6 by 6 inches (152 by 152 mm) square.
- E. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in School District's name and registered with manufacturer.
- G. Maintenance Data: Manufacturer's instructions for care and cleaning of each type of product. Include information about both recommended and potentially detrimental cleaning materials and methods.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Protect work from moisture damage.
- C. Protect work from UV light damage.
- D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.
- E. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

## 1.6 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for metal crash rails. Complete forms in School District's name and register with manufacturer.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures or internal connection failures.
    - b. Deterioration of materials beyond that expected of normal use, as intended by manufacturer.
- C. Installer Warranty: Provide 5-year warranty for metal crash rails commencing on Date of Substantial Completion. Complete forms in School District's name and register with installer.
  - 1. Failures include, but are not limited to, the following:
    - a. Detachment of rail system from substrate.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
  - 1. Protective Corridor Handrails and Corner Guards:
    - a. Babcock-Davis: [www.babcockdavis.com/#sle](http://www.babcockdavis.com/#sle).
    - b. Construction Specialties, Inc: [www.c-sgroup.com/#sle](http://www.c-sgroup.com/#sle).
  - 2. Protective Wall Panels: Fiber Reinforced Laminate (FRL):
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

### 2.2 PERFORMANCE CRITERIA

### 2.3 PRODUCT TYPES

- A. Corner Guards - Surface Mounted, Adhered PETG:
  - 1. Basis of Design: Acrovyn VA-200N manufactured by Construction Specialties, Inc.
  - 2. Material: Polyethylene terephthalate (PET or PETG); PVC-free.
  - 3. Performance: Resist lateral impact force of 100 lbs (445 N) at any point without damage or permanent set.
  - 4. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
  - 5. Width of Wings: 1-1/2 inches.
  - 6. Corner: Square.
  - 7. Color: Fog #265.
  - 8. Projection From Wall to Outside of Guard: 0.060 inch (1.5 mm).
  - 9. Length: One piece, 48 inches (1219 mm).
  - 10. Mounting: Self-adhered.
- B. Corner Guards - Surface Mounted, Stainless Steel:
  - 1. Basis of Design:
    - a. Korogard Stainless Steel Corner Guard model GS20 manufactured by Koroseal Interior Products, Inc.
  - 2. Material: Type 304 stainless steel, finish, 16 gauge.
  - 3. Finish: No. 4 Satin.
  - 4. Performance: Resist lateral impact force of 100 lbs (445 N) at any point without damage or permanent set.
  - 5. Width of Wings: 2 inches (51 mm).
  - 6. Corner: Square.
  - 7. Length: One piece, 48 inches (1219 mm).

8. Mounting: As selected by the Architect.
- C. Protective Wall Panels:
  1. Basis of Design:
    - a. Product manufactured by Construction Specialties, Inc.
  2. Material: Fiber Reinforced Laminate (FRL): Thermofused melamine overlay, decorative paper and fire-rated phenolic paper with fiber reinforcing inner layers.
  3. Thickness: 0.075 inch (1.90 mm).
  4. Panel Size: 3 feet by 8 feet (914 mm by 2440 mm).
  5. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 55 or less, when tested in accordance with ASTM E84.
  6. Color and Pattern: Fog #265, Standard Texture.
  7. Texture: As selected by Architect from manufacturer's standard finishes.
    - a. Texture Direction: Horizontal.
  8. Mounting: Adhesive.

## **2.4 FABRICATION**

- A. Fabricate components with tight joints, corners and seams.

## **2.5 SOURCE QUALITY CONTROL**

- A. Refer to Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Provide wall and door protection systems of each type from a single source and manufacturer.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on drawings.
- C. Verify that substrate surfaces for adhered items are clean and smooth.
  1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.
- D. Start of installation constitutes acceptance of project conditions.

### **3.2 INSTALLATION**

- A. Position protective wall covering no less than 1 inch (25.4 mm) above finished floor to allow for floor level variation.
  1. Apply adhesive with 1/8 inch (3.2 mm) V-notch trowel to an area of wall surface that can be completed within cure time of the adhesive.

### **3.3 TOLERANCES**

- A. Maximum Variation From Required Height: 1/4 inch (6 mm).
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch (6 mm).

### **3.4 CLEANING**

- A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

**END OF SECTION 10 26 00**

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## **SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  - 1. Washroom accessories.
  - 2. Toilet accessories.
  - 3. Shower room accessories.
  - 4. Warm air dryers.
  - 5. Childcare accessories.
  - 6. Custodial accessories.
  - 7. Accessories necessary for a complete installation.

#### **1.2 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- F. ASTM B16/B16M - Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines; Current.
- G. ASTM B19 - Standard Specification for Cartridge Brass Sheet, Strip, Plate, Bar, and Disks; Current.
- H. ASTM B30 - Standard Specification for Copper Alloys in Ingot and Other Remelt Forms; Current.
- I. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.
- J. ASTM F446 - Standard Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area; 2019.
- K. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2022.
- L. DIN EN 12221-1 - Child use and care articles - Changing units for domestic use - Part 1: Safety requirements; 2013.
- M. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- N. ISO 17966 - Assistive products for personal hygiene that support users - Requirements and test methods; Current.
- O. ISO 22196 - Measurement of antibacterial activity on plastics and other non-porous surfaces; 2011.
- P. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- Q. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.
- R. UL 60601 - UL Standard for Safety Medical Electrical Equipment, Part 1: General Requirements for Safety; Current.

### 1.3 PERFORMANCE REQUIREMENTS

- A. Grab Bars:
  - 1. Grab bars and any wall or other surfaces adjacent to grab bars shall be free of sharp or abrasive elements and shall have rounded edges. The space around the grab bars shall be as follows:
    - a. 1-1/2 inches between the grab bar and the wall.
    - b. 1-1/2 inches minimum between the grab bar and projecting objects below and at the ends.
    - c. 12 inches minimum between the grab bar and projecting objects above.
  - 2. Grab Bars shall be designed to resist a single concentrated load of 250 lbs. applied in any direction at any point of the grab bar such as to produce the maximum load effect.

### 1.4 SUBMITTALS

- A. Product Data: Technical Data including construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 1. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  - 2. Include electrical characteristics.
- B. Samples: Provide a sample to demonstrate each exposed product finish specified.
- C. Product Schedule: Show types, quantities, sizes, and installation locations by room of each accessory required. Identify locations using room designations indicated.
- D. Maintenance Data: Submit for inclusion in maintenance manuals.

### 1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Accessibility Requirements: Comply with applicable requirements.
    - a. Texas Accessibility Standards (TAS).
- 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. Source Limitations: Obtain products from single source from single manufacturer.

### 1.6 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.

### 1.7 WARRANTY

- A. Mirrors: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, visible silver spoilage defects.
  - 2. Warranty Period: 15 years from date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
  - 1. AJW Architectural Products.
  - 2. American Specialties, Inc.
  - 3. Bobrick Washroom Equipment, Inc.
  - 4. Bradley Corporation.
  - 5. Brey-Krause Manufacturing Co.

6. GAMCO Specialty Accessories; a division of Bobrick.
  7. Georgia Pacific.
  8. Tubular Specialties Manufacturing, Inc.
- B. Substitutions: Refer to 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

## **2.2 MATERIALS**

- A. Stainless Steel: ASTM A666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated
- B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings
- C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness
- D. Galvanized Steel Sheet: ASTM A653/A653M, with G60 (Z180) hot dip zinc coating
- E. Galvanized Steel Mounting Devices: ASTM A153/A153M, hot dip galvanized after fabrication
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed
- G. Mirrors: ASTM C1503, Mirror Glazing Quality, clear glass mirrors, nominal 6.0 mm thick

## **2.3 COMPONENTS**

- A. Underlavatory Guard: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
  1. Material and Finish: Antimicrobial, molded plastic, white

## **2.4 FABRICATION**

- A. 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 School District's representative.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F446.

### **3.2 ADJUSTING AND CLEANING**

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items. Remove temporary labels and protective coatings. Clean and polish exposed surfaces according to manufacturer's written recommendations.

## **PART 4 SCHEDULE**

### **4.1 TOILET ACCESSORY SCHEDULE**

- A. TA-1C - Soap Dispensers – Counter-Mounted:
  1. Mounting: Undercounter.
  2. Basis of Design: Bobrick B-8226.

3. Locations: Where indicated on Drawings.
- B. TA-1W - Soap Dispensers – Wall-Mounted:
  1. Mounting: Surface.
  2. Basis of Design: Bobrick B-2111.
  3. Locations: Where indicated on Drawings.
- C. TA-2 - Lavatory Mirrors, Typical:
  1. Mounting: Surface.
  2. Basis of Design: Bobrick B-290.
  3. Size: 24 inches by 36 inches.
  4. Location: At each lavatory.
- D. TA-2F - Full-Length Mirrors:
  1. Mounting: Surface.
  2. Basis of Design: Bobrick B-290.
  3. Size: 24 inches by 72 inches.
  4. Location: Where indicated on Drawings.
- E. TA-3 - Toilet Paper Dispensers:
  1. Mounting: Surface.
  2. Basis of Design: Bobrick B-265.
  3. Locations: At each water closet.
- F. TA-4 - Paper Towel Dispensers:
  1. Mounting: Surface.
  2. Basis of Design: Bobrick B-262.
  3. Locations: Where indicated on Drawings.
- G. TA-5 - Grab Bars: (At Wheelchair-Accessible Water Closets):
  1. Size/Finish: 1-1/2 inch diameter satin stainless steel.
  2. Basis of Design: Bobrick B-6806.
  3. Mounting: Attach with concealed mounting kit. Mount parallel to floor.
  4. Location: At each wheelchair-accessible water closet.
- H. TA-6 - Sanitary Napkin Dispensers:
  1. Mounting: Surface.
  2. Basis of Design: Bobrick B-2706.
  3. Operation: Single coin / Double coin - (25/50 cents).
  4. Capacity: 20 Napkins/ 30 Tampons.
  5. Locations: At each women's toilet room.
- I. TA-7 - Sanitary Napkin Disposal:
  1. Mounting: Surface.
  2. Basis of Design: Bobrick B-270.
  3. Locations: Where indicated on Drawings.
- J. TA-8 - Shelf with Mop and Broom Holders and Hooks:
  1. Mounting: Surface.
  2. Model No.: B-239 x 34.
  3. Capacity: Four hooks, three mop holders.
  4. Locations: Mop sink at each custodial rooms.
- K. TA-9 - Grab Bars: (At Accessible Shower):
  1. Mounting: Surface.
  2. Basis of Design: Bobrick B-6861 modified (24 x 16).
  3. Locations: At each accessible shower stall.
- L. TA-10A - Folding Benches: Adult Height:
  1. Mounting: Surface, reversible.



2. Basis of Design: Bobrick B-5181.
  3. Locations: Where indicated on Drawings.
- M. TA-10C - Folding Benches, Child Height (15 inch (375 mm) seat height):
1. Mounting: Surface, reversible.
  2. Basis of Design: Bobrick B-5181.
  3. Locations: Where indicated on Drawings.
- N. TA-11 - Clothing Hook:
1. Mounting: Surface.
  2. Basis of Design: Bobrick B-6717.
  3. Locations: All shower locations.
  4. Toilet and Shower Partitions: If toilet and shower partitions are utilized, hooks are to be provided by the partition manufacturer(s) as part of their hardware package.
- O. TA-12 - Shower Curtains, Rods and Hooks:
1. Basis of Design:
    - a. Rods: Bobrick B-6107 (36 inches or as indicated).
    - b. Curtains: Bobrick B-204-2 (42 inches x 72 inches or as required).
    - c. Hooks: Bobrick B-204-1.
  2. Mounting/Locations: Where indicated on Drawings.
- P. TA-13 - Electric Hand Dryers:
1. Mounting: Semi-Recessed, maximum 3-9/16 inch recess.
  2. Basis of Design: Bobrick B-750, white.
  3. Voltage: 120 volt, single phase.
  4. Location: Where indicated on Drawings.
- Q. TA-14 - Paper Towel Dispenser/Trash Receptacle Combination:
1. Mounting: Surface.
  2. Basis of Design: Bobrick B-3949.
  3. Locations: Where indicated on Drawings.
- R. TA-15 - Grab Bars: (At Ambulatory-Accessible Toilet Compartments):
1. Size/Finish: 1-1/2 inch diameter satin stainless steel, lengths as indicated in drawings.
  2. Basis of Design: Bobrick B-6806.
  3. Mounting: Attach with concealed mounting. Mount parallel to floor.
  4. Location: At each ambulatory-accessible toilet compartment.
- S. TA-16 - Child Changing Station:
1. Type: Horizontal station to accommodate infants and toddlers.
  2. Basis of Design:
    - a. Model KB300 manufactured by Koala Kare Products, a division of Bobrick.
  3. General Requirements:
    - a. Comply with applicable accessibility and regulatory requirements..
    - b. Comply with with ASTM F2285.
    - c. Provide universal instruction graphics and safety messages in multiple languages.
    - d. Provide replacable restraining straps.
  4. Construction and Features:
    - a. Antifungal to comply with ASTM standards.
    - b. Frame and Hinge Mechanism: Concealed 11 gauge chassis, compromised of 1 inch (24 mm) diameter integral steel tubing that supports the changing bed and interacts with 11 gauge steel wall mounting bracket to provide steel-on-steel hinge stop. The wall frame shall serve as wall-mounting bracket.
    - c. Bed Surface: Injection molded polypropylene with antimicrobial additive, and ISO 22196 tested for efficacy.
    - d. Surface shall be contoured, concave, and smooth. Bed surface shall be minimum 535 square inches (3452 sq. cm).

- e. Dual Cavity Dispenser:
    - 1) Include integral spring tab.
    - 2) Capacity: 50 liners.
    - 3) Equip with tumbler lock, keyed as required by the School District.
  - f. Performance: Unit shall have minimal deflection from 90 degrees with a 200 lbs. static load placed in the center of the changing surface. Unit shall comply with ASTM F2285 static load requirement of 100 lbs.
  - g. Comply with requirements applicable in the jurisdiction of the project, including, but not limited to, ADA Standards, ICC A117.1, Building Code, and applicable local regulations. Also complies with ASTM F2285 and DIN EN 12221-1 for changing units for domestic use.
  - h. Operation: Concealed pneumatic cylinder providing controlled opening and closing of the changing station bed.
  - i. Instruction Graphics: Universal instruction graphics and safety messages in multiple languages.
  - j. Safety Straps: Replaceable, restraining straps.
  - k. Color: Grey 01.
5. Finish: Manufacturer's standard stainless steel.
6. Location: Where indicated on Drawings.
- T. TA-16A - Adult Changing Station:
- 1. Type: Horizontal, adjustable-height station to accommodate adults.
  - 2. Construction and Features:
    - a. Safety: Unit tested to meet ISO/IEC 60601-2-52, UL 60601, and ISO 17966 Unit shall have a battery backup system to safely operate changing bed in the event of a power interruption.
    - b. Unit designed to have redundancy by being equipped with two chains for height adjustability.
    - c. Emergency Stop: Unit is equipped with emergency stop ISO 2858 to break power to actuator in an emergency.
    - d. Powered-Height Adjustability: Electronically adjustable from 12 inches (300 mm) to 41 inches (1041 mm). Unit shall have two sets of electronic controls: located on face of wall cover; and, on front of changing bed in open, down position. Provide optional control pendant available for height adjustment.
    - e. Front Safety Guard: One-hand operation. Guard shall lock in raised position along front side of changing bed. Guard shall have dip in top edge to facilitate caregiver reaching over guard to change patient. Guard shall rotate and lock under changing bed in stored position.
    - f. Weight Capacity: Tested to support 500 lbs (227 Kg). static load.
    - g. Durability: Cycle tested through range of motion 28,000 times at 500lbs. Stress tested to 100,000 cycles with 500lbs. bounce load test. Meets IK10 impact rating.
    - h. Cleaning: The unit shall be designed and tested to meet IPX4 rating and shall have no exposed wiring/cables for disinfecting and cleaning. Unit can be hosed without compromising the electronics.
    - i. Frame: Shall be constructed of 2 inch powder coated steel tubing.
    - j. Changing Bed: Surface shall be 75-1/4 inches (1911 mm) long, 31-1/2 inches (800 mm) wide. Can be raised and lowered with one-hand. Produced from UHMW PE 1000 to be cut resistant while providing hammock for comfort. Surface shall be designed to be replaceable in the field.
    - k. Warranty: Three year limited warranty on parts; one year on labor.
    - l. Electrical: The unit shall operate at 24V / via 120V wall outlet. It shall include a grounded power cord and have a splash proof control system rated at IPX4.
  - 3. Color: As selected by Architect from manufacturer's full line
  - 4. Dimensions: 75-5/16 inches long by 60-15/32 inches high by 40-9/32 (open) 9-23/32 (closed) inches deep.

5. Basis of Design: Koala Kare Changing Stations, Model KB3000-AHL, manufactured by Koala Kare Products, a division of Bobrick.
  6. Location: Where indicated on Drawings.
- U. TA-17R - Trash Receptacle, Recessed:
1. Mounting: Recessed.
  2. Basis of Design: Bobrick B-3644.
  3. Locations: As indicated on Drawings.
- V. TA-17U - Trash Receptacle Undercounter:
1. Mounting: Free standing.
  2. Basis of Design: Bobrick B-2280.
  3. Locations: As indicated on Drawings.
- W. TA-18 - Vertical Grab Bar:
1. Mounting: Surface.
  2. Basis of Design: Bobrick B-6806x18.
  3. Locations: As indicated on Drawings.
- X. TA-19 – Water Closet Cover Dispenser:
1. Mounting: Recessed.
  2. Basis of Design: Bobrick B-301.
  3. Locations: At each water closet.
- Y. TA-20 - Folding Utility Shelf:
1. Mounting: Surface.
  2. Basis of Design: Bobrick B-287.
  3. Locations: At each toilet compartment.

**END OF SECTION 10 28 00**

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## **SECTION 10 43 00 - EMERGENCY AID SPECIALTIES**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Automated external defibrillators (AEDs).
- B. Automated external defibrillator (AED) cabinets.
- C. Emergency oxygen tank cabinets.
- D. First aid cabinets.
- E. Bleeding control cabinets.
- F. Key boxes.
- G. Accessories.

#### **1.2 RELATED REQUIREMENTS**

- A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 09 90 00 - Painting and Coating: Field paint finish.

#### **1.3 DEFINITIONS**

- A. Automated External Defibrillator (AED): A Food and Drug Administration (FDA)-approved portable device, which automatically analyzes the heart rhythm and recognizes the presence of ventricular fibrillation and/or tachycardia. If defibrillation is warranted, the AED automatically charges and prompts (visual and/or audio) the operator to deliver an electrical shock.

#### **1.4 REFERENCE STANDARDS**

#### **1.5 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide AED operational features, color and finish, anchorage details, and installation instructions.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include test schedules and recertification requirements.

### **PART 2 PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
  - 1. Emergency Aid Cabinets and Accessories:
    - a. Activar Construction Products Group, Inc. - JL Industries; LifeStart 1400 Series AED Cabinet: [www.activarcpg.com/#sle](http://www.activarcpg.com/#sle).
    - b. Modern Metal Products, a division of Technico, Inc: [www.modern-metal.com/#sle](http://www.modern-metal.com/#sle).
  - 2. Key Boxes:
  - 3. AED Floor Signs:
    - a. Brimar Industries, Inc: [www.brimar.com/#sle](http://www.brimar.com/#sle).
    - b. Insite Solutions, LLC: [www.stop-painting.com/#sle](http://www.stop-painting.com/#sle).

#### **2.2 AUTOMATED EXTERNAL DEFIBRILLATORS (AEDS)**

- A. Automated External Defibrillators (AEDs) - General: FDA approval required.

1. Automated external defibrillators (AEDs) shall be provided by School District.

## **2.3 EMERGENCY AID CABINETS**

- A. Basis of Design:
  1. Lifestart 1400 Series manufactured by Activar.
- B. Type: Automated external defibrillator (AED), Emergency oxygen, First aid, and Bleeding control.
- C. Cabinet Construction: Non-fire-rated.
  1. Stainless Steel.
- D. Cabinet Configuration: Surface-mounted type as indicated on Drawings..
  1. Size each cabinet to accommodate \_\_\_\_\_ as indicated on Drawings.
  2. Trim:
    - a. At Recessed Cabinets: Flat square edge, with \_\_\_\_ inch (\_\_\_\_ mm) wide face.
  3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
- E. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with wire pull handle and nylon catch. Hinge door for 180 degree opening with two butt hinges.
- F. Door Glazing: Acrylic plastic, clear, 1/8 inch (3 mm) thick, flat shape and set in resilient channel glazing gasket.
- G. Cabinet Mounting Hardware: Appropriate to cabinet, with predrilled holes for placement of anchors.
- H. Fabrication: Weld, fill, and grind components smooth.
- I. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.
- J. Finish of Door Pull or Handle: Stainless steel.
- K. Finish of Cabinet Interior: White powder coat.

## **2.4 KEY BOXES**

- A. Basis of Design: 3200 Series manufactured by Knox Company.
- B. Mounting: Fully-recessed, as indicated on drawings. Surface mounted units are not acceptable.
- C. Finish: Black.

## **2.5 ACCESSORIES**

- A. Theft Alarm: Battery operated audible and strobe light alarm, 10 second delay for disarming, activated by opening cabinet door. Alarm deactivated when door is closed.
- B. Alarm Contacts: Contact devices.
  1. Magnetic door contact for existing alarm systems.
- C. Cabinet Door Signage: "AED" decal, as required, or vinyl self-adhering, prespaced black lettering and identifying graphic in accordance with authorities having jurisdiction (AHJ).
- D. Plastic Wall Signage: Flat style.
- E. AED and Oxygen Floor Signs:
  1. Floor Sign: 17-1/2 inch (445 mm) diameter vinyl sign with "AED OXYGEN" and AED icon.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

### **3.2 INSTALLATION**

- A. AED Installation:

1. Install in accordance with manufacturer's instructions.
  2. Install cabinets plumb and level in wall openings, at height indicated on Drawings.
  3. Secure rigidly in place.
  4. Place AEDs in cabinets.
- B. Wall Signs:
1. Location: Where indicated on Drawings.
  2. Apply on walls after field painting is completed and has been accepted.
- C. Cabinet Lettering:
1. Location: Face of door framing.
- D. Key Box Installation:
1. Install in accordance with manufacturer's instructions.
  2. Location: As indicated on Drawings or as directed by Authorities Having Jurisdiction (AHJ).

### **3.3 ADJUSTING AND CLEANING**

- A. Remove temporary protective coverings and strippable films, unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust doors to operate smoothly without binding.
- C. On completion of installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes. Replace products that cannot be restored to factory-finished appearance. Use materials and procedures recommended by cabinet manufacturer.

### **3.4 CLOSEOUT ACTIVITIES**

- A. Refer to Section 01 77 00 - Closeout Procedures for closeout submittals.
- B. Refer to Section 01 79 00 - Demonstration and Training for additional requirements.

**END OF SECTION 10 43 00**

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## **SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Fire extinguishers.
  - 2. Fire extinguisher cabinets.
  - 3. Accessories.
- B. Related Sections:
  - 1. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
  - 2. Section 09 90 00 - Painting and Coating: Field paint finish.

#### **1.2 REFERENCE STANDARDS**

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- B. FM (AG) - FM Approval Guide; Current Edition.
- C. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.
- D. UL (DIR) - Online Certifications Directory; Current Edition.

#### **1.3 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, anchorage details, and installation instructions.
- C. Shop Drawings: Indicate locations of cabinets, cabinet physical dimensions, rough-in measurements for recessed cabinets, locations of individual fire extinguishers, mounting measurements for wall bracket, installation procedures, and accessories required for complete installation.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Provide FM Approvals for the following:
  - 1. Multipurpose Dry Chemical Fire Extinguishers.
- G. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

#### **1.4 FIELD CONDITIONS**

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

### **PART 2 PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
  - 1. Fire Extinguishers:
    - a. Ansul, a brand of Tyco Fire Protection Products, a division of Johnson Controls International: [www.ansul.com/#sle](http://www.ansul.com/#sle).
    - b. JL Industries, an Activar Construction Products Group, Inc. brand: [www.activarcpg.com/#sle](http://www.activarcpg.com/#sle).
    - c. Kidde, a unit of United Technologies Corp: [www.kidde.com/#sle](http://www.kidde.com/#sle).
    - d. Nystrom, Inc: [www.nystrom.com/#sle](http://www.nystrom.com/#sle).

- e. Oval Fire Products: [www.ovalfireproducts.com/#sle](http://www.ovalfireproducts.com/#sle).
- f. Potter-Roemer, a member of Morris Group International: [www.potterroemer.com/#sle](http://www.potterroemer.com/#sle).
- g. Pyro-Chem, a division of Johnson Controls International: [www.pyrochem.com/#sle](http://www.pyrochem.com/#sle).
2. Fire Extinguisher Cabinets and Accessories:
  - a. JL Industries, an Activar Construction Products Group, Inc. brand: [www.activarcpg.com/#sle](http://www.activarcpg.com/#sle).
  - b. Kidde, a unit of United Technologies Corp: [www.kidde.com/#sle](http://www.kidde.com/#sle).
  - c. Larsen's Manufacturing Co., a member of Morris Group International: [www.larsensmfg.com/#sle](http://www.larsensmfg.com/#sle).
  - d. Nystrom, Inc: [www.nystrom.com/#sle](http://www.nystrom.com/#sle).
  - e. Oval Fire Products: [www.ovalfireproducts.com/#sle](http://www.ovalfireproducts.com/#sle).
  - f. Potter-Roemer, a member of Morris Group International: [www.potterroemer.com/#sle](http://www.potterroemer.com/#sle).

## 2.2 FIRE EXTINGUISHERS

- A. Existing fire extinguisher for reuse:
  1. Verify fire extinguisher is in good working order prior to installation. If not, notify School District.
- B. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
  1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
- C. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
  1. Basis of Design: Cosmic 10E manufactured by JL Industries.
  2. Stored Pressure Operated: Deep Drawn.
  3. Class: A:B:C type.
  4. Size: 10 pound (4.54 kg).
  5. Finish: Baked polyester powder coat, color to be selected by Architect.
  6. Temperature range: Minus 65 degrees F (Minus 54 degrees C) to 120 degrees F (49 degrees C).

## 2.3 FIRE EXTINGUISHER CABINETS

- A. Existing fire extinguisher cabinet for reuse:
  1. Verify fire extinguisher cabinet is in good working order prior to installation. If not, notify School District.
- B. General:
  1. Basis of Design:
    - a. Model A-116 Semi-Recessed Fire Extinguisher Cabinet manufactured by JL Industries.
  2. Size to accommodate indicated extinguisher and accessories.
  3. Doors:
    - a. Door Glazing: Float glass, clear, 1/8 inch (3 mm) thick, and set in resilient channel glazing gasket.
  4. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
  5. Fabrication: Weld, fill, and grind components smooth.
  6. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.
  7. Finish of Cabinet Interior: White enamel.
- C. Standard Cabinet Construction:
  1. Non-fire-resistance-rated.
  2. Formed primed steel sheet; 0.036 inch (0.9 mm) thick base metal.
- D. Cabinet Configuration: Partially-Recessed.
  1. Trim: Flat square edge.

## **2.4 ACCESSORIES**

- A. Extinguisher Brackets: Formed steel, chrome-plated.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

### **3.2 INSTALLATION**

- A. Locate as indicated on Drawings, as directed by the School District, and as follows:
  - 1. Provide one Multipurpose Fire Extinguisher with wall bracket in each of the following locations:
    - a. Mechanical Rooms.
    - b. Electrical Rooms.
    - c. MDF/IDF/Telecommunications Rooms.
    - d. Fire Riser Rooms.
    - e. Auditoriums of 4000 square feet or less.
- B. Install in accordance with manufacturer's instructions.
- C. Install cabinets plumb and level in wall openings, such that it complies with accessibility requirements.
- D. Secure rigidly in place.
- E. Place extinguishers in cabinets.
- F. Position cabinet signage at \_\_\_\_\_.

### **3.3 MAINTENANCE**

- A. Refer to Section 01 77 00 - Closeout Procedures for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.
- C. Provide a separate maintenance contract for the service and maintenance of \_\_\_\_\_ for \_\_\_\_\_ years from Date of Substantial Completion.

**END OF SECTION 10 44 00**

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## **SECTION 10 51 13 - METAL LOCKERS**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Metal lockers.
- B. Locker benches.

#### **1.2 RELATED REQUIREMENTS**

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete base construction.
- B. Section 06 10 00 - Rough Carpentry: Wood base construction.
- C. Section 06 10 00 - Rough Carpentry: Wood blocking and nailers.
- D. Section 06 20 00 - Finish Carpentry: Bench tops for locker bench support brackets.

#### **1.3 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. ASTM A879/A879M - Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface; 2022.
- E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- F. ASTM F1267 - Standard Specification for Metal, Expanded, Steel; 2018 (Reapproved 2023).
- G. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

#### **1.4 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.
  - 1. Wired Access Control: Include power requirements and standard wiring diagrams for specified products.
- C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.
  - 1. Wired Access Control: Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.
- D. Full Size Sample: One full-size locker of each construction specified for evaluation of construction.
- E. Samples: Submit two samples 3 by 6 inches (75 by 150 mm) in size showing color and finish of metal locker material.
- F. Manufacturer's Installation Instructions: Indicate component installation assembly.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Protect locker finish and adjacent surfaces from damage.

### **PART 2 PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
  - 1. Art Metal Products: [www.artmetalproducts.com](http://www.artmetalproducts.com).
  - 2. ASI Storage Solutions: [www.asi-storage.com](http://www.asi-storage.com).

3. DeBourgh Manufacturing Co: [www.debourgh.com](http://www.debourgh.com).
4. List Industries, Inc: [www.listindustries.com](http://www.listindustries.com).
5. Lockers MFG: [www.lockersmfg.com](http://www.lockersmfg.com).
6. Lyon Workspace Products: [www.lyonworkspace.com](http://www.lyonworkspace.com).
7. Republic Storage Systems Co: [www.republicstorage.com](http://www.republicstorage.com).
8. Tennsco Storage: [www.tennsco.com](http://www.tennsco.com).
9. WEC Manufacturing: [www.itswec.com](http://www.itswec.com).

- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

## 2.2 LOCKER APPLICATIONS

- A. Student Lockers: Metal lockers, recessed mounted.
1. Basis of Design: Products manufactured by ASI Storage Solutions.
  2. Width: 12 inches (305 mm).
  3. Depth: 18 inches (457 mm).
  4. Height: 72 inches (1830 mm).
  5. Configuration: Two tier.
  6. Fittings: Size and configuration as indicated on drawings.
    - a. Hat shelf.
    - b. Single shoe shelf.
    - c. Coat rod.
    - d. Hooks: One single prong.
  7. Ventilation: Louvers at top and bottom of door panel.
  8. Locking: Padlock hasps, for padlocks provided by Owner.
    - a. Locking Action: Positive, automatic type, whereby locker may be locked when open, then closed without unlocking.
  9. Provide sloped top.
  10. Color: As selected from manufacturer's full range by Architect.

## 2.3 METAL LOCKERS

- A. Accessibility: Design units indicated on drawings as 'accessible' to comply with ICC A117.1 and ADA Standards.
- B. Locker Case Construction:
1. Heavy-Duty, Welded Construction: Made of formed and welded together sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
    - a. Assembly: Do not use bolts, screws, or rivets to assemble locker bodies.
    - b. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:
      - 1) Unperforated Steel Sheet: Commercial Steel (CS), Type B, supplied for exposed applications and complying with ASTM A1008/A1008M and the following:
        - (a) Uncoated.
        - (b) Zinc-Coated by the Hot-Dip Process: Comply with ASTM A653/A653M, coating designation G60/Z180.
        - (c) Zinc-Iron-Alloy-Coated by the Hot-Dip Process: Comply with ASTM A653/A653M, coating designation A40/ZF120.
        - (d) Zinc-Coated by the Electrolytic Process: Comply with ASTM A879/A879M, coating designation 30Z.
        - (e) Perforations: Manufacturer's standard pattern of square holes.
      - 2) Expanded Steel Sheet: Made from ASTM A1008/A1008M carbon steel sheet and complying with ASTM F1267, Type II, expanded and flattened, style 3/4 -

- 16, with a minimum 70 percent open area.
    - (a) Class 1, uncoated.
    - (b) Class 2, hot-dip zinc-coated, galvanized or galvanized.
  - 3) Body and Shelves: 16 gauge, 0.0598 inch (1.52 mm).
  - 4) Backs: 18 gauge, 0.0478 inch (1.21 mm).
  - 5) Base: 18 gauge, 0.0478 inch (1.21 mm).
    - (a) Height: 4 inches (100 mm).
  - 6) Legs: Manufacturer's standard
    - (a) Form by extending frame members.
    - (b) Fabricate from 14 gauge, 0.0747 inch (1.90 mm) nominal thickness steel sheet specified above, welded to bottom of locker.
    - (c) Height: 6 inches (152 mm).
  - c. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
    - 1) Door Frame: 16 gauge, 0.0598 inch (1.52 mm), minimum.
  - d. Where ends or sides are exposed, provide flush panel closures.
  - e. Provide filler strips where indicated or required, securely attached to lockers.
  - 2. Standard-Duty, Knocked Down Construction: Made of formed sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
    - a. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:
      - 1) Unperforated Steel Sheet: Commercial Steel (CS), Type B, supplied for exposed applications and complying with ASTM A1008/A1008M and the following:
        - (a) Uncoated.
        - (b) Zinc-Coated by the Hot-Dip Process: Comply with ASTM A653/A653M, coating designation G60/Z180.
        - (c) Zinc-Iron-Alloy-Coated by the Hot-Dip Process: Comply with ASTM A653/A653M, coating designation A40/ZF120.
        - (d) Zinc-Coated by the Electrolytic Process: Comply with ASTM A879/A879M, coating designation 30Z.
        - (e) Perforations: Manufacturer's standard pattern of square holes.
      - 2) Expanded Steel Sheet: Made from ASTM A1008/A1008M carbon steel sheet and complying with ASTM F1267, Type II, expanded and flattened, style 3/4 - 16, with a minimum 70 percent open area.
        - (a) Class 1, uncoated.
        - (b) Class 2, hot-dip zinc-coated, galvanized or galvanized.
    - 3) Body and Shelves: 24 gauge, 0.0239 inch (0.61 mm).
    - 4) Backs: 24 gauge, 0.0239 inch (0.61 mm).
    - 5) Base: 18 gauge, 0.0478 inch (1.21 mm).
      - (a) Height: 4 inch (100 mm).
    - 6) Legs: Manufacturer's standard.
      - (a) Form by extending frame members.
      - (b) Fabricate from 14 gauge, 0.0747 inch (1.90 mm) nominal thickness steel sheet specified above, welded to bottom of locker.
      - (c) Height: 6 inches (152 mm).
  - b. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
    - 1) Door Frame: 16 gauge, 0.0598 inch (1.52 mm), minimum.
  - c. Where ends or sides are exposed, provide flush panel closures.
  - d. Provide filler strips where indicated, securely attached to lockers.
- C. Drawer Base with Bench:
  - 1. Top, Bottom, Sides, Back, and Drawer: 16 gauge, 0.0598 inch (1.52 mm) sheet steel.

2. Slides: Steel, full extension arms, ball bearings; self-closing; capacity as recommended by manufacturer for drawer height and width.
  3. Integral self latching mechanism triggered by operation of wardrobe door.
  4. Bench: Mixed hardwood.
- D. Latches and Door Handles: Manufacturer's standard.
1. Latching Components: 300 Series Stainless Steel (ASTM A240/A240M).
  2. Latching: Manufacturer's standard for locking arrangement selected.
    - a. Three-Point Lift Handle Gravity Latch: Pocket-mounted, provide for doors 18 inches (457 mm) or taller.
      - 1) Handle Pocket, Recess: Stainless steel flush-mounted cup recessed into face of door.
      - 2) Handle: Steel finger lift mechanism with exposed portion encased in molded plastic trigger.
        - (a) Padlock Eye: Integral with lift trigger, sized for use with 9/32 inch (7.1 mm) diameter padlock shackles.
      - 3) Latching Mechanism: Spring activated nylon slide latch enclosed in steel latch channel allows closing of door while padlock or built-in lock is in position.
      - 4) Lock Hole Filler Plate: Manufacturer's standard. Provide for lockers intended to be unsecured or secured with padlocks.
      - 5) Rubber bumpers riveted to door stops for silent operation.
    - b. Three-Point Pull Handle Gravity Latch: Surface-mounted, provide for doors 18 inches (457 mm) or taller.
      - 1) Handle: Steel finger lift mechanism.
      - 2) Latching Mechanism: Spring activated nylon slide latch enclosed in steel latch channel allows closing of door while padlock or built-in lock is in position.
      - 3) Padlock Eye: Integral with lift handle, sized for use with 9/32 inch (7.1 mm) diameter padlock shackles.
      - 4) Lock Hole Filler Plate: Manufacturer's standard. Provide for lockers intended to be unsecured or secured with padlocks.
      - 5) Rubber bumpers riveted to door stops for silent operation.
    - c. Three-Point/Three-Sided Cremone Latch.
      - 1) Latching mechanism operated by a steel handle welded to a three-point Cremone-type assembly.
      - 2) Latching rods, 3/8 inch (9.5 mm) diameter, engage top and bottom edge of locker frame. 3/16 inch (4.8 mm) thick center latch engages door jamb.
    - d. Single-Point Latch: Provide for doors indicated.
      - 1) Stationary latch welded securely to locker frame.
      - 2) Latch extends no more than 1-1/4 inch (31.8 mm) into locker opening, penetrating through cup.
      - 3) Flush-mounted, recessed stainless steel cup in a formed door with 18 gauge, 0.0478 inch (1.21 mm) vertical back panel stiffener.
    - e. Spring Latch: Provide for box-size lockers and where indicated.
      - 1) 16 gauge, 0.0598 inch (1.52 mm) cold rolled steel, zinc plated with a 10 gauge, 0.1345 inch (3.42 mm) latch and 16 gauge, 0.0598 inch (1.52 mm) stainless steel lock hasp and completely enclosed stainless steel spring.
      - 2) Assembled using six nickel-plated rivets.
      - 3) Equip box locker doors with a padlock hasp and a stainless steel strike plate with an integral handle pull. Box locker doors may also be equipped with built-in locks.
    - f. Access Control Single-Point Latch: Provide for doors indicated.
      - 1) Wireless integrated access control locking devices.
      - 2) Stationary latch welded securely to locker frame.
      - 3) Rubber bumpers riveted to door stops for silent operation.



- E. Cup, Pocket: Manufacturer's standard, with integral pull, and recessed surface punched for installation of lock, latch lift mechanism, and number plate.
- F. Hinges: Continuous piano hinge with powder coat finish to match locker color.
- G. Hinges: Heavy-duty, 7-knuckle type; two for doors under 42 inches (1050 mm) high; three for doors over 42 inches (1 050 mm) high.
- H. Sloped Top: 20 gauge, 0.0359 inch (0.91 mm), with closed ends.
- I. Trim: 20 gauge, 0.0359 inch (0.91 mm).
- J. Coat Hooks: Stainless steel or zinc-plated steel.
- K. Number Plates: Provide oval shaped aluminum plates. Form numbers \_\_\_\_ inch (\_\_\_\_ mm) high of block font style with ADA designation, in contrasting color.
- L. Locks: Locker manufacturer's standard type indicated in Applications article above.
- M. RFID Lock System Components and Accessories: Manufacturer's standard.
  - 1. Graphic user interface for central configuration, monitoring and management of locker system.
  - 2. Locker management software with ability to generate audit trail: Logging all actions on the lock including date, time, lock status, RFID media type, and serial number in a centralized SQL database.
  - 3. Programmable networked RFID locking device
  - 4. Contactless RFID Media: Cards, wristbands, key fobs, and other NFC connected devices.
  - 5. Power: Battery operated.
  - 6. Connectivity: Wired.
- N. Locker Groups: Gang lockers in groups of two and assemble in factory for shipment as a single unit.

## 2.4 LOCKER BENCHES

- A. Locker Benches: Stationary type; bench top of laminated birch; painted steel pedestals.
  - 1. Accessibility: Comply with ICC A117.1 and ADA Standards.
  - 2. Height: \_\_\_\_ inch (\_\_\_\_ mm).
  - 3. Length: \_\_\_\_ inch (\_\_\_\_ mm).
- B. Locker Bench Support Brackets: Welded structural aluminum single arm floor mount pedestal bench support brackets; pre-drilled for bench top material attachment and for wall anchorage.
  - 1. Accessibility: Comply with ICC A117.1 and ADA Standards.
  - 2. Height: \_\_\_\_ inch (\_\_\_\_ mm).
  - 3. Depth: \_\_\_\_ inch (\_\_\_\_ mm).
  - 4. Load Capacity per Bracket: 400 pounds (181 kg).
  - 5. Finish: Clear anodized.
  - 6. Bracket Spacing: 36 inches on center (914 mm on center), maximum. Project-specific spacing to be determined based on field measurements.
  - 7. Bracket-to-Wall Attachment: Fasteners/anchors recommended by bracket manufacturer for wall construction conditions encountered.
  - 8. Products:
    - a. Rakks/Rangine Corporation; Bench Support Brackets; Model \_\_\_\_ : <http://www.rakks.com/#sle>.
    - b. \_\_\_\_\_.
    - c. \_\_\_\_\_.
    - d. Substitutions: See Section 01 60 00 - Product Requirements.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that prepared bases are in correct position and configuration.

- B. Verify bases and embedded anchors are properly sized.
- C. Verify that power and ethernet are installed and enabled. See manufacturer drawings for recommended outlet or junction box placement.

### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Place and secure on prepared base.
- C. Install lockers plumb and square.
- D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds (445 N).
- E. Bolt adjoining locker units together to provide rigid installation.
- F. Install end panels, filler panels, and sloped tops.
- G. Install fittings if not factory installed.
- H. Replace components that do not operate smoothly.

### **3.3 CLEANING**

- A. Clean locker interiors and exterior surfaces.

**END OF SECTION 10 51 13**

## **SECTION 10 56 13 - METAL STORAGE SHELVING**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Four post shelving.
- B. Case type shelving.
- C. Case type cabinets.
- D. Shelving accessories.

#### **1.2 RELATED REQUIREMENTS**

- A. Section 06 10 00 - Rough Carpentry: Blocking and reinforcement in walls for anchoring shelving units.
- B. Section 09 21 16 - Gypsum Board Assemblies: Blocking and reinforcement in walls for anchoring shelving units.
- C. Section 10 56 26 - Mobile Storage Shelving: Installation of metal storage shelving on mobile carriages.

#### **1.3 REFERENCE STANDARDS**

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

#### **1.4 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Rated uniform shelf loads.
  - 2. Details of shelving assemblies, including reinforcement.
  - 3. Accessories.
  - 4. Substrate preparation instructions and recommendations.
  - 5. Storage and handling requirements and recommendations.
  - 6. Installation methods.
  - 7. Specimen warranty.
  - 8. Maintenance methods.
- C. Test Reports: Provide independent agency test reports documenting compliance with specified structural requirements.
  - 1. In lieu of test reports, detailed drawings stamped and sealed by a Professional Engineer, licensed in the state of Texas, will be acceptable.
- D. Shop Drawings: Indicate location, type, and layout of shelving, including lengths, heights, and aisle layout, and relationship to adjacent construction.
  - 1. Indicate methods of achieving specified anchoring requirements.
- E. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and finishes.
- F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in School District's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for School District's use in maintenance of project.
  - 1. Refer to Section 01 77 00 - Closeout Procedures, for additional provisions.
  - 2. Extra Shelves: Two of each size with shelf brackets.

#### **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

- B. Installer Qualifications: Company specializing in performing the work of this section with minimum \_\_\_\_ years of documented experience and approved by manufacturer.

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

- A. Inspect for dents, scratches, or other damage. Replace damaged units.  
B. Store in manufacturer's unopened packaging until ready for installation.  
C. Store under cover and elevated above grade.

### **1.7 WARRANTY**

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.  
B. Provide one year manufacturer warranty covering defects of manufacturing and workmanship and rust and corrosion.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
1. Four Post Shelving:
  2. Case Type Shelving:
    - a. ASI Storage Solutions: [www.asi-storage.com/#sle](http://www.asi-storage.com/#sle).
    - b. List Industries, Inc; Case Shelving: [www.listindustries.com/#sle](http://www.listindustries.com/#sle).
    - c. Penco Products, Inc: [www.pencoproducts.com/#sle](http://www.pencoproducts.com/#sle).
    - d. SpaceSaver Corporation: [www.spacesaver.com/#sle](http://www.spacesaver.com/#sle).
    - e. Tennsco Storage; Q-Line Shelving: [www.tennsco.com/#sle](http://www.tennsco.com/#sle).
  3. Case Type Shelving Cabinets:
    - a. DeBourgh Manufacturing Co; Industrial Storage Cabinets: [www.debourgh.com/#sle](http://www.debourgh.com/#sle).
    - b. List Industries, Inc; Metal Storage Cabinets: [www.listindustries.com/#sle](http://www.listindustries.com/#sle).
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

### **2.2 SHELVING - GENERAL**

- A. Refer to Drawings for layout and sizes.  
B. Anchors: Provide anchoring hardware to secure each shelving unit to floor and wall.
  1. Provide hardware of type recommended by manufacturer for substrate.
  2. Refer to Drawings for additional details of anchorage.

### **2.3 FOUR POST SHELVING**

- A. Four Post Shelving: Steel post-and-beam or post-and-shelf type with sway bracing, shelving brackets, shelving surfaces, and accessories as specified.
1. Unit Width: \_\_\_\_ inches (\_\_\_\_ mm), center to center of posts.
  2. Shelf Capacity: Uniform distributed load of \_\_\_\_ psf (\_\_\_\_ kPa), minimum.
  3. Shelf Beam Capacity: \_\_\_\_ lbs (\_\_\_\_ kg) per shelving bay.
  4. Shelf Depth: \_\_\_\_ inches (\_\_\_\_ mm), minimum.
  5. Unit Depth: Not more than \_\_\_\_ inch (\_\_\_\_ mm) greater than shelf depth.
  6. Clear Shelf Opening Height: \_\_\_\_ inches (\_\_\_\_ mm), minimum.
  7. Shelves per Unit: \_\_\_\_.
  8. Unit Height: \_\_\_\_ inches (\_\_\_\_ mm), overall, maximum.
  9. Finish: \_\_\_\_\_.
    - a. Color: Manufacturer's standard gray.
    - b. Color: To be selected by Architect from manufacturer's standard range.
  10. Provide single-face and double-face units where indicated.
  11. Number of Units: As indicated on Drawings.

- B. Posts: Formed sheet members; perforations exposed on face of members are not acceptable.
  - 1. Metal Thickness: \_\_ gauge, \_\_ inch (\_\_ mm).
  - 2. Post Shape: \_\_\_\_ intermediate posts, \_\_\_\_ end posts forming corners.
  - 3. Post Face Width: \_\_ inches (\_\_ mm), maximum.
  - 4. Connecting Hardware: \_\_\_\_\_.
  - 5. Post Bases: Flat steel foot plate.
- C. Bracing: Formed sheet members.
  - 1. Back Sway Bracing: \_\_\_\_\_; at back of each unit.
  - 2. Side Sway Bracing: \_\_\_\_\_; at each side of each unit.
  - 3. Refer to Drawings for additional details of bracing.

## 2.4 CASE TYPE SHELVING AND CABINETS

- A. Case Type Shelving: Steel, closed sides and backs, with shelving brackets, shelving surfaces, and accessories as specified.
  - 1. Unit Width: 60 inches (1524 mm), overall.
  - 2. Shelf Capacity: Uniform distributed load of 100 psf (4.8 kPa), minimum.
  - 3. Shelf Deflection: L/140, maximum, under specified uniform load.
  - 4. Adjustability of Shelving: At intervals of 6 inches (150 mm) on center.
  - 5. Shelf Depth: 24 inches (610 mm), minimum.
  - 6. Unit Depth: Not more than 1/2 inch (13 mm) greater than shelf depth.
  - 7. Clear Shelf Opening Height: 12 inches (152 mm), minimum.
  - 8. Shelves per Unit: As indicated on drawings.
  - 9. Unit Height: 84 inches (2134 mm), overall , maximum.
  - 10. Finish: As selected by the Architect from manufacturer's full line.
    - a. Color: As selected by Architect from manufacturer's standard range.
  - 11. Provide single-face and double-face units where indicated.
  - 12. Number of Units: As indicated on Drawings.
- B. Case Construction: Formed sheet metal comprising vertical support members and enclosure panels.
  - 1. Shelf Support Members: \_\_ gauge, \_\_ inch (\_\_ mm), minimum; manufacturer's standard profile.
  - 2. Face Width of Exposed Vertical Supports: \_\_ inches (\_\_ mm), maximum.
  - 3. Panels: \_\_ gauge, \_\_ inch (\_\_ mm), minimum.
  - 4. Provide panels at intermediate divisions as well as ends.
  - 5. Provide canopy tops of same construction as shelves.
  - 6. Connecting Hardware: \_\_\_\_\_.
  - 7. Post Bases: Flat steel foot plate.
- C. Shelves: Formed sheet metal, finished on all surfaces.
  - 1. Thickness: \_\_ gauge, \_\_ inch (\_\_ mm), minimum.
  - 2. Shelf Edge Profile: Extending \_\_ inch (\_\_ mm), maximum, below top surface of shelf.
  - 3. Provide raised edge lip on \_\_\_\_\_; height \_\_ inches (\_\_ mm).
  - 4. Shelf Connection to Posts: \_\_\_\_\_.
- D. Cabinet Doors: Manufacturer's standard welded steel.
  - 1. Style: \_\_\_\_\_.
  - 2. Hinges: \_\_\_\_\_.
  - 3. Handles: \_\_\_\_\_, \_\_\_\_\_.
  - 4. Pulls: \_\_\_\_\_.
  - 5. Locks: \_\_\_\_\_.

## 2.5 ACCESSORIES

- A. Kick Plates: Formed sheet metal; enclose open space between bottom shelf and floor on all front sides and open ends; finished to match.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that substrate is level and that clearances are as specified.
- B. Verify that walls are suitable for shelving attachment.
- C. Do not begin installation until substrates have been properly prepared.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### **3.2 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

#### **3.3 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Anchor and reinforce as specified, as indicated on drawings, and as recommended by manufacturer.
- C. Install shelving with shelf surfaces level and vertical supports plumb; adjust feet and bases as required.
- D. Out-Of-Square Tolerance - Four Post Shelving: Maximum of 1/8 inch (3 mm) difference in distance between bottom shelf and canopy top, measured along any post in any direction.

#### **3.4 CLEANING**

- A. Clean shelving and surrounding area after installation.

#### **3.5 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

**END OF SECTION 10 56 13**

## **SECTION 10 56 17 - WALL-MOUNTED STANDARDS AND SHELVING**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Steel shelf standards, brackets, and accessories.
- B. Closet rods for mounting on brackets.
- C. Shelves.

#### **1.2 RELATED REQUIREMENTS**

- A. Section 06 10 00 - Rough Carpentry: Wood blocking in walls for attachment of standards.
- B. Section 06 20 00 - Finish Carpentry: Wood shelves.
- C. Section 09 21 16 - Gypsum Board Assemblies: Blocking in metal stud walls for attachment of standards.

#### **1.3 REFERENCE STANDARDS**

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
- B. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- C. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- G. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

#### **1.4 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- D. Maintenance Materials: Furnish the following for School District's use in maintenance of project.
  - 1. Refer to Section 01 77 00 - Closeout Procedures for additional provisions.
  - 2. Extra Brackets: Ten of each size of standard straight bracket.

#### **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

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

- A. Store products under cover and elevated above grade.
- B. Store products in manufacturer's unopened packaging until ready for installation.

### **PART 2 PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01

requirements regarding substitutions to be considered.

1. Steel Shelf Standards and Brackets:
    - a. Knappe & Vogt Manufacturing Company; 87™/187™ Series:  
[www.knappeandvogt.com/#sle](http://www.knappeandvogt.com/#sle).
  2. Shelving:
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

## 2.2 COMPONENTS

- A. Steel Shelf Standards, Brackets, and Accessories:
1. Shelf Standard Accessories:
    - a. At shelves indicated as sloping provide adjustable slant brackets.
    - b. Where cornices are indicated as part of shelving provide cornice brackets.
    - c. Where shelves are indicated to be fastened to brackets provide brackets with flanges for screwing into end of shelf, steel shelf rests, or flanged brackets; fasten with screws.
    - d. Provide other accessories as indicated.
  2. Closet Rods: Steel tubing for wall mounting in flange fittings.
    - a. Type: Round stainless steel, standard duty; 1-1/16 inch (27 mm) outside diameter, 0.087 inch (2.21 mm) wall thickness.
    - b. Length: As required for application, up to 12 feet (3655 mm).
    - c. Provide mounting fittings to suit application.
- B. Shelves:
1. Aluminum Shelves: Extruded aluminum sections with textured flat top and bottom ribs; ASTM B221 6063-T5 alloy and temper; finished on all surfaces.
    - a. Shelf Capacity: Uniform distributed load of 50 psf (2.4 kPa), minimum.
    - b. Shelf Deflection: 1/4 inch (6 mm) in 36 inches (914 mm), maximum, under specified uniform load.
    - c. Shelf Thickness: 6/10 inch (15 mm).
    - d. Shelf Length: As indicated on drawings.
    - e. Shelf Depth: 12 inches (305 mm).
    - f. Finish: Clear anodized.
    - g. Accessories: Provide shelf lip brackets, shelf hold-down clips, shelf splines, label holders, shelf end caps, sliding book ends, and shelf bridge clips.
- C. Fasteners: Screws as recommended by manufacturer for intended application or as otherwise required by project conditions. Finish of exposed to view fasteners to match finish of standards and other components.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Mount standards or brackets to solid backing capable of supporting intended loads.
- C. Install brackets, shelving, and accessories.



- D. Provide double sided foam tape between adjoining sections of aluminum shelving to maintain alignment.

**3.4 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION 10 56 17**

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## **SECTION 10 56 26 - MOBILE STORAGE SHELVING**

### **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. Manual mobile storage shelving systems.
  - 2. Mechanically assisted mobile storage shelving systems.
  - 3. Motorized mobile storage shelving systems.
- B. Related Sections:
  - 1. Section 03 30 00 - Cast-in-Place Concrete.
  - 2. Section 10 56 13 - Metal Storage Shelving: Shelving to be mounted on mobile carriages.
  - 3. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
  - 4. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
  - 5. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2023.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

#### **1.4 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
  - 1. System components.
  - 2. Accessories.
  - 3. Substrate preparation instructions and recommendations.
  - 4. Storage and handling requirements and recommendations.
  - 5. Installation methods.
  - 6. Specimen warranty.
- C. Shop Drawings: Indicate location, type, and layout of mobile storage shelving system, including lengths, heights, and aisle layout, and relationship to adjacent construction.
  - 1. Indicate location and configuration of rails.
  - 2. Indicate method of installation and configuration for shelving mounted on carriages.
  - 3. Provide location and details of anchorage devices to be embedded in or fastened to the structure.
  - 4. Motorized Systems: Include plan views indicating locations of system components and proposed size, type, and routing of conduits and/or cables. Include system interconnection schematic diagrams.
- D. Selection Samples: For each finish product specified, provide color chips representing manufacturer's full range of available colors and finishes.
- E. Design Data: Provide design calculations, bearing seal and signature of structural engineer licensed to practice in the State in which the Project is located, showing loads at points of attachment to the building structure.

- F. Test Reports: Provide independent agency test reports documenting compliance with specified structural requirements.
  - 1. In lieu of test reports, detailed drawings stamped and sealed by a Professional Engineer licensed in the State in which the Project is located will be acceptable.
- G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in School District's name and registered with manufacturer.

### **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years of documented experience.
- C. Motorized Systems: Listed by an organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

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

- A. Inspect for dents, scratches, or other damage. Replace damaged components.
- B. Store in manufacturer's unopened packaging until ready for installation.
- C. Store under cover and elevated above grade.

### **1.7 WARRANTY**

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Provide one year manufacturer warranty covering defects of manufacturing and workmanship and rust and corrosion.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures
  - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

### **2.2 MOBILE STORAGE SHELVING SYSTEMS - GENERAL**

- A. System Description: High-density movable shelving system consisting of shelving units mounted on rail-guided wheeled carriages.
  - 1. Carriage Operation: Manual, Mechanically-Assisted, or Motorized, as indicated on Drawings.
  - 2. Carriage Capacity: Refer to Basis of Design product.
  - 3. Rail Mounting: Refer to Shelving System information below.
- B. Accessibility Requirements:
  - 1. Comply with Texas Accessibility Standards (TAS).
- C. Components:
  - 1. Carriages: Rectangular steel frames of type and size required for selected system.
    - a. Finish: Powder coat paint; color to match shelving.
  - 2. Wheels: Cold rolled steel; dual flanged.
  - 3. Rails: Cold rolled steel; type and size to carry loads imposed by system.
  - 4. Subrails: Aluminum; use as required for recessed rails.
  - 5. Anti-Tip Device: Provide manufacturer's standard rail device to prevent tipping of system.
  - 6. Floor Panels: Underlayment grade plywood, 3/4 inch (19 mm) thick.
  - 7. Ramps: Steel; 9 degrees maximum slope.

8. Floor Covering: As indicated on Drawings.
9. Grout: Non-shrink hydraulic type cement.
  - a. Minimum Compressive Strength at 7 Days: 8,000 pounds per square inch (55 MPa) when tested according to ASTM C109/C109M.
- D. Accessories:
  1. Anchors and Leveling Screws: Types and sizes recommended by manufacturer for specified rail mounting and floor system.
  2. Bumpers: Manufacturer's standard rubber stops.
  3. Label Holders: \_\_\_\_\_ type, attached to face panel.

### **2.3 MANUAL MOBILE STORAGE SHELVING SYSTEMS**

- A. Basis of Design:
- B. Control: Pulling or pushing fixed handle glides carriage left or right.

### **2.4 MECHANICALLY-ASSISTED MOBILE STORAGE SHELVING SYSTEMS**

- A. Basis of Design:
- B. Rail Mounting: Recessed in concrete slab with finished floor flush with top of rails.
- C. Drive System: Provide uniform movement of the carriage without drifting or jerking.
  1. Chain and sprocket system with full length torque resistant steel shaft.
  2. Provide two wheels per rail for each carriage, direct-driven on one side.
- D. Control: Three-spoke operating handle with manual locking latch.
  1. Minimum Gear Ratio: 1 lbf (4.4 N) to move a load of 6000 lbs (2722 kgs).
- E. Safety System: Mechanical safety brake at toe level the full length of the carriage. Light pressure of 1.5 lbf (6.7 N) on aluminum bar activates safety mechanism to stop carriage movement.

### **2.5 MOTORIZED MOBILE STORAGE SHELVING SYSTEMS**

- A. Basis of Design:
- B. Rail Mounting: Recessed in concrete slab with finished floor flush with top of rails.
- C. Drive System: Provide uniform movement of the carriage without drifting or jerking.
  1. Chain and sprocket system with full length torque resistant steel shaft connected to gear motor.
  2. Provide two wheels per rail for each carriage, direct-driven on one side.
- D. Motorized Carriage Movement:
  1. Carriage Speed: Programmable, with controlled acceleration and deceleration.
  2. Provide active braking system for halting carriage movement.
  3. Provide photosensors for detection and control of spacing between carriages.
- E. Controls:
  1. Provide user control device on the accessible end(s) of each mobile carriage for initiation of access to selected aisles and indication of system status.
- F. Safety System:
  1. Aisle-Entry Sensors: Provide sensors at accessible end(s) of each mobile carriage for cross-aisle detection of users entering or exiting an aisle.
  2. Inter-Aisle User/Object Detection:
  3. Design system to prevent carriage movement upon system or component failure.
- G. Security Provisions:
  1. Provide restricted PIN-code or password-protected access to system configuration.
- H. Sequence of Operations:
  1. When system status is "Ready to Use", initiation of movement (LEFT/RIGHT) on user controls automatically operates carriages to open selected aisle.

2. When system status is "Aisle in Use", initiation of movement (LEFT/RIGHT) on user controls does not operate carriages.
3. Initiation of STOP on user controls immediately halts any moving carriages.
4. Detection by safety provisions that there are users or objects in the aisle immediately halts any moving carriages and changes system status to "Aisle in Use".
5. Permit automatic reset to "Ready to Use" status upon detection by safety provisions that there are no users or objects in the aisle.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that substrate is in proper condition to install rails and flooring system per manufacturer's requirements.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### **3.2 INSTALLATION**

- A. General: Install system components and accessories in accordance with manufacturer's printed instructions.
- B. Motorized Systems:
  1. Perform work in accordance with NECA 1 and in compliance with NFPA 70 requirements.
  2. Conduit: Comply with Section 26 05 33 - Raceway and Boxes for Electrical Systems.
  3. Provide grounding and bonding in accordance with Section 26 05 26 - Grounding and Bonding for Electrical Systems.
  4. Identify system wiring and components in accordance with Section 26 05 53 - Identification for Electrical Systems.
- C. Position system components level and plumb within manufacturer's specified tolerances.
- D. For recessed rail installation, grout rails the full length of the system.
- E. Maintain a minimum of 1/4 inch (6 mm) of grout between the high points of concrete subfloor and bottom of rails.
- F. Extend rails under stationary shelving units.
- G. Position carriages ensuring wheels align properly on rails. Fasten multiple carriages together forming a single movable base.
- H. Install shelving with shelf surfaces level and vertical supports plumb; fasten to carriage supports with vibration-proof fasteners.

#### **3.3 FIELD QUALITY CONTROL**

- A. Refer to Section 01 40 00 - Quality Requirements for additional requirements.

#### **3.4 ADJUSTING**

- A. Adjust mobile storage shelving components and accessories to provide for smooth operation of system.

#### **3.5 CLEANING**

- A. Clean shelving and surrounding area after installation.

#### **3.6 CLOSEOUT ACTIVITIES**

- A. Refer to Section 01 77 00 - Closeout Procedures for closeout submittals.
- B. Refer to Section 01 79 00 - Demonstration and Training for additional requirements.
- C. Demonstration: Demonstrate proper operation of system to the School District, and correct deficiencies or make adjustments as directed.

- D. Training: Train the School District's personnel on operation, adjustment, and maintenance of system.
  - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
  - 2. Provide minimum of two hours of training.
  - 3. Instructor: Manufacturer's authorized representative.
  - 4. Location: At project site.

### **3.7 PROTECTION**

- A. Protect installed system from subsequent construction operations.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

**END OF SECTION 10 56 26**

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## **SECTION 10 73 16.13 - METAL CANOPIES**

### **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. Freestanding, shop-fabricated metal canopies.
  - 2. Freestanding, shop-fabricated walkway covers.
  - 3. Accessories necessary for a complete application.
- B. Related Sections:
  - 1. Section 03 30 00 - Cast-in-Place Concrete: Concrete footings.

#### **1.3 REFERENCE STANDARDS**

- A. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2016.
- B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- C. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- D. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2021, with Editorial Revision.
- E. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
- F. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- G. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.
- H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- J. ASTM B247 - Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings; 2020.
- K. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2020.
- L. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2020.
- M. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
- N. ASTM E2950 - Standard Specification for Metal Canopy Systems; 2014 (Reapproved 2020).
- O. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2022.
- P. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
- Q. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.

R. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

#### **1.4 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Submit product data sheets, including material descriptions and finishes, and preparation instructions and recommendations.
- C. Shop Drawings: Prior to commencement of fabrication, submit detailed shop drawings, showing profiles, sections of components, finishes, and fastening details.
- D. Design Data: Submit comprehensive structural analysis of design for the specified loads. Stamp and sign calculations by professional engineer.
- E. Designer's Qualification Statement.
- F. Manufacturer's Qualification Statement.
- G. Erector's Qualification Statement.
- H. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- I. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in School District's name and registered with manufacturer.

#### **1.5 QUALITY ASSURANCE**

- A. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
  - 1. Comply with applicable code for submission of design calculations as required for acquiring permits.
  - 2. Cooperate with regulatory agency or authorities having jurisdiction (AHJ), and provide data as requested.
- B. Perform work in accordance with AISC 303.
  - 1. Maintain one copy on site.
- C. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project.
  - 1. Not less than three years of documented experience.
- D. Erector Qualifications: Company specializing in performing the work of this section.
  - 1. Not less than three years of documented experience and approved by canopy manufacturer.
- E. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

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

- A. Deliver materials to project site ready for erection.
- B. Package using methods that prevent damage during shipping and storage on site.
- C. Store materials under cover and elevated above grade.

#### **1.7 WARRANTY**

- A. Refer to Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Metal Canopies: Correct defective work within a two year period after Date of Substantial Completion.
- C. Finish Warranty: Provide manufacturer's one year warranty on factory finish against cracking, peeling, and blistering.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
  - 1. Aluminum Systems:
    - a. Aluminum Techniques, Inc.: [www.aluminumtechniques.com](http://www.aluminumtechniques.com).
    - b. AVAdek, Inc.: [www.avadek.com](http://www.avadek.com).
    - c. Duo-Gard Industries, Inc.: [www.duo-gard.com](http://www.duo-gard.com).
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

### **2.2 SHOP FABRICATED ALUMINUM CANOPIES AND WALKWAY COVERS**

- A. Pre-engineered system complying with ASTM E2950.
- B. Design and fabricate metal canopy system to resist wind loads without failure, damage, or permanent deflection in accordance with ASCE 7:
  - 1. Loads: As indicated on Drawings.
- C. Thermal Movement: Design system to accommodate thermal movement caused by ambient temperature range of 120 degrees F (49 degrees C) and surface temperature range of 180 degrees F (82 degrees C) without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects on assembly components.
- D. Configuration: As indicated on Drawings.

### **2.3 COMPONENTS**

- A. Aluminum:
  - 1. Sheet and Plate: ASTM B209/B209M.
  - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221/ASTM B221M, Alloy 6063-T5/T52.
  - 3. Extruded Structural Pipe and Tubes: ASTM B429/B429M, Alloy 6063-T6.
  - 4. Structural Profiles: ASTM B308/B308M.
  - 5. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.
  - 6. Drawn Seamless Tubing: ASTM B210/B210M, Alloy 6063-T832.
  - 7. Plate and Sheet: ASTM B209/B209M, Alloy 6061-T6.
  - 8. Die and Hand Forgings: ASTM B247/ASTM B247M, Alloy 6061-T6.
  - 9. Castings: ASTM B26/B26M, Alloy A356.0-T6.
- B. Anchor Bolts: ASTM A307 or ASTM A572/A572M, formed with bent shank, assembled with template for casting into concrete.
  - 1. Minimum exposed thread of 7 inches (178 mm) above footing and 23 inch (584 mm) minimum embedment.
  - 2. Provide nuts and washers as required for column leveling and plumbing.
- C. Concrete Footings: Refer to Structural for additional requirements.

### **2.4 SHOP FABRICATION**

- A. Provide a complete system ready for erection at project site.
- B. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.
- C. Perform welding in accordance with AWS D1.1/D1.1M.
- D. Fabricate connections for bolt, nut, and washer connectors.

### **2.5 FINISHES**

- A. Structural Aluminum Components:

## **2.6 ACCESSORIES**

- A. Structural Bolts: ASTM F3125/F3125M, Grade A325, minimum 3/4 inch (19 mm) diameter.
- B. Trim, Closure Pieces, and Flashings: Same material, thickness and finish as sheet metal decking; factory-fabricated to required profiles.
  - 1. Exposed Fasteners: Not permitted.
- C. Grout: ASTM C1107/C1107M; non-shrinking; premixed compound consisting of non-metallic aggregate, cement, water-reducing and plasticizing agents.
- D. Fasteners, Non-Structural: ASTM F593 stainless steel or ASTM A307 carbon steel.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and site area for conditions that might prevent satisfactory installation.
- B. Verify that foundation, electrical utilities, and placed anchors are in correct position.
- C. Verify that bearing surfaces are ready to receive this work.
- D. Do not proceed with installation until all conditions are satisfactory.

### **3.2 INSTALLATION - FRAMING**

- A. Erect framing in accordance with AISC 303.
- B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation.
- C. Set column base plates with non-shrink grout to achieve full plate bearing.
- D. Fasten columns to anchor bolts.
- E. Do not field cut or alter structural members without approval.
- F. After erection, prime welds, abrasions, and surfaces not shop primed.

### **3.3 INSTALLATION - CANOPY COVERING**

- A. Install in accordance with manufacturer's instructions.
- B. Fasten metal decking to steel support members, aligned level and plumb.
- C. Install fascia panels, trim, and flashing.
- D. Separate dissimilar metals using concealed bituminous paint.
- E. Touch-up damaged finish coating using material provided by manufacturer to match original coating.

### **3.4 TOLERANCES**

- A. Maximum Variation from Level: Plus/Minus 1/8 inch (3.175 mm).

### **3.5 CLEANING**

- A. Clean surfaces of dust and debris; follow manufacturer's cleaning instructions for the finish used.

### **3.6 PROTECTION**

- A. Protect canopy after installation to prevent damage due to other work until Date of Substantial Completion.

**END OF SECTION 10 73 16.13**

## **SECTION 11 21 73 - COMMERCIAL LAUNDRY AND DRY CLEANING EQUIPMENT**

### **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: Requirements including but not limited to:
  - 1. Laundry equipment.
  - 2. Appliance coordination including service connections, supply lines, and power.
  - 3. Accessories necessary for a complete installation.

#### **1.3 SUBMITTALS**

- A. Product Data: Technical data including product specifications and installation and maintenance instructions.
- B. Product Certificates: Submit certificate from product manufacturer stating compliance with requirements and intended use of product.
- C. Warranties: Submit manufacturer warranty indicated product is warranted in a light commercial application.
- D. Operation and Maintenance Data: Submit for each residential appliance to include in operation and maintenance manuals.

#### **1.4 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  - 2. UL and NEMA: Provide electrical components required as part of light commercial appliances listed and labeled by UL and complying with applicable NEMA standards.
  - 3. Energy Ratings: Provide energy efficient appliances that carry labels indicating energy cost analysis (estimated annual operating costs) and efficiency information.
  - 4. Accessibility Requirements: Comply with applicable requirements.
    - a. S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
    - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
    - c. Texas Accessibility Standards (TAS) 2012.
- B. Source Limitations: Obtain light commercial appliances from single source and each type of light commercial appliance from single manufacturer.
- C. Pre-Installation Conference: Conduct conference at site.

#### **1.5 WARRANTY**

- A. Warranties: Written warranty signed by manufacturer in which laundry equipment manufacturer agrees to repair or replace appliances or components that fail in materials or workmanship within specified warranty period.
  - 1. Provide appliance and equipment rated for light commercial grade or higher. Residential appliances are not acceptable unless manufacturer specifically warrants residential units in a commercial application and only with Architect's approval.
- B. Clothes Washer: Full warranty, including parts and labor, for onsite service on the product.
  - 1. Warranty Period: Three years from date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.1 LAUNDRY EQUIPMENT**

- A. Product Options: Information on Drawings and in Specifications establishes requirements for product's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
- B. Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
  - 1. Washing Machine:
    - a. Continental.
    - b. General Electric.
    - c. UniMac.
    - d. Speed Queen.
  - 2. Tumble Dryer:
    - a. Continental.
    - b. General Electric.
    - c. UniMac.
    - d. Speed Queen.
  - 3. Laundry Carts:
    - a. Dandux.
- C. Washer-Extractor:
  - 1. Basis of Design: Continental Girbau L1075 Front Loader Washer Extractor.
  - 2. Capacity: 75 lbs (32 kg).
  - 3. Dimensions:
    - a. Width: 43 inches (1093 mm).
    - b. Height: 57 inches (1440 mm).
    - c. Depth: 46 inches (1163mm).
  - 4. Cylinder Diameter: 35.5 inches (900 mm).
  - 5. Cylinder Depth: 20 inches (500 mm).
  - 6. Cylinder Volume: 11.2 cu. ft. (318 liters).
  - 7. Door Opening Size: 21.6 inches (549 mm).
  - 8. Washing Speed (RPM): 40.
  - 9. Spin Speed (RPM): 510.
  - 10. G Force: 131.
  - 11. Water Inlet Connection: 3/4 inch (19 mm).
  - 12. Drain Diameter: 3 inch (76 mm).
  - 13. Water Flow: 16 gallons per minutes (60 liters per minute)
  - 14. Voltage/Hz # of Wire/Phase: 208-240/60/3, 3W+G, 25.
  - 15. Power Consumption: (2.7 kW).
  - 16. Finish: Stainless steel.
- D. Tumble Dryer:
  - 1. Basis of Design: Continental Girbau CG75-85 Pro Series II Commercial Dryer.
  - 2. Capacity: 85 lbs.
  - 3. Drum: Perforated stainless steel.
    - a. Diameter: 37 inches (940 mm).
    - b. Depth: 36 inches (914 m).

- c. Volume: 22.4 cu/ft. (0.638 cu/m).
- 4. Dimensions:
  - a. Width: 38.62 (981 mm).
  - b. Depth: 54.25 (1378 mm).
  - c. Height: 76.62 (1946 mm).
- 5. Motor: 3/4 hp (0.56 kW).
- 6. Door Opening: 26.89 inches (683 mm)
- 7. Exhaust Connection: 8 inches (200 mm).
- 8. Exhaust Air Flow: 750 (354 l/s).
- 9. Controls: Touch pad controls for drying cycle, temperatures, and fabric selectors.
- 10. Features:
  - a. Removable lint filter.
  - b. Electronic temperature and moisture level sensor controls.
  - c. End of cycle signal.
  - d. Interior drum light.
  - e. Self-leveling legs.
  - f. Sensor activated fire extinguishing system.
- 11. Voltage/Hz # of Wire/Phase: 200-208v/60 hz/1.
- 12. Finish: Stainless steel.
- E. Laundry Carts : Ten bushel, yellow glosstex carts.
  - 1. Basis of Design: Dandux Model 40-720CG.
  - 2. Quantity: Three.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine conditions for compliance with requirements for installation tolerances and conditions affecting performance of work. Coordinate installation of equipment, appliances, fixtures, and other items.
  - 1. Examine roughing in for piping systems and verify actual locations of piping connections before equipment installation.
  - 2. Examine electrical circuits and rating and verify locations and sufficient ratings for items requiring electrical power.
  - 3. Examine space to receive items and verify the space is of sufficient size and configuration for items.
- B. Proceed with installation after correcting unsatisfactory conditions.

#### **3.2 INSTALLATION**

- A. Comply with manufacturer's written instructions. Install fixtures level and plumb according to roughing in drawings.
- B. Power Supply: Coordinate power supply, grounding, outlets, and electrical wiring with locations indicated for appliances and equipment.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- D. Utilities: Refer to plumbing and electrical sections for plumbing, venting, and electrical requirements.
- E. Connections and Hook ups: Coordinate location of services.
  - 1. Grounding: Ground equipment in accordance with applicable standards and code requirements.
  - 2. Wiring: Connect wiring in accordance with manufacturer recommendations.
  - 3. Provide necessary electrical outlets.

### **3.3 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections with the assistance of a factory authorized service representative:
  - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturer written recommendations. Certify compliance with each manufacturer appliance performance parameters.
  - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After installation, start units to confirm proper operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- B. An appliance will be considered defective if it does not pass tests and inspections.
- C. Prepare and submit test and inspection reports.
- D. Test each equipment item to verify proper operation. Make necessary adjustments. Replace malfunctioning appliances and components, then retest. Repeat procedure until units operate properly.

### **3.4 CLEANING**

- A. Clean equipment with manufacturers' recommended cleaning methods and materials. After completing installation of equipment and fixtures, inspect exposed finishes and repair damaged finishes. Remove packing materials from site.

### **3.5 PROTECTION**

- A. Provide protective covering for installed appliances. Do not allow use of equipment items for temporary facilities.

**END OF SECTION 11 21 73**



SECTION 11 40 00

FOOD SERVICE EQUIPMENT

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The general provisions of the Contract, including General and Supplementary Conditions and General Documents, apply to the Work specified in this Section.

**1.2 SUMMARY OF THE WORK**

- A. Project Name and Location: Barrientes CTE  
Edinburg ISD
- B. Approval of Working Surface: Any contractor performing work over the work of other contractors shall notify the Architect of any unsatisfactory conditions. The beginning of work by any contractor shall constitute acceptance of the previous work.
- C. Field Verification of All Dimensions: Before ordering any materials or doing any work, field verify all measurements of the building and be responsible for their accuracy. No extras will be allowed for variations from drawings in existing conditions or work performed under this contract. Any discrepancies found shall be submitted to the Architect or Foodservice Design Professionals (FDP) for instructions before proceeding.
- D. Cutting and Patching: No excessive cutting will be permitted, nor shall any structural members be cut without the written approval of the Architect. Each Contractor shall leave all chases and openings straight, true, and of the proper size in their work, as may be necessary for the proper installation of their and other contractors' work. After such work has been installed, the contractor shall carefully fit around, close, repair, patch, and point up the same as directed to the satisfaction of the Architect.
- E. Cooperation: The General Contractor, all other contractors, and all subcontractors shall coordinate their work with all adjacent work and shall cooperate with all other trades to facilitate the general progress of the work. Each trade shall afford all the other trades every reasonable opportunity to install their work and store their material.
- F. Inspection and Tests: The architect, Owner, Foodservice Design Professionals (FDP), and their representative shall always have access to the work, whether in preparation or progress. Provide proper and safe facilities for such access and inspection.
- G. Fees, Permits, and Inspections: Secure and pay fees for all permits, licenses, and inspections as required by all authorities having jurisdiction. Give all notices and comply with all laws, ordinances, codes, rules, regulations, and contract requirements bearing on the work.

**1.3 SCOPE OF WORK**

- A. Include the Work specified, shown, or inferable as part of Food Service Equipment. Portions of this Work may be subcontracted to those qualified to do such work as necessary because of jurisdictional trade agreements and restrictions.
- B. The General Contractor is responsible for Related Work specified in other Sections: i.e., final plumbing, electrical and mechanical connections. The Kitchen Equipment Contractor (KEC) is responsible for all internal connections.

- C. Specifications and drawings have been prepared to form the basis for procurement, erection, start-up, and equipment adjustment in this contract. Plans and specifications shall be considered mutually explanatory. Work required by one, but not by the other, shall be performed as though required by both. Items required by one but not by the other shall be provided as though required by both. Work shall be accomplished as called for in specifications and shown on drawings so that all equipment items shall be entirely functional for the purpose for which they were designed and intended. Provide all necessary material, tools, equipment, and labor required for the complete delivery, un-crating, erection, and installation as designated on the food service equipment plan and, in the specifications, to be made ready for final connection by the appropriate Division contractors. When there is any discrepancy between drawings and specifications, bidders should seek clarification of any discrepancies from the Architect and or Foodservice Design Professionals (FDP) before bidding.
- D. Should the drawings disagree in themselves or the specifications with the drawings (*and clarification was not sought before bidding*), the higher cost, better quality, more stringent, and greater quantity of the work or materials shall be completed without additional costs to the Owner.

#### 1.4 OTHER DIVISIONS/CONTRACTORS RELATED WORK

**A. Division 03 (Concrete) is responsible for but not limited to:**

- 1. Slab depressions reinforced concrete wearing bed at prefabricated walk-in assemblies.
- 2. Concrete or masonry platforms (with a finished top and coved base at the perimeter) for the raised setting of food service equipment.
- 3. Slab depressions to receive stainless steel drain trench liner/grate assemblies (provided under this Section).

**B. Division 09 (Finishes) responsible for but not limited to:**

- 1. Interior finished floor with a coved base at prefabricated walk-in assemblies.

**C. Division 10 (Specialties) responsible for but not limited to:**

- 1. S/S Corner Guards throughout the kitchen (unless specified otherwise).
- 2. Lockers.

**D. Division 22 (Plumbing) is responsible for but not limited to:**

- 1. All connections shall be made in accordance with local codes and national standards, except where plans and specifications exceed those codes and standards.
- 2. Empty PVC and wide-sweep bends for refrigerant piping to beverage lines, Co2 lines, and remote food service equipment refrigeration systems.
- 3. Rough-in and final connection of plumbing systems to food service equipment and between components (including materials and labor). Accessories provided loose with food service equipment by Section 11 40 00 to be field installed by Division 22. This includes but is not limited to the installation of all faucets (water fill faucets, pre-rinse faucets, etc.), hoses, gas disconnects, and drains from the equipment point of connection to building plumbing systems. All drain lines are provided and installed by Div. 22.

- a. Kitchen Equipment Contractor is responsible for providing all faucets (water fill faucets, pre-rinse faucets, etc.), drain fittings, mixing valves, control valves, water pressure regulators, vacuum breakers, and all accessories for equipment specified under 11 40 00. Division 22 is responsible for installation.
4. Indirect drain line runs from the equipment to the nearest drain or floor sink—lines to be type 'K' Copper.
5. If any plumbing accessories or fittings are provided loose with equipment by 11 40 00, Div. 22 is to attach to equipment and provide final connection.
6. Gas Supply Systems with all components and fittings required for a complete system.
7. Water Supply Systems with all components and fittings required for a complete system.
8. Compressed Air Systems with all components and fittings required for a complete system (if required for this project).
9. Piping and Drainage Systems (Sanitary and Grease-laden). **Systems must be cleaned and flushed before the final connection with food service equipment - Critical.**
10. Floor Sinks (Provide and Install). Flange and grates to be flush with the finished floor.
11. Floor Drains (Provide and Install). Flange and grates to be flush with the finished floor.
12. Trench Drains (Provide and Install). Trench Liners provided by 11 40 00. Flange and liners to be flush with the finished floor.
13. Grease Traps as required (Size, Provide, Locate, and Install). Verify with local codes to bypass or pipe through Grease Trap and/or Interceptor.
14. P-Traps as required (including all disposers).
15. Interconnect water through Water Filter (Filter provided by 11 40 00 unless otherwise specified) to equipment.
16. Gas Quick Disconnect Installation (Quick Disconnect provided by 11 40 00).
17. Safety Restraint Cable Installation (Safety Restraint Cable Provided by 11 40 00).
18. Specified couplings and piping to all equipment furnished by 11 40 00.
19. Air Compressors (if required for this project) (Size, Provide, and Install unless otherwise specified).
20. Water Softeners (if required for this project) (Size, Provide, and Install unless otherwise specified).
21. Pressure Boilers (if required for this project) (Size, Provide, and Install unless otherwise specified).
22. Hand Sinks (Provide (unless otherwise specified) and Install). Provide a hot water tempering valve if required. Water temperature to be at least 100 degrees and flow for at least 20 seconds.
23. Ice Bin Drain Insulation (if Ice Machine is provided in this project) (Provide and Install).

24. Unions at disposer solenoid valves (if Disposer is provided in this project) (Provide and Install).
25. Back Flow Prevention as required (Provide and Install - including all disposers). Back-Siphonage shall be installed at all fixtures and equipment where backflow and/or back-siphonage may occur and where a minimum air gap cannot be provided between the water to the fixture or equipment at its flood/level rim. When furnished with equipment, vacuum breakers shall override the above if acceptable with applicable codes. Division 22 is responsible for verifying requirements with local codes.
26. Janitor Sink with Faucet (Provide and Install).
27. Freeze Proof Hose Bibb at the exterior of the building by receiving door (if shown on food service plans) (Provide and Install - unless otherwise specified).
28. Reverse Osmosis Systems (Size, Provide (unless otherwise specified), Locate, and Install).
29. All piping within the counter body or under fabricated counters must be run to a connection point below the counter body by Section 11 40 00—final connection by Division 22.
30. Exhaust Hood condensate drain connections (if Exhaust Hood is provided in this project) (Provide and Install).
31. Interconnection of ½" CW to Pre-Rinse and Disposers cone/body inlets piped through the solenoid and vacuum breaker (if Disposer is provided in this project).
32. Fire System Piping. The exposed piping is to be chrome plated.
33. Pipe ½" cold water to swirl inlets at disposers (if Disposer is provided in this project).
34. Water Treatment for Ice Builders (Non-Chlorinated water with a PH Level of 10 or Higher) and any drains and overflows. Piping from Ice Builders to Tumble Chillers by Div. 23 (if Ice Builders and Tumble Chillers are provided in this project).
35. Refer to Section 2.2 PLUMBING / MECHANICAL REQUIREMENTS for additional information.

**E. Division 23 (Mechanical) responsible for but not limited to:**

1. All connections shall be made following local codes and national standards, except where plans and specifications exceed those codes and standards.
2. Empty EMT Conduit with pull-wire and wide-sweep bends for refrigerant piping to remote food service equipment refrigeration systems.
3. Rough-in and final connection of mechanical systems to food service equipment, walk-in assemblies, and between components (including materials and labor).
4. A mechanical contractor will test and balance rooms and exhaust hoods. **Balance report for food service Exhaust Hoods to be provided to Foodservice Design Professionals (FDP) immediately upon completion (send to Houston.Submittal@fdp.org) and must be submitted with O&M manuals.**

5. Exhaust Hoods, Condensate Hoods, Fire Suppression Systems, connections, and controls (Provide and Install – unless otherwise specified). Provide tempered air at all supply ducts.
  - a. If Exhaust/Condensate Hoods and Fire Suppression Systems are specified under Section 11 40 00, Division 23 is responsible for all Exhaust and Condensate Hood connections (Provide and Install).
6. VFD System and controllers when required by code (Provide and Install).
7. Provide and install all ventilation (direct or indirect), air conditioning, and heating systems (unless otherwise specified).
8. Coordinate Supply and Return ducts above Serving Counters. No cold air is to blow directly on hot food counters or open-air refrigerated merchandisers.
9. Coordinate Supply and Return ducts away from equipment with top-mounted refrigeration. No cold air is to blow directly on compressors.
10. Mechanical Contractor to locate temperature monitors within return ducts.
11. Circulating air above walk-in assemblies (Provide and Install).
12. Circulating air above and in air gaps at warehouse cold storage assemblies (Provide and Install).
13. Water Chillers as required (if equipment is provided in this project) (Provide, Size, and Locate).
14. Piping from Ice Builders to Tumble Chillers (if equipment is provided in this project) (Size, Provide and Install).
15. Refer to Section 2.2 PLUMBING / MECHANICAL REQUIREMENTS for additional information.

**F. Division 26 (Electrical) responsible for but not limited to:**

1. Rough-in and final connection of electrical systems to food service equipment, walk-in assemblies, and between components (including materials and labor). Accessories provided loose with food service equipment by Section 11 40 00 to be field installed by Division 26.
2. Empty EMT Conduit with pull-wire and wide-sweep bends for refrigerant piping to remote food service equipment refrigeration systems.
3. Empty EMT Conduit with pull-wire and wide-sweep bends for interconnect cables between LAN and POS terminals, change-makers, pre-check units, printers, CPUs, etc. Division 26 to verify where the conduit will run for POS System (i.e., Manager's Office or IDF Room).
4. Empty EMT Conduit with pull-wire and wide-sweep bends for fire suppression systems. Interconnect the Fire Protection System to panel box shunt trips and building alarms.
5. Walk-in Assembly Light Fixture Installation (Provided loose by Section 11 40 00) (if Walk-in is provided in this project).

6. Table Limit Switch Installation (Provided loose by Section 11 40 00) (if Dishmachine is provided in this project).
7. Electrical Materials and Devices (Shunt-trip breakers, surge protectors, lighting control devices, conduit, wire, etc.).
8. Switches and Stainless Steel Disconnects as required (Provide, Locate, and Install – to be in an accessible location).
9. Charging Stations for Forklifts, Pallet Stackers, and Pallet Jacks (Size, Provide, Locate, and Install) (if equipment is provided in this project).
10. Interconnection between Condensate Fan and Dishmachine control panel (if equipment is provided in this project).
11. Interconnection between Exhaust Hood fans and switch (if equipment is provided in this project).
12. Interconnection between Exhaust Hood lights and switch (if equipment is provided in this project).
13. Door Heaters, Lights, Coils, and Heated Pressure Relief Ports pre-wired to the junction box at the top of walk-in assemblies (if equipment is provided in this project) provided by Section 11 40 00—final connection by Div. 26.
14. If any electrical accessories, fittings, and cord/plugs are provided loose with equipment by 11 40 00, Div. 26 is to attach to equipment and provide final connection.
15. Provide waterproof receptacles in wet areas.
16. All electrical connections beneath Exhaust Hoods (if equipment is provided in this project) to extend to shunt trip breakers with electrical panel box for shutdown during fire mode.
17. Receptacles will be pre-wired to Junction Box or Load Center for final connection by Division 26.
18. All electrical lighting, power, and distribution systems.
19. Do not interconnect more than three (3) convenience outlets on one (1) breaker.
20. Other than convenience outlets, all electrical connections on food service plans are dedicated breakers.
21. Doorbell at receiving door (Provide and Install –audible throughout Kitchen, Office, and Dry Storage room).
22. Adequate lighting at receiving door.
23. Dedicated circuit for heated drain line connection in Walk-In Freezer (120/1/16.0 Amp) at each coil.
24. (if Walk-in is provided in this project) Provide and install (2) Edwards 860 Series (or equal) red lens, surface-mounted Xenon Emergency Strobe Beacons. One (1) to be located in the Kitchen above Walk-In Freezer door (or Cooler door when Freezer is within Cooler in an 'inline' assembly), and One (1) to be located in the Cafetorium (Coordinate location with Owners). Provide all conduit and wiring required and

interconnect the illuminated Push Button Panic Alarm in the Walk-In Freezer to both Strobe Beacons (**Critical**). Coordinate with Division 27.

25. Electrical contractor to provide conduit with pulled wires prior to installation of equipment.
26. Refer to Section 2.5, ELECTRICAL REQUIREMENTS, for additional information.

**G. Division 27 (Communication) responsible for but not limited to:**

1. Data line coordination for food service equipment.
2. Time clocks as required.
3. Video cameras for learning assistance in food service areas as required (Provide, Locate, and Install).
4. (if Walk-in is provided in this project) (Provide conduit, data line, and interconnect the illuminated Push Button Panic Alarm inside the Walk-In Freezer to the Building Automation System (BAS). When activated, facility personnel are to be notified - coordinate notification requirements with the Owner (**Critical**). Coordinate with Division 26.

**H. Division 28 (Electronic Safety and Security) is responsible for but not limited to:**

1. Security Cameras as required (Provide, Locate, and Install).

**I. General Contractor responsible for but not limited to:**

1. Any wall penetration required for food service equipment utilities. Escutcheon plates or S/S sleeves are to be provided and installed as needed.
2. Bulk Freezer Ventilation Pipe (if Bulk Freezer is provided in this project) (Provide and Install unless otherwise specified).
3. Core drilling for Guide Rails (if Guide Rails are provided in this project).
4. Refrigeration Roof Curbs / Roof Jack (if Refrigeration System is provided in this project and located on the roof).
5. Interior Bollards (if required for this project) – to be epoxy painted per local codes (Provide and Install).
6. Furnish and Install ¾" Plywood blocking in the wall for mounting equipment furnished by Section 11 40 00 as required.
7. Walk-in Depressions (to be dead level) and sand leveling bed (if Walk-in is provided in this project and recess is shown).
8. Structural bracing for Bulk Walk-in Assembly ceiling panels if required.
9. Menu System Video Monitors in Servedy (unless otherwise specified).
10. Structural bracing for Menu System Video Monitors if required.
11. Interior/Exterior refrigeration penetrations and sleeves at building penetrations.

12. DoorScope viewer (peephole) with wide viewing angle at receiving door.
13. Canopy at receiving door. Coordinate height with the height of Receiving Door (8') and the mounting height of Air Screen above the door.
14. Soap and towel dispenser provided by Owner. G.C. is responsible for installation.
15. Washer and Dryer (Provide and Install, unless otherwise specified).
16. Dwarf wall at exposed front/ends of cafeteria serving counters with the finish as selected by the Architect if required in this project).
17. Final cleaning of all equipment before demonstrations.

### 1.5 QUALITY ASSURANCE

- A. In addition to complying with all applicable laws, statutes, building codes, and regulations of public authorities, comply with the following:
  1. National Sanitation Foundation (all equipment to bear label)
  2. National Electric Code
  3. Underwriters' Laboratories, Inc. (all applicable equipment to bear label)
  4. American Gas Association Laboratories
  5. National Fire Protection Association
  6. Americans with Disabilities Act
  7. Food and Drug Administration HAACP Guidelines
  8. International Energy Conservation Code (IECC)
  9. Department of Energy
  10. Environmental Protection Agency
- B. Furnish certification of regularly manufactured equipment listing or classification by Underwriter's Laboratories, Inc. with the initial submittal.
- C. Furnish a list of equipment and components (internal and external) that are not of domestic origin. All equipment and components (internal and external) should be of domestic origin when possible. This information should be provided with the initial submittal.
- D. Projects outside the continental United States shall adhere to all local authorities having jurisdiction over that project.

### 1.6 SUBSTITUTIONS

- A. **The specified equipment items or components are intended to be the basis of the bid. All other brands, including any additional names, which may be listed as "Alternates" or "Approved Equal," must conform with the general and item specifications, warranties, size/dimensions, quality, accessories, function, voltage, horsepower, etc. of the first-named brand and be subject to Paragraph C-03 of this Article.**



- B. Proposed Substitutions:
  - 1. Submitted at least 14 calendar days before Bid Date.
  - 2. Submit proposed substitutions with catalog data and manufacturer's shop details indicating all modifications required to conform with the specified brand.
  - 3. List of deviations must include equipment name, model number, accessories, and features with deviation(s) noted for specified and proposed alternate equipment. Equipment without listed deviation(s) will be considered furnished as specified.
- C. Substitutions with prior approval:
  - 1. Submitted on Bidder's letterhead attached to Proposal Form with individual additive/deductive amounts stipulated and the documentation required in Paragraph B-02.
  - 2. Owner reserves the right to accept or reject any or all substitution proposals before execution of the Contract.
  - 3. Provide all design/engineering services required to adjust in space, systems, utilities, etc., and pay all additional costs of utilities, construction, or professional services that may be incurred due to the acceptance of any substitution.
- D. All appliances or other equipment within a common group or category (e.g., refrigerators, kettles, ovens, shelving, etc.) must be from the same manufacturer.

## 1.7 INTERPRETATION OF DOCUMENTS

- A. During Bidding: Bidder's, supplier's, or vendor's questions and comments about Construction Document's clarity or intent will be addressed by addendum.
- B. After Award:
  - 1. Clarification Bulletin will confirm Construction Document requirements.
  - 2. Request for Information submitted by Contractor shall contain Contractor's proposed resolution.

## 1.8 WARRANTY

- A. Provide a written warranty for parts and labor for one year **from the date of Substantial Completion**, including an extended four-year replacement warranty on compressor bodies.
- B. Components of equipment subject to replacement before one year's use (such as refrigerator door gaskets) and those items which may fail due to improper or inadequate periodic maintenance by the Owner/Operator (such as an uncleaned refrigeration system condenser) are not intended to be included within the scope of the Warranty.
- C. Refrigeration Systems/Equipment: One-year free service available within twenty-four hours of notification.
- D. Furnish three copies of a list of all equipment and their respective local service agencies, indicating the address, telephone number, and name of the person to contact. The service agencies selected shall be factory-authorized for the equipment assigned whenever possible.
- E. Provide the following for refrigeration systems/equipment unless specified otherwise:

1. One (1) year of free refrigeration system service is available within twenty-four hours of notification.
  2. Provide five (5) year manufacturer's registered written replacement warranty certificate covering compressor bodies. Warranty to cover labor costs for the first year.
  3. Provide ten (10) years of the manufacturer's registered written replacement/repair warranty certificate covering walk-in assembly panels. Warranty to cover defects in material and workmanship. Warranty to cover labor costs for the first year.
  4. Provide two (2) year parts and labor warranty for **all parts/components (including third-party components that may be utilized) (including freon)**, walk-in cooler(s), and freezer(s) not otherwise covered herein.
- F. **All above-stated warranty periods are from the date of Substantial Completion.** All replacement parts due to a warranty call should be the same quality as the original, or better if the original were defective. Replacement parts should be of a domestic origin where possible.

## 1.9 SUBMITTAL DATA

- A. **All submittals must be received, reviewed, and approved as noted prior to equipment procurement. If any equipment is procured prior to this process, it is on the KEC to replace any equipment, accessories, or other components that may not meet the specifications or design intent for the facility, including all costs associated with rectifying the errors made procuring the equipment before this critical process.**
- B. Special Requirements: The following are in addition to any general requirements given elsewhere in the Documents.
- C. Submittal Requirements:
1. Kitchen Equipment Contractor to furnish all submittals via PDF, drawings to be scaled per General Specifications and provided in Three (3) submittal packages.
  2. Foodservice Design Professionals requires the below-listed business days for each package submitted. Packages are to be submitted within 14 days between each issued package. Each package should contain individual submittal sets.
    - a. Package One to include (2) Individual sets: 10 Business Days for Review
      - i. Equipment rough-in
      - ii. Equipment Brochure
    - b. Package Two to include (3) Individual sets: 10 Business Days for Review
      - i. Exhaust Hoods
      - ii. Walk-in Cold Storage Assemblies
      - iii. Refrigeration
    - c. Package Three to include (4) Individual sets: 15 Business Days for Review
      - i. Custom Fabrication

- ii. Serving Counters
  - iii. Merchandising Equipment
  - iv. Miscellaneous Submittals
- D. Submittals to be identified with the below-listed file name structure:
  - 1. 11 40 00-1 EQUIPMENT BROCHURE
  - 2. 11 40 00-2 EQUIPMENT ROUGH-IN PLANS
  - 3. 11 40 00-3 CUSTOM FABRICATION
  - 4. 11 40 00-4 SERVING COUNTER
  - 5. 11 40 00-5 EXHAUST HOODS
  - 6. 11 40 00-6 WALK-IN COLD STORAGE ASSEMBLY
  - 7. 11 40 00-7 REFRIGERATION
  - 8. 11 40 00-8 BEVERAGE MERCHANDISER
- E. Package One (1) requires both submittals: Brochure and Rough-in plans. **If not sent together, the submittal will be rejected.**
- F. Foodservice Design Professionals (FDP) will notate all submittals in RED. Architects and General contractors will be notated in color per their direction.
- G. If hard copy submittals are required, Kitchen Equipment Contractor will furnish all copies to the specified trades as required.
- H. If discrepancies, missing information, or incorrect information occur within the documents, Kitchen Equipment Contractor is to seek clarification or note the need for further direction on submittals. The Kitchen Equipment Contractor is to bid the higher of the discrepancies. *Refer to Section 1.3 SCOPE OF WORK: Subsection D.*
- I. Brochure Format (for regularly manufactured equipment and components):
  - 1. Front and rear protective cover with labeled project name.
  - 2. Brochure index: Indicate Functional Area/Room number, item number, quantity, description, and manufacturer.
  - 3. A separate flysheet for each component or item of equipment, indicating item number, name, quantity, manufacturer, optional equipment, modifications, special instructions, and utility requirements. Any equipment or assembly containing more than one buyout sub-assembly or component shall have the second item listed in parenthesis beside the primary item name—for example, Serving Counter (hot food well).
  - 4. Catalog specification sheet with all options notated on the specification sheet and manufacturer's drawing.
- J. Shop Drawings (Rough-In Drawings):

1. Separate drawing sheets: same size as Contract Drawings (Contract Drawings are not to be traced or reproduced). Submittal drawings are to be provided by Kitchen Equipment Contractor and not copied or reproduced from Contract Documents. Any reproduced submittal drawings will be rejected.
  2. ¼" scale drawing of fixed/movable food service equipment and prefabricated Walk-in assemblies with itemized schedules.
  3. Special Conditions Drawings, sizing, and locating the following conditions:
    - a. Slab depressions, cores, sleeves, or block-outs (walk-in assemblies, drain trenches, piping, etc.).
    - b. Concrete or masonry platforms.
    - c. Pipe sleeves or roof jacks.
    - d. Wall openings or block-outs for pass-through equipment, recessed control panels, in-wall fire-protection system components, etc.
    - e. Blocking grounds or anchor plates required in walls for equipment support/attachment.
    - f. Above-ceiling hanger assemblies for support of exhaust hoods, ceiling-mounted pot racks, etc.
    - g. Access panels in walls or ceiling for service of equipment.
    - h. Ceiling pockets or recesses for unusually high equipment.
    - i. In-wall carriers for wall-hung or cantilevered equipment.
  4. Electrical Rough-In Drawing
  5. Plumbing and Mechanical Rough-In Drawing
  6. Required information:
    - a. All fixed and portable food service equipment shown on Contract Drawings.
    - b. All prefabricated Walk-In Assemblies and Conveyor/Dishtable Assemblies shown on Contract Drawings.
    - c. All general-use and convenience utilities or services indicated on Contract Drawings, including those required by or connected to equipment or devices, not in this Section.
    - d. All Rough-In Drawings: Fully dimensioned from engineering benchmark (column lines, when provided) and finished-room surface to the point of stub-up through floor and stub-out through wall or ceiling for all mechanical, electrical, and plumbing services.
    - e. Connection number/tag system and symbols: Identical to Contract Drawings.
- K. Shop Drawings (Manufacturer's and Fabricator's):

1. Sheet Size: Identical to Contract Drawings, drawn or plotted at a ¼" scale for plan view, ½" for elevations, and 1½" for sections and construction details.
  2. Included information: The item number, name, and quantity.
  3. Construction details, sections, and elevations to reflect the requirements of the Specifications and Drawings.
  4. Indicate adjacent walls, columns, and equipment.
  5. Indicate plumbing and electrical schematic drawings for equipment such as conveyors, waste systems, self-cleaning exhaust hoods, exhaust hood fire protection systems, and fabricated fixtures with a single electrical or plumbing connection.
  6. Mechanical or electrical operating components or products integrated into a fabricated fixture: ventilation and service access required or recommended by the manufacturer, including panel size and location to permit easy lubrication, adjustment, or replacement of all moving parts.
- L. All equipment and engineering rough-in plans sheet numbers are to match the contract documents. All equipment item numbers and engineer item numbers located on the schedules are to match the contract documents. All engineering requirements must be updated to accommodate the provided equipment and match the contract documents. The Kitchen Contractor coordinates any MEP revisions to accommodate the supplied and proposed equipment. The Kitchen Equipment Contractor is responsible for any costs associated with equipment substitution.
- M. Foodservice Design Professionals (FDP) drawings and schedules are not to be copied in any way. Any replicated drawings of Foodservice Design Professionals (FDP) will be rejected.

#### **1.10 SERVICE MANUAL**

- A. Three copies bound in 1½" hardback, three-ring binders (as many volumes as required by the scope of the project) with the same data as the brochure after installation (Refer to "Submittal Data"). Provide separate service manuals for each independent area within the project scope (Main Kitchen, Culinary, Concession, etc.).
- B. Each Volume: Section for maintenance of finish materials (e.g., stainless steel, plastic laminates, FRP, Plexiglas, etc.).
- C. Catalog specification sheet and/or manufacturer's shop drawings.
- D. Each Volume: Index of items, manufacturer's operating/maintenance information, replacement parts data, list of all product warranties, and price lists. Provide the name, title, and address of personnel at each respective manufacturer and service personnel to be contacted for spare/replacement parts and service after the warranty period.
- E. To the extent possible, provide two copies of the manufacturer's video instructional cassettes for operating, maintenance, and equipment service.
- F. Internally subdivide binder contents with permanent page dividers, logically organized by equipment item number or manufacturer name, with tab titling printed under reinforced, laminated plastic tabs.
- G. Electronically submitted manuals must follow the formatting requirements listed above.

H. **Service Manual to be provided to the owner before kitchen equipment demonstration.**

**1.11 VERIFICATION AND COORDINATION OF PROJECT / DATA**

- A. Utilities Rough-in Drawings and field verifications are to be completed within four weeks after receipt of notice-to-proceed. Review Contract Drawings and Submittal Data for accuracy and completeness and notify Architect of conflicts and proposed adjustments. Coordinate work with other sub-contractors.
1. KEC to provide on-site field verification of all underground utilities before pouring concrete for capacity and location and coordinate with General Contractor. Submit a review to Architect and General Contractor. If rough-ins need to be relocated, KEC will compensate other trades for the required relocation.
  2. KEC to provide on-site field verification of all other utility connections and locations and coordinate with General Contractor. Submit a review to Architect and General Contractor.
- B. On-Site Inspection Reports
1. Before concrete pour: The Kitchen Equipment Contractor is to submit a copy of the report below to the Architect, General Contractor, and Foodservice Design Professionals (FDP) within 24 hours of the inspection. The form to be submitted is contained within these General Specifications.
  2. Before delivery of equipment: The Kitchen Equipment Contractor is to submit a copy of the report below to the Architect, General Contractor, and Foodservice Design Professionals (FDP) within 24 hours of the inspection. The form to be submitted is contained within these General Specifications.



FOODSERVICE DESIGN PROFESSIONALS

**On - Site Inspection Report**  
**Prior to Delivery of Equipment**

Inspection Date \_\_\_\_\_ Project Name \_\_\_\_\_

Project Location \_\_\_\_\_

Inspector's Name \_\_\_\_\_ Company \_\_\_\_\_

Inspector's Contact Number \_\_\_\_\_ Email \_\_\_\_\_

Architectural Firm \_\_\_\_\_ Project Architect \_\_\_\_\_

Architect's Contact Number \_\_\_\_\_ Email \_\_\_\_\_

General Contractor \_\_\_\_\_ Project Manager \_\_\_\_\_

G.C. Contact Number \_\_\_\_\_ Email \_\_\_\_\_

Food Service Consultant Foodservice Design Professionals, LLC Project Manager \_\_\_\_\_

Contact Number 281.350.2323 Email \_\_\_\_\_

An on-site Inspection to verify the location of INSTALLED utilities was conducted on this date. The following conditions were observed and brought to the attention of the General Contractor. (KEC is to provide a written description and copy of the Utility Plan indicating the corrective action required).

1. What difficulties were encountered?

Inspector's Initials \_\_\_\_\_

**This Inspection Report is the responsibility of the Kitchen Equipment Supplier and the General Contractor. Coordination between the two parties is mandatory.**  
**Neither the Architect nor FDP need to be present at these inspections.**

**EMAIL A COPY OF THIS REPORT AND ANY ADDITIONAL INFORMATION TO THE ARCHITECT, GENERAL CONTRACTOR AND FOODSERVICE DESIGN PROFESSIONALS, LLC.**

- C. Review critical systems/components for application, performance, and capacity and submit calculation worksheets with the initial submission of brochure/rough-in drawings, with all proposed adjustments noted, including:
1. Exhaust hood removal/supply air volume, velocity, static pressure, duct collar sizes, and locations.
  2. Refrigeration Systems (compressor, condenser, and evaporator) capacities/sizes, quantities, and refrigerant piping distances/sizes.
  3. Exhaust Hood Fire Suppression Systems (nozzle locations, air handler, fuel interlocks, piping/distance limitations).
  4. Locations of Vacuum Breakers.
  5. Conformance of Refrigerated Components/Equipment with HACCP Guidelines (e.g., salad/sandwich pans, upright/open refrigerator cabinets, salad bars) with HACCP Guidelines.
  6. Gas and water line sizes and manifold configurations.
  7. Diameter and length of flexible connector lines for fixed/movable gas appliances.
  8. Fabricated Equipment load center panels (individual and total amperage calculations and circuit balance).
  9. ADA compliance of workstations, service positions, passageways, etc.
- D. Ceiling mounted appliances/fixtures: Verify and coordinate dimensions/location of support framing/hangers with the General Contractor—all material and installation below 12'-0" AFF: Section 11 40 00.
- E. Dimension Responsibility: Obtain actual or guaranteed measurements for the proper equipment fit. All dimensions indicated in Contract Documents are approximate and are as accurate as can be determined at the time. Field-check all horizontal/vertical measurements and conditions at the building before fabrication or delivery of equipment and notify the Architect of all conflicts or deviations from the dimensions shown.
- F. Checking Dimensions at Site: Before ordering any materials or doing any work, verify all measurements of the building and be responsible for their correctness. No extras will be allowed for variations from drawings in existing conditions or work performed under this contract. Any discrepancies found shall be submitted to the Architect for instructions before proceeding.
- G. Scheduling to Fit Openings: Should it become necessary to schedule the construction of walls or partitions before delivery of fixed equipment, the equipment must be fabricated for passage through finished openings. Maintain close contact with the project and be cognizant of all conditions, including vertical handling limitations within the building (elevator cabs or openings, stairs, etc.) and possible hoisting requirements. Coordinate all procedures with General Contractor and Project Team.
- H. Refrigerated and Dry Storage Areas: Verify and coordinate dimensions to accommodate scheduled modular shelf sections. Notify Architect of the variance between the Contract Documents and actual conditions.



- I. Color/Pattern Selections: Submit selection samples of solid polymer products, plastic laminate, paint or stain finishes, and vinyl-coated surface material of equipment as selected by the Owner.
- J. Movable Equipment Interface: Rolling stock (pan racks, carts, dollies, dish/tray/rack dispensers) required to fit through or into fixed equipment (roll-in refrigerators, counter bodies, etc.) is to be reviewed and coordinated for compatibility at the time initial of shop drawing submittal. Indicate conflicts and proposed adjustments.
- K. Relocation of Work: Relocate or re-route work as required to coordinate related items free of charge if no extra work is involved.
- L. **Kitchen Equipment Contractor must provide FDP with the food service equipment lump sum pricing (including material and labor) after the contract has been executed and before submittals are provided to FDP. This information is critical to FDP for accounting/billing purposes.**

#### 1.12 EQUIPMENT FURNISHED / INSTALLED BY OTHERS

- A. Obtain and coordinate utility requirements of Owner-Furnished/Owner-Installed (OF/OI) equipment with the building utilities and rough-in drawings/provisions.
- B. Coordinate physical data of OF/OI appliances or equipment and incorporate information into Submittal Drawings. Vendor- or Purveyor-Furnished equipment (e.g., coffee/tea equipment): same as OF/OI.

#### 1.13 WORK INSTALLED BUT FURNISHED BY OTHERS

- A. Coordinate delivery/installation schedule of Owner-Furnished/Contractor-Installed (OF/CI) equipment with the Owner at least ninety (90) days before equipment requirement.
- B. Obtain and coordinate utility requirements of OF/CI equipment with the building utilities and rough-in drawings/provisions.
- C. Receive at the job site and fully incorporate into installation procedures as if furnished under this Section.

### PART 2 - PRODUCTS

#### 2.1 FABRICATED FIXTURES MATERIAL / COMPONENTS

- A. Stainless steel sheets or shapes: 18-8, Type 302, polished to 180 grit No. 4 finish.
  - 1. Stainless steel joints and seams: Heli-arc welded, free of pits and flaws, ground smooth, and polished to a No. 4 finish.
  - 2. The "grain" direction of horizontal stainless-steel surfaces: Longitudinal, including the backsplash. The polishing procedure at right-angle corners of fixtures shall provide a mitered appearance.
- B. Galvanized Iron Sheets: Armco copper bearing Zinc Grip or Zinc Grip/Paint Grip.
  - 1. Galvanized iron joints and seams: Arc-welded, free of pits, flaws, and ground smooth.
  - 2. Galvanized sheets or shapes: Washed with mineral spirits and painted with Rust-Oleum gray semi-gloss enamel.

- C. Sound Deadening: Schnee Butyl Sealant ½” wide rope positioned continuously between all frame members or contact material and underside of stainless-steel surface (sinks, tabletops, food wells, over shelves, and undershelves). Tighten stud bolts for maximum compression of sealant and trim excess.
- D. Plastic Laminates: Color/pattern selected by Architect, in 1/16” thickness for flat surfaces: 1/32” thickness for radiused surfaces. Plastic laminates and adhesives must be NSF-approved (Standard No. 35).
- E. Solid Polymer products: Color/pattern/material selected by Architect in thickness as specified. Solid Polymers and adhesives must be N.S.F. approved (Standard No. 51).
- F. Casters:
  - 1. Fabricated fixtures with “Open Base” construction: Jarvis and Jarvis Model No. 5-405-113P-NSF swivel casters with grease seals on forks and wheels; Zerk fitting in swivel; two casters: Model No. E-75 Verti-Lock brakes. All casters: B-7” rolling bumpers with stainless steel top discs.
- G. Cutting Boards: 1/2” thick Read Products, Inc. “Richlite” cutting board, size as indicated.
- H. Identification Plates, Labels, Tags:
  - 1. Prohibited Information: Names of suppliers, fabricators, and contractors.
  - 2. NSF Labels: Required on all pieces of equipment.
  - 3. Required Information: Function or purpose of controls such as display light switches, food warmer controls, etc.
  - 4. Plate Construction: Engraved phenolic plastic, secured to equipment with epoxy cement or stainless-steel screws. Furnish samples.

## 2.2 PLUMBING / MECHANICAL REQUIREMENTS

- A. Plumbing Fittings and Components: Furnished under this Section as follows:

Note: Fitting and components described in Items 1, 2, 3, 4, and 5 are furnished loose by 11 40 00 for final installation and connection by Division 22.

- 1. Control valves and appliance pressure regulators for water, gas, steam, and vacuum breakers: wherever required on food service equipment (chrome-plated where exposed).
- 2. Faucets and drains with and without connected overflows (unless otherwise indicated) for all sinks.
- 3. Specialty food service water-fill faucets, hose bibbs, or hose assemblies indicated in drawings/specifications.
- 4. Wade Model No. W-10 Shock-Stop shock absorbers for all food service equipment with quick-opening or solenoid-operated water valves.
- 5. T&S HW-6 Series Water Quick Disconnect hose, diameter per water connection size requirements, with safety fitting, w/coiled restraining device, full port ball valve, antimicrobial coating, lifetime warranty.

6. Extensions of indirect waste fittings to open-sight floor sink or floor drains from sinks, under bar equipment, and food-holding components of serving counters (e.g., cold pans, hot food wells, refrigerator/freezer coils not equipped with condensate evaporators) furnished and installed by Division 22. Drains: All drains to be type 'K' Copper – Paint with aluminum paint where exposed. **Div. 22 to ensure a minimum air gap of 1" and not less than twice the effective opening of the indirect waste pipe, per code. Div. 22 to ensure all drain lines are centered over floor sink grate openings and no water splashes on the floor.**
  7. Piping brackets and supports beneath fabricated equipment.
  8. Closed Base Bodies: Removable 18-gauge stainless steel closure panel at plumbing penetrations under the top.
  9. Control valves on Open Base fixtures: Mounted on a 14-gauge stainless steel gusset-shaped panel with h 3½" setback from the countertop edge/rim to the face of the control handle.
  10. Fill hose/faucet at support pedestals or Closed Base Body: Installed in a 15" x 18" x 5" deep recessed mounting panel. Panel bottom: sloped on a 60° angle, with 3/8" stainless steel rod hanger-bracket for the hose.
  11. Provide filtration option as shown on contract documents (a, b, c, or combination thereof):
    - a. In-line Water Filter System:
      - i. Everpure System filters for coffee/tea brewers, icemakers, water chillers, convection steamers, and beverage systems. They should be sized per the manufacturer's recommendation.
    - b. Remote Central Water Filter System.
    - c. Remote and/or In-line Reverse Osmosis system.
- B. Gas-Heated Equipment Fittings and Components: Furnished under this Section as follows:
1. Fixed Equipment: T&S Manufacturer Safe-T-Link "HG-4-SK" Series gas appliance connector: Coated Hose w/NPT Male Ends, Swivel Links, 2-Piece Quick Disconnect, 90° Elbow & Installation Kit. Diameter per fuel volume/connection size requirements. Gas valve diameter size per fuel volume/connection size requirements.
    - a. Restraining device: Heavy duty steel cable, fastened to equipment and walls, 3" to 6" shorter than equipment connector length.
- C. Final Plumbing Connections Provisions:
1. Fabricated equipment containing components, fittings, and devices indicated on food service connection drawings to be connected to the building systems: each component, fitting, or group thereof pre-piped to a utility compartment for final connection by Division 22. Refer to drawings for capacities.
  2. Field-assembled equipment (e.g., prefabricated walk-in assemblies, exhaust hoods, ware wash machines, convection ovens, etc.): plumbing components completely interconnected under this Section for final connection arrangements indicated on Utility Connection Drawings.

3. All plumbing final connection points of equipment shall be tagged, indicating the following:
  - a. Item number
  - b. Name of devices or components
  - c. Type of utility (water, gas, steam, drain, chilled water)
- D. Ducts and Vents:
  1. Exhaust hoods furred-in to ceiling: 2" high duct collar for final connection to the duct system.
  2. Warewash machines equipped with integral vent cowls or extended hoods: furnished with 18-gauge stainless steel seamless duct risers to 6" above the finished ceiling for final connection. The duct: trimmed at the ceiling with a 16-gauge stainless steel angle flange with all corners welded.
- E. Refer to Section 1.4: OTHER DIVISIONS/CONTRACTORS RELATED WORK; Sub Sections E. Plumbing and F. Mechanical for additional information.

### **2.3 FOOD SERVICE EQUIPMENT REFRIGERATION SYSTEMS**

- A. Install complete with all refrigerants, oil, dials, dehydrators, gauges, and controls required for the system's proper operation.
- B. Self-contained or factory-installed compressors: Check and adjust to the proper operating temperature prescribed by FDA/HACCP.

### **2.4 PLUMBING TRIM**

- A. Faucets: Furnished for all sinks or equipment requiring open water supply.
- B. Fill Faucets: Furnished for appliances requiring open water supply.
- C. Drain Fittings: Furnished for all sinks or equipment requiring removal of liquids. Install specified chrome-plated or stainless-steel fittings in die-stamped openings with washers and locknuts. The solder may be used as a sealer but shall not be applied to the top surface of the drain fittings.

### **2.5 ELECTRICAL REQUIREMENTS**

- A. All electrical systems, components, and accessories within the work of this Section: Certified to be in accordance with NEC 70.
- B. Electrical Fittings and Components: Furnished under this Section as follows. Coordinate food service equipment loads, voltage, and phase with the building system and confirm any existing or OF/OI equipment requirements.
- C. Cord and Caps:
  1. Coordinate all food service equipment cord/caps with related receptacles.
  2. All 120, 120/208, and 208 volts "plug-in" equipment shall have Type SO or SJO cord and plug with ground wire fastened to the frame/body of the item.

3. Cord lengths for fixed equipment: Adjusted to eliminate loose-hanging excess.
  4. All non-fixed plug-in “buy-out” equipment: Hubbell configuration and ratings as required.
  5. All mobile electrical support equipment (heated cabinets, dish carts, etc.) and counter appliances mounted on mobile stands (mixers, food cutters, toasters, coffee makers, microwave ovens, etc.): 8'-0" cord length with cord-hanger strap secured to the rear of equipment or mobile stand.
- D. Switches and Controls:
1. Each motor-driven appliance or electrically heated unit: Equipped with a control switch or starter per Underwriters' Laboratories, Inc., with low-voltage and overload protection.
  2. Disposer controls recess-mounted in the wall: External fittings and accessories removed from the enclosure and furnished with 16-gauge stainless steel perimeter angle flange with welded corners. Install control at 4'-0" AFF to the bottom of the enclosure.
  3. Disposer controls recess-mounted in counter-splash risers: External fittings and accessories removed from NEMA 4 enclosure and furnished with 16-gauge stainless steel perimeter angle flange with welded corners. Install control at 3'-0" AFF to the bottom of the enclosure. Provide the panel with a 60" long Seal-Tite electrical conduit from the bottom of the control panel for final field connections under Division 26.
  4. Equipment that is not provided with built-in circuit breakers or fused terminal block and is indicated on Utility Connections Drawings to be directly connected to the building electrical system: a NEMA 4 stainless steel disconnect switch furnished and installed by Division 26.
  5. All remote manual starters, disconnect switches, magnetic contactors or starters, and push-button stations: NEMA Type 4 enclosure; NEMA Type 1 enclosure only when installed in a Closed Base Body.
- E. Heating Elements:
1. Electrically heated equipment: Thermostatic controls.
  2. Water heating equipment: Equipped with positive low water shut-off.
- F. Receptacles and Switches:
1. Receptacles installed in vertical panels of support pedestals or Closed Base Bodies: installed in 12" x 8½" x 3" deep recessed mounting panel sloped at a 60° angle and turned up to the top of the opening.
  2. Pre-wire receptacles in closed base fixtures to a junction box installed within 6" from the bottom of utility or compressor compartments.
  3. Receptacles mounted on Open Base fixtures: Installed on a 12" x 10½" x 4½" deep 14-gauge stainless steel panel with returned ends and sloping recess—secure panel to the underframe of fixture top.
  4. Pre-wire receptacles on open base fixtures to a junction box secured to a leg or mounted on the underside of the lower shelf. Vertical runs of wiring: Made in rigid conduit or within the tubular leg.

5. Receptacles installed in/on-fabricated equipment: Hubbell, Inc. assemblies horizontally mounted in a metal box with stainless steel cover plate.
  6. Switches installed in/on-fabricated equipment: Hubbell, Inc. with metal box and stainless-steel cover plate. Switches: pre-wired to the controlled device and a junction box installed within 6" from the bottom of the utility or compressor compartment. All refrigeration system switches: Installed within the compressor compartment near the door opening.
  7. Load centers installed in/on fabricated equipment to have all fixture components pre-wired to the load center with balanced phase loading. Load center: Ready for final connection by Division 26 and flush-mounted within the utility compartment rear panel, set back 8" from the access door. All breaker/device information will be typewritten on the circuit schedule in the load center door (number corresponding breaker/device) with an enclosed schematic wiring diagram of fixture components.
  8. All receptacles are to be pre-wired to the cord and plug assembly and routed through the over-shelf post at all island equipment locations unless specified otherwise.
- G. Light Fixtures:
1. Light fixtures with lamps installed in/on fabricated or field-assembled equipment: pre-wired to a junction box for final connection (continuous-run fixtures when indicated).
  2. LED Display Light: Install light fixtures full-length of Display Stand and Serving Shelf with stud bolts and pre-wire through support posts to an apron-mounted switch.
  3. Heat Lamps: Installed to the underside of serving shelf assemblies. When multiple 24" heat lamps are specified, provide maximum length heat lamp chassis. Install all switches remotely from lamps.
  4. **Walk-in assembly LED Light Fixtures: Furnished by Section 11 40 00, final installation by Div. 26. All electrical wiring and conduit, provided by Div. 26, electrically connected through the Vapor Proof light fixture base connection, located on the interior door header—all Conduit to be EMT Watertight. Door frame wiring stubs out the top of panels 8" in flexible conduit for final connection by the electrical contractor. All horizontal conduits: below ceiling panels. All lighting fixtures will be wired from inside the assembly—no penetrations through the ceiling panels. Seal-sleeved penetrations are airtight at both sides of the panel. KEC is responsible for verifying that trade contractors seal all penetrations.**
- H. Final Electrical Connection Provisions:
1. Fabricated equipment containing electrically operated components or fittings indicated on Utility Connections Drawings: Direct connected, with each component, fitting, or group pre-wired to a junction box for final connection by Division 26. Refer to drawings for circuit loading.
  2. Fabricated equipment containing electrically operated components and devices indicated: Circuit-breaker load center with each component or device pre-wired to a separate circuit breaker for balanced phase loading and single final connection by Division 26.
  3. Field-assembled equipment (e.g., prefabricated walk-in assemblies, exhaust hoods, ware wash machines, etc.) shall have electrical components completely interconnected

in this Section for final connection arrangements as indicated on Utility Connection Drawings by Division 26.

4. Pre-wire the following groups of walk-in assembly electrical devices to a top-mounted junction box for final connection by Division 26 per compartment grouping (unless otherwise indicated).
  - a. Light fixtures and switches; heated pressure-relief ports.
  - b. Door/jamb heaters.
  - c. Evaporator fans, defrost elements and drain line heaters.
5. All electrical final connection points of equipment shall be tagged, indicating the following:
  - a. Item number.
  - b. Name of devices on the circuit.
  - c. Total electrical load.
  - d. Voltage and phase.
- I. Lamps: in all food service equipment containing light fixtures. Refrigerator or heated cabinets: All exposed LED lamps above or within a food zone: Shat-R-Shield lamps or standard lamps, sleeved with end caps.
- J. Refer to Section 1.4: OTHER DIVISIONS/CONTRACTORS RELATED WORK; Subsection F. Division 26 (Electrical) for additional information.

## **2.6 CUSTOM – FABRICATED / ASSEMBLED UNITS**

- A. Mechanical or electrical operating components or products integrated into a fabricated fixture: Ventilation and service access required or recommended by the manufacturer. The size and placement of the service access panel(s) permit easy lubrication, adjustment, or replacement of all moving parts and are to be indicated on fabrication shop drawings.

## **2.7 BAKER TABLETOPS (Unless specified otherwise)**

- A. 14-gauge 304 S/S top with 2" square turn down at the front, 6" high enclosed splash at two (2) sides and rear. Brace same as "Counter/Tabletops."
- B. 1¼" x 6" high integral coved riser at rear and ends unless indicated otherwise on drawings.
- C. 16-gauge stainless steel flour-trough at free long sides, secured to the underside of the top. Trough: 3" diameter with eased edges/corners.

## **2.8 COUNTER / TABLETOPS**

- A. 14-gauge stainless steel; all free edges turned down 2" with ¾" tight hem at the bottom—free corners: rounded on ¾" radius.
- B. Marine edges: Turned up ½" on 45° angle and turned down 2" with ¾" tight hem at the bottom.

- C. Cafeteria serving countertops at hot food stations: Full-length x 3½" x ½" high raised rail at (customer's) front side with 45° integral turndown to counter surface.
- D. Tops abutting high fixtures or walls: Cove up specified height and slope back 1½" at the top on 45° angle; 2½" slope where piping occurs. Turn down 1" at the rear of the splash and tight ends to the bottom of the top turndown. Secure splash turndown to the wall with a 4" long 14-gauge stainless steel "Z" clip anchored to the wall, 36" OC.
- E. Freestanding tables and all serving counter splash-risers: Turned back at a 90° angle with 1" turndown at the rear.
- F. Brace tops with rigid-welded 1½" x 1½" x 1/8" galvanized steel angle frame at the perimeter with cross bracing 2'-0" OC maximum. Provide 4" x 4" x 12-gauge stainless steel triangular pads where leg gusset welds to frame. Paint the entire frame with Rust-Oleum gray semi-gloss enamel. Angle frames: Secured to the underside of top surfaces with ¼" studs welded 9" OC maximum with chrome-plated washer, lock washer, and cap nut. Studs: Such length that cap nuts can be made up tight, bringing the top down snugly on the angle frame, eliminating all vibrations or "oil-canning."
- G. Tops: 1½" overhang at free sides of underframe or Closed Base Body.
- H. Mockett Model No. SG5-26 chrome-plated/plastic grommet assembly or integrally welded stainless-steel flange or inverted gusset where service utilities or support posts penetrate or abut tops, ground, and polished to match the top. When conditions permit, provide a 1" x 1½" rectangular backsplash opening for service utilities instead of piercing the horizontal surface. Install stainless steel split tubing at the raw edge of the opening.
- I. Extend underbracing members to the wall, turn down 6", and anchor to the wall when specified to be mounted on leg/bracket assembly.
- J. All openings in tops: 3/16" high raised die-formed edges.
- K. All top openings for pans or inserts: 20-gauge stainless steel, watertight liners, 8½" deep, secured to the underside of the countertop.
- L. All "built-in" and "drop-in" counter equipment/appliances to have framing members at the perimeter of the opening.
- M. Scrap Basket: 18-gauge stainless steel construction 6½" x 6½" x 21¾" long. Top of container: 5/8" wide x ¼" high full perimeter flange with ¼" diameter stainless steel rod bail handle. Interior vertical corners coved on ½" radius. Countertop: Fitted with 6¾" square die-stamped opening.

## 2.9 COLD PANS

- A. 14-gauge stainless steel with ¾" coved interior welded integrally to the countertop with a 3/16" raised edge at the perimeter of the opening – depth of cold pan to follow NSF 7 compliance.
- B. Slope bottom to required quantity of Component Hardware Model No. E16-4021 drain fittings at 48" OC maximum. Sleeve through insulation at drain fittings and extend common drain line into utility compartment for indirect waste connection.
- C. ½" OD copper refrigerant lines in a serpentine pattern, 1½" OC flattened for maximum contact. Secure tubing to the underside of ¼" thick aluminum "distribution plate" installed tight to the underside of the frost plate area and apply cold-conductive mastic to all surfaces.



- D. Component Hardware Model No. E16-4021 drain fittings at 48" OC maximum, sleeved through the insulation with common drain line extended into utility compartment.
- E. Heat Cable: Low-wattage, full-perimeter, below countertop at the edge of depression. Secure with "Z" clips, 9" OC, and interwire with compressor switch for simultaneous operation.
- F. Enclose the sides and bottom of pans with an airtight 18-gauge galvanized jacket and pack with 2" fiberglass insulation set in mastic.
- G. Compressor: Size as indicated or required to accommodate the size of the cold pan. Locate the compressor in the compartment below the unit or as shown on the drawings.
- H. Sectional 16-gauge stainless steel perforated false bottom ( $\frac{1}{4}$ " holes, @  $\frac{3}{4}$ " OC). Turn down  $1\frac{1}{2}$ " on all sides, weld corners, and provide finger rings. False bottom sections: 24" long maximum.

## 2.10 DRAWERS

- A. Stainless Steel Liners: Component Hardware Model No. S81-2020C (20" x 20"), easily removable with drawer in the fully extended position.
- B. Drawer Frame: 16-gauge stainless steel flanged out at the top. Weld the frame to a double-panel 16-gauge stainless steel drawer front with full-length recessed pull at the top (similar profile as Garcy Model No. R-1060) with closed ends.
- C. Channel-formed horizontal pull:  $\frac{3}{4}$ " turndown at the front and ends with  $\frac{1}{2}$ " tight hem. The front edge of the pull: flush with the face of the drawer. Recess behind pull: sloped up on a 60° angle, terminating 1" below the bottom edge of pull.
- D. Mount drawer frame on Component Hardware Model No. S52-2020 self-closing slides, with Delrin bearings, full-depth of the fixture. Secure slides to the body or brackets to eliminate lateral movement in the extended position. Refrigerator drawers: Component Hardware Model No. S52-2024 stainless steel slides with Delrin bearings.
- E. Drawer enclosure in an Open Base Fixture: 18-gauge stainless steel flanged out at the top for attachment to the underside of the tabletop. The lower edge of the enclosure is flanged in toward the open bottom. Mount drawer slides to enclosure and brace as required. The face of the enclosure is to be the same length and height of the drawer face. Provide  $\frac{3}{4}$ " deep offset in front of the enclosure and  $2\frac{1}{2}$ " from the underside of the tabletop for a flush-fitting appearance.
- F. Drawer enclosure on freestanding fixture: Full depth of table framing.
- G. Drawer enclosure in a Closed Base Fixture: Completely partitioned from the adjoining area. Drawer front: Flush fitting with the face of the body.
- H. Drawer Liners other than tool/utility: **Bread Drawer:** S/S liner sized to fit drawer; **Refrigerated Drawer:** S/S liner sized to fit drawer.
- I. Cash Drawer: Integral stainless-steel body, 3" deep.

## 2.11 FOOD WELLS (UNLESS SPECIFIED OTHERWISE)

- A. Food Warmer Controls: Remote-mounted in sloping recessed apron panel. The control panel is recessed  $2\frac{1}{2}$ " from the bodyline at the top of the 60° slope and 1" at the lower edge.

Terminate slope angle 2½" below the countertop. Mount panel on concealed piano hinge at bottom edge; secure with screws at upper corners.

- B. Manifold all warmer drains and extend to within the utility compartment for indirect waste connection. Install valve in the drain line and extend handle through compartment door.
- C. Removable 18-gauge stainless steel closure panel at the underside of warmers.
- D. 14-gauge stainless steel plate/utensil shelf full-length of hot food station unless noted otherwise: 10" below countertop x 9" deep, with rear panel covered up to the underside of the countertop; end panels turned up square. Front of shelf: Turned down 1½" and returned under for closure panel attachment.
- E. Food wells: Hatco Model No. HWBIBRT-FULD insulated food warmer (1200 watts, 208 volts, single phase) secured to the underside of 12" x 20" die-stamped countertop openings with thermal breaker mastic rope applied at the perimeter of food well flange.
- F. Soup Warmers: Hatco Model No. HWB-11QTD soup warmer secured to the underside of 11" diameter die stamped countertop opening with thermal breaker mastic rope applied at the perimeter of soup well flange. The maximum allowable temperature of the countertop at the contact surface is: 120°F. Each warmer: Equipped with one 11-quart stainless steel round insert and slotted cover.

## 2.12 SINKS

- A. 14-gauge stainless steel; all interior corners (horizontal/vertical) covered on ¾" radius. 1½" wide double-walled partitions with flat tops between compartments.
- B. Continuous exterior panels of multiple-compartment sinks: 14-gauge stainless steel filler panel welded ground and polished between compartments.
- C. Sinks (with overflow): Score and slope sink bottom ½" to die-stamped opening fitted with Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. 14-gauge stainless steel bracket: Welded to sink bottom for drain stem with 1½" handle clearance.
- D. Where sinks are installed in fixtures with Closed Base Body, provide a Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. (Sinks with dimensions larger than 20" x 20" in Closed Base Body will not have overflow fitting.) 14-gauge stainless steel bracket: welded to sink bottom with T & S Model No. BL-4740-1 guide bushing. Install on shortened drain stem, one T & S Model No. BL-4710-1 remote control stem assembly only (length as required) with Model No. 113-L universal joint and white blank button. Set drain control handle in Cambro Model PSB-6 bowl with bottom omitted (dress raw edge) to permit passage of drain handle—secure bowl in utility compartment door or body panel with clear silicone.
- E. When single-hole deck-mounted faucets are specified, install overflow fitting in the sidewall of the sink compartment and provide ell-fitting in connecting tubing.
- F. Flush Covers when specified: 1/2" thick Read Products, Inc. "Richlite" cutting board, size as indicated. Support clips: ¼" stainless steel rod 2" long, formed at 45° with two ¾" leg ends (¼" long threaded ends). Insert rod clips through tight-clearance holes in the sink, seal watertight, and secure with stainless steel acorn nuts or tack-weld at the exterior of the sink wall. Set support clips ½" below the top. Provide a 14-gauge stainless steel channel or angle support frame to store covers when not in use. Cover holder: Adjacent to sink compartment, below countertop, or under drawer assembly.

### 2.13 TRAY SLIDES (UNLESS OTHERWISE SPECIFIED)

- A. Tray slides: 12" wide, solid 14-gauge stainless steel turned up 2" at the rear behind countertop turndown; turned down 4" at the front and free ends unless otherwise indicated.
- B. Three ¼" high die-formed inverted "V" ridges at 4" OC, 2" from the leading edge, terminating 2" from ends of tray slide with tapered ridge ends.
- C. Ridges formed on radius: Equal-length segments with 2" separation between chords.
- D. Secure tray slides to countertop/body frame, same as "Countertops." Enclose the exposed underside of the tray slide with 18-gauge stainless steel.
- E. When indicated, project tray slides 2" beyond the serving countertop and return the entire width of the serving counter at free ends.
- F. All tray slides are to be provided and mounted per ADA requirements.

### 2.14 DISHTABLES

- A. Soiled/clean dishtable: 14-gauge stainless steel; free edges coved up 3" with 1½" diameter rolled rim and bullnose corners.
- B. Edge of dishtables next to high fixtures or walls: Coved up 10" and sloped back 1½" on 45° angle; 2½" slope where piping occurs. Turn down 1" at the rear of splash and secure to wall with 4" long 14-gauge stainless steel "Z" clips anchored to the wall, @ 36" OC.
- C. Exposed rear splash: 16-gauge stainless steel finish panel from the top of the splash to the bottom edge of the rolled rim with a welded vertical joint at the end. Secure the panel with concealed attachment and install bracing 24" OC.
- D. Cove all interior corners (horizontal/vertical) on ¾" radius and slope tables 1/8" per foot to sinks, scuppers, or ware wash machines, maintaining level crown/splash.
- E. Brace dishtables with 1" x 4" 12-gauge stainless steel channels down the top centerline and between each pair of legs, with closed ends. Bracing: secured to the underside of the dishtable with ¼" studs welded 6" OC maximum, with chrome-plated washer, lock washer, and cap nut. Studs: such length that the cap nuts can be made up tight, bringing the dishtable down on the channel members, eliminating all vibration and "oil-canning."
- F. Integrally welded stainless steel flange or inverted gusset where service utilities or support posts penetrate or abut tops; ground and polished to match the top.
- G. Hose Bibb: Chicago Model No. 305VBRCF; mounted on 12-gauge stainless steel flange or inverted gusset bracket with 3/8" stainless steel rod hose hanger.
- H. Extend underbracing members to the wall, turn down 6", and anchor to the wall when specified to be mounted on leg/bracket assembly.
- I. Paper-Drop Opening: 9" square with 4" integral chute having hemmed bottom edge. Slope dishtable top 1" toward the opening, forming a 16" square tapered deposit point.
- J. Accessible Tray-Drop Opening: 10" x 18" with integral 16-gauge stainless steel seamless chute sloped at 45° angle toward the center of mobile soak sink position.

- K. All dishtables with a Conveyor Type Dishmachine must have a table limit switch provided by Manufacturer and installed by Division 26. Wiring must be concealed within dishtable fabrication.

## 2.15 DISH / TRAY DEPOSIT ASSEMBLY

- A. 14-gauge stainless steel deposit shelf, size as indicated. Extend the frame through the opening, flush with the public side of the partition, height as local code authorities require. Turn the shelf down 1" at the front with  $\frac{3}{4}$ " return at the bottom (either scribed into a partition or forming reveal). Shelf: 1" square turndown at the long rear side, integral with conveyor slider pan, tray-accumulator, or dishtable. Extend the rear/end splash to align with the head of the deposit station opening. Modify rolled rim at the operator's side of the tray drop window to have a 3" rolled rim.
- B. 18-gauge stainless steel window frame with perimeter flange channel-formed 1" x  $\frac{3}{4}$ " at both wall sides. Weld all corners of the frame and install with concealed attachment. Align/about one jamb of the frame with end splash of conveyor slider pan or dishtable whenever adjacent.

## 2.16 UTENSIL – WASH COUNTERS

- A. 14-gauge stainless steel; all free edges coved up 3" with 1 $\frac{1}{2}$ " diameter rolled rim and bullnose corners.
- B. Edges of utensil-wash counters next to high fixtures or walls: Coved up 10" and sloped back 1 $\frac{1}{2}$ " on 45° angle; 2 $\frac{1}{2}$ " slope where piping occurs. Turn down 1" at the rear of splash and secure backsplash to the wall with 4" long 14-gauge stainless steel "Z" clip anchored to wall @ 36" OC. Vacuum breaker pockets: 4" long square turnback sections aligned with the slope break line.
- C. Exposed Rear Splash: 16-gauge stainless steel finished panel from the top of the splash to the bottom edge of the rolled rim with a welded vertical joint at the end of the splash and  $\frac{1}{2}$ " turnback at the bottom of the panel. Secure the panel with concealed attachment and install bracing 24" OC.
- D. Cove all interior corners (horizontal/vertical) on  $\frac{3}{4}$ " radius and slope tables 1/8" per foot, maintaining level crown.
- E. Brace utensil-wash counters with 1" x 4" 12-gauge stainless steel channels down the centerline of the top and between each pair of legs, with closed ends. Bracing: Secured to underside of dishtable with  $\frac{1}{4}$ " studs welded 6" OC. maximum, with a chrome-plated washer, lock washer, and cap nut. Studs: Such length that the cap nuts can be made up tight, bringing the dishtable down on the channel members, eliminating all vibration and "oil-canning."
- F. Integrally welded stainless steel flange or inverted gusset where service utilities or support posts penetrate or abut tops: ground and polished to match the top.
- G. Extend underbracing members to the wall, turn down 6", and anchor to the wall when specified to be mounted on a leg/bracket assembly.
- H. Hose Bibb: Chicago Model No. 305VBRCF; mounted on 12-gauge stainless steel flange or inverted gusset bracket with 3/8" stainless steel rod hose hanger.

## 2.17 DOORS

- A. 18-gauge x 1" stainless steel double pan-formed welded construction, insulated with 1" thick polyurethane boards. Seal the perimeter joint of the pans. Offset the lower horizontal framing member of the Closed Base Body to align the flush access door with the bottom of the Body.
- B. Channel-formed full-length horizontal recessed pull:  $\frac{3}{4}$ " turndown at the front and ends with  $\frac{1}{2}$ " tight hem. The front edge of the pull: Flush with the face of the door. Recess behind pull: Sloped up on a 60° angle and terminated 1" below the bottom edge of pull.
- C. Door Hardware
  - 1. Two Component Hardware Model No. M75-1002 stainless steel hinges (notch door/jamb at hinge location).
  - 2. Component Hardware Model No. 35-2000 Concealed Magnetic Catch.
  - 3. Component Hardware Model No. D30-4780 lock in the upper free corner of the door.
- D. Louvered opening: Cut-out opening size as indicated, turn in 1", and weld. All corners: Ground and polished.
  - 1. Full-height 18-gauge stainless steel louver with 1" vanes at 45°,  $\frac{1}{2}$ " spacing. Perimeter channel-formed frame:  $1\frac{1}{2}$ " x 1".
  - 2. 45° x 1" x  $\frac{1}{2}$ " x opening width plus  $\frac{1}{2}$ " 18-gauge stainless steel louver.
  - 3. Tack the louver flange's weld tab to the door's back panel.
- E. Drain handles opening: 6" diameter hole through the double pan to accommodate Cambro Model No. PSB-6 Bowl:
  - 1. Secure the bowl to the door panel with clear silicone.
  - 2. Omit the bottom of the bowl. Dress raw edges of opening for passage of drain handle.
  - 3. Exposed insulation at the penetration of the door pan: Painted black.
- F. Sliding Doors: fabricate same as Paragraph "A."
  - 1. Aluminum Sliding Door Track: Component Hardware Model No. B57-0000 Series, length as required. Secure to angle frame at the top of the underside.
  - 2. Front/rear door sheaves: Stainless steel  $\frac{3}{4}$ " side-mounted door hangers; two (2) required per door.
  - 3. Recessed Vertical Pull at Upper Corner of Door: Component Hardware Model No. P63-1012.
  - 4. By-Passing Door Guides secured to bottom shelf: Component Hardware Model No. B62-1093.
  - 5. Door Stop at the bottom edge of door: Component Hardware Model No. B60-1086.
- G. Offset the lower horizontal framing member of the Closed Base Body/utility compressor compartment to align the door flush with the bottom of the Body.

## 2.18 CLOSED BASE BODIES

- A. Frame: Rigid-welded 1½" x 1½" x 1/8" galvanized steel angle forming a continuous structure around the top and bottom perimeters of the fixture, a post at each corner, studs spaced 48" OC maximum. The top of the frame is cross-braced with 1½" angles, 2'-0" OC maximum.
- B. 18-gauge stainless steel panels and trim with concealed attachment. All seams: Welded, ground, and polished.
- C. Exposed Vertical Corners: Rounded on ¾" radius. Closed Base Bodies adjacent to walls or fixtures: square corners.
- D. Vertical and horizontal channel members at shelf interior or drawer enclosures, such as corners and center mullions: Closed and sealed.
- E. Closed Base Bodies set on finished masonry platforms: closed and caulked at the underside of equipment overhang and bolted to the platform. Body overhang of the platform: 1" at free ends and 2" at the front and exposed rear sides.
- F. Closed Base Bodies not set on the platform: Component Hardware Model No. A54-2-6, 6" legs spaced 4'-0" OC maximum.

## **2.19 COMPRESSOR COMPARTMENTS**

- A. Same material as Closed Base Bodies with back and end partitions; omit bottoms only.
- B. 10-gauge steel slide-out support: Channel frame on full extension slides with 125 lb. minimum capacity secured to fixture frame with anti-vibration mountings for maximum sound deadening. Closed Base Body on the solid platform: front-to-back slide-out support channels set 4" above the bottom for air circulation.
- C. Access Door: 18-gauge stainless steel double-pan type with a channel formed horizontal recessed pull full length of the top (similar profile as Garcy Model No. R-1060) with closed ends. Channel-formed horizontal pull: ¾" turndown at front and face of the door. Recess behind pull slopes up on a 60° angle, terminating 1" below the bottom edge of pull. Offset the lower horizontal framing member of the Closed Base Body to align the flush access door with the bottom of the body. Door hardware: two Component Hardware Model No. M75-1002 stainless steel hinges (notch door/jamb at hinge locations) and Component Hardware Model No. 35-2000 concealed magnetic catch.
- D. Access Doors Louver: Full-height, with 1½" x 1" x 18-gauge stainless steel channel-formed frame with welded corners. 18-gauge stainless steel louver. Submit a sample of the design for approval.

## **2.20 UTILITY COMPARTMENTS**

- A. Closed Base Bodies or Pedestal Supports: Fitted with utility compartments wherever piping or wiring is required in/on the fixture.
- B. Same material as Closed Base Bodies with full-height back and end partitions. Omit bottoms except at hose-reel locations.
- C. Access Doors: 18-gauge stainless steel double-pan type with a channel formed horizontal recessed pull full-length of the top (similar profile to Garcy Model No. R-1060) with closed ends. Channel-formed horizontal pull: ¾" turn down at the front of the door, a recess behind the pull slopes up on a 60° angle, terminating 1" below the bottom edge of the pull. Offset the lower horizontal framing member of the Closed Base Fixture to permit flush alignment of the

door with the face and bottom edge of the body. Door hardware: two Component Hardware Model No. M75-1002 stainless steel hinges (notch door/jamb at hinge locations) and one Component Hardware Model No. 35-2000 concealed magnetic catch.

- D. No shelves of Closed Base Fixtures are to be penetrated.

## 2.21 UTENSIL RACKS

- A. Rack:  $\frac{1}{4}$ " x 2" 300 series stainless steel flat bar with No. 4 finish, fully welded and formed to match the shape shown on drawings. Lowest band - 7'-6" AFF unless otherwise indicated.
- B. Ceiling Mount Supports 1-5/8" diameter 16-gauge stainless steel tubing from band to 18" above the ceiling. Anti-sway bracing above the ceiling - 1 $\frac{1}{2}$ " Unistrut members. Tubing penetrations at the ceiling - Component Hardware Model No. A16-0206 stainless steel gussets.
- C. Table Mount Supports 1-5/8" diameter 16-gauge stainless steel tubing extended through countertop. Secure to closed base framing or cross rail/undershelf on the open base fixture. Tubing penetrations of countertops - integrally welded stainless steel inverted gusset.
- D. Utensil Rack Hooks - Component Hardware Model No. J77-4401 stainless steel hooks spaced 8" OC maximum.
- E. Electrical Receptacle: NEMA No. 5-20-R or as noted. Mount in fully welded 3 $\frac{1}{2}$ " x 5 $\frac{1}{2}$ " x 3" 14-gauge stainless steel enclosure with  $\frac{1}{2}$ " radius corners. Stainless steel cover plate to fit specified receptacle. Pre-wire through tubular support for final connection above the ceiling by Division 26.

## 2.22 CASHIER / SERVING COUNTERS

- A. Exterior Body Panels, when specified:  $\frac{3}{4}$ " thick marine grade hardwood plywood with plastic laminate or solid polymer in Architect's selection of color/pattern at all exposed surfaces; backing sheet where concealed.
- B. Position, size, and finish horizontal or vertical reveal as Architect directs.
- C. Secure panels to counter body framing in a concealed manner. Install removable panels with "Z" clips overlapping body framing members.
- D. Hinged doors in exterior body panel(s) - Grass Model No. 1200VZ or 1200VZ8 self-closing hinges. Three (3) required per door; Grass Model No. G/HRZ base plate at each hinge; Ives Model No. TM820 concealed push latch at each door. Confirm Model No. and provide samples with the submittal.
- E. Cashier counter to have 16-gauge s/s intermediate shelf, turned down 1 1/2" with tight hem at front. Cove up 2" at rear and sides. Brace undershelf with 1" x 4" 14-gauge stainless steel channel at the longitudinal centerline. Provide an outlet for power/data within the body above the intermediate shelf. Provide cash drawer inserts per district standards.
- F. Sneeze Guards to be adjustable and meet NSF standards.

## 2.23 OPEN BASE STRUCTURES

- A. 1-5/8" OD x 16-gauge seamless stainless-steel tubing legs beveled at the bottom. 1¼" OD cross rails fully welded (360° smooth and polished) to legs at 10" AFF, OC.
- B. Top of Leg: Inserted in Component Hardware Model No. A20-0206 gusset fully welded to table frame or sink bottom.
- C. Bullet Foot: Component Hardware Model No. A10-0851.
- D. Freestanding fixtures requiring utility connections: Component Hardware Model No. A10-0854 flanged feet at the fixture corners, anchored to the floor with non-corrosive bolts.
- E. Table Bases: Maximum leg spacing of 6'-0" OC; dishtable and utensil wash counter bases at 5'-0" OC.
- F. Open Base equipment specified to be supported by brackets at the rear side only (not completely cantilevered): Tubular legs at the front side only with Component Hardware Model No. A10-0854 flanged feet anchored to the floor with non-corrosive bolts. Front-to-back cross rail: fitted into Component Hardware Model No. A20-0406 circular gusset secured to the wall with non-corrosive bolts.

## 2.24 UNDER SHELVES

- A. Open Base Structures: 16-gauge stainless steel turned down 1½" with tight hem at the bottom. Notch all corners to fit tubular legs and weld from the underside to fill the gap, grind, and polish. Cove up 2" at the rear or ends adjacent to wall, columns, refrigerators, etc. The turn-up at freestanding fixtures is to be hemmed tight to the bottom of the turndown. Brace undershelf with 1" x 4" 14-gauge stainless steel channel at the longitudinal centerline and each intermediate pair of legs.
- B. Open Base Structure specified to be supported by brackets at the rear side only (not completely cantilevered): 16-gauge stainless steel turned down 1 ½" at free sides with tight hem at the bottom edge. Notch all corners to fit tubular legs as required and weld from the underside to fill the gap, grind, and polish. Cove up 2" at rear ends, as indicated. Fill the gap at the front-to-back rail, grind, and polish. Brace undershelf with 1" x 4" x 1" 14-gauge stainless steel channel at longitudinal centerline between front to back rails.
- C. Closed Base Fixtures: 16-gauge stainless steel turned down 1½" at front. Front edge of bottom shelf: Turned back and sealed to finished masonry platform or boxed for leg application. Center shelf has ¾" tight hem.
  - 1. Shelves: Turn up square at ends (coved up at rear only) to the shelf above or countertop flanged out for attachment with no open spaces at interior.
  - 2. All shelf partitions at exposed ends of cabinet bodies or interiors: Free of exposed framing members.
  - 3. Reinforce shelves with full-length 1" x 4" x 14-gauge stainless steel closed hat channel.
  - 4. Unless otherwise noted, all closed base undershelves must be 22" deep and clear.
  - 5. Fully weld smooth and polish the vertical seam of the shelf turndown/turn up with the face of the body partition.
  - 6. Seal the vertical seam of the square turn-in at the exposed interior of open shelf sections.



## 2.25 ANCHOR PLATES / WOOD GROUNDS

- A. Behind the finished surface, wherever building walls, partitions, or ceiling construction will not accommodate direct attachment of equipment such as over shelves, wall cabinets, hose reels, utensil racks, exhaust hoods, display cases, etc. Material and installation by General Contractor. Location and coordination with trades by Section 11 40 00.
- B. Anchor Plates: Not less than 12" x 12" x ¼" thick steel, secured to the structure above or behind the finished surface, positioned at attachment points.
- C. Wood Grounds: Length required by fixture, component, or device, 24" wide x ¾" thick plywood secured to partition system before gypsum board installation.
- D. Above ceiling supports: Structural shapes (4" x 8.0 lb. channel) suspended from the structure. Maximum height 15'-0" AFF. Size: width of equipment x length of equipment plus 6'-0". Cross bracing at 6'-0" OC maximum.

## 2.26 OVER SHELVES

- A. 16-gauge stainless steel with free edges turned down 1" with ½" tight hem at the bottom—¾" radius at free corners.
- B. Turn up 2" raw at walls and sides with a horizontal coved corner at the rear. Round front corners of turn up on ¾" radius.
- C. Where shelf width exceeds 12" width, reinforce with ½" x 4" x 14-gauge stainless steel closed hat channel full-length of the shelf.
- D. Wall-Mounted Shelves: 16-gauge stainless steel brackets 48" OC maximum, set in 6" from ends.
- E. Freestanding Shelves: Where splash is required at free over shelves, turn up square 2" at ends, cove up at the rear, and hem tight to lower edge of front turndown. Weld exposed corners.
  - 1. Freestanding over shelves: 16-gauge stainless steel cantilevered brackets at the rear of the table; double-cantilevered brackets at the center of the table. Posts for cantilevered over shelves are 1-5/8" OD x 16-gauge stainless steel secured to the underframe, 4'-0" OC. Ends of shelves: Secured to adjacent wall/fixture or mounted on 1¼" diameter stainless steel posts.
  - 2. Freestanding over shelves not on cantilevered brackets: 1¼" OD x 16-gauge stainless steel posts, each pair at 4'-0" OC maximum.
- F. Baker Table Over shelves: Supported 18" above the top with 1¼" OD stainless steel tubular supports with channel shoe secured to risers.
- G. Glass/Cup Rack Over shelf at Dishtables: 14-gauge stainless steel with 1½" deep "vee" trough at free long sides with 1" tight hem inside the trough. Provide a ½" marine edge at free ends and; a 4" splash at the wall. Suspend shelf at 18" above dishtable surface on posts/brackets anchored to dishtable frame/wall at rear; 1" OD stainless steel tubing supports from the structure above the ceiling at front edge, 60" OC at each end.
  - 1. Install at both ends a ½" stainless steel drain tube (connecting both vee-troughs) extended to the dishtable surface through splash turnback.

2. Rack-rest: horizontal full-length 1-5/8" OD stainless steel tubing supported at 10" OC above shelf (8" OC for double service shelf) by 1 1/4" OD stainless steel tubing with closed ends. Support tubing: welded, ground, and polished, spaced 60" OC.
3. Rack-rest supports to wall: 4" x 4" x 10-gauge stainless steel flange plates welded to support tubing. Anchor flanged plates to blocking ground with non-corrosive bolts.

## **2.27 DRAIN TRENCH LINER / GRATING**

- A. Liners: 14-gauge stainless steel in sizes as indicated.
- B. Interior of liners: 6" deep with all interior corners (horizontal/vertical) covered on 3/4" radius; sloped and scored 1" to integrally welded Component Hardware Model No. D34-Y011 basket drain assemblies @ 48" OC, fitted with 6" long welded tailpiece. Stainless steel safety chain: connected to basket strainer assembly and top of liner wall.
- C. Liners: 1" wide perimeter shoulder at the top, turned up flush with finished floor, tight hemmed back down to the shoulder level, and flanged out 2" for attachment to the slab.
- D. Underside of sloping liner portion: 2" long "Z" clips.
- E. Grating: IMC-TEDDY PFG-ADA removable fiberglass grating:
  1. 1" deep "I" bearing bars with 0.6" wide top flange.
  2. Full perimeter frame, section quantities, and sizes indicated.
  3. Maximum of 2'-0" sections.
  4. Grating bars should be spaced 0.4" apart per ADA requirements.
  5. Grating to be two (2) equal sizes.

## **2.28 WALL PANELS**

- A. Wall Panels: 18-gauge stainless steel, double pan-formed 1/2" thick with internal stiffener members. Fill with USDA-approved thermal insulation, full height, and width of panels, and attach to the interior with mastic. The maximum allowable temperature at the rear side of the panel: is 120°F.
  1. Height of panels as required: Top of tile base to the underside of the hood, top of tile base to the top cap of stub wall, or top of splash to the underside of the hood.
  2. Level and square lower edge and sides.
  3. Butt joints on all panels.

## **2.29 HIGHLIGHTING**

- A. Polish the following vertical surfaces to a No. 8 finish:
  1. Serving and display shelf turndowns.
  2. Conveyor and dish/tray deposit station turndowns/frame.

3. Tray slide turndowns.

### 2.30 SHOP / FIELD JOINTS

- A. Field joints: The least number is used only when equipment size must be limited for building or interior space access.
- B. Stainless steel tops (including edges and splashes): Fully welded, ground, and polished to match adjacent surfaces.
- C. Vertical field joints of fixture backsplashes that are inaccessible from the back: terminate 1" above the horizontal coved corner. The remaining height of the field joint: hairline butt joint with offset draw-angle behind. All horizontal/vertical draw joints: located and noted on shop drawings.
- D. Hairline butt joint: 1½" x 1½" x 1/8" steel angles welded to the back/underside of countertop/shelf. Offset angle beyond joining metal edge ½" (min.) to provide a flat backing surface for a joint with the angle of other joining metal edge, set for ½" space between vertical legs of angles. Bolt sections together with 5/16" machine bolts, lock washers, acorn head cap nuts, set 3" OC.
- E. Closed Base Bodies: Draw-type with hairline seam fully field-welded.
- F. Millwork: Plastic laminated joints shall be dowelled, glued, and draw-bolted with fasteners.
- G. Solid Polymer: Surfaces drawn tight, filled, sanded, and finished to match adjacent surfaces.

### 2.31 PRE-APPROVED KITCHEN EQUIPMENT CONTRACTORS

- A. Only the following named Subcontractors and those approved later, if any, are approved for inclusion in the Contractor's Bid.
- B. **Any contractor requesting inclusion within this bid must submit AIA form 305 a minimum of 14 days before the bid date for review or as required by Architect.**
  1. Stafford Smith, Mr. JP Garcia, 7129 North Loop East, Houston, TX 77028, Phone: 713.892.5001, Email: [jpgarcia@staffordsmith.com](mailto:jpgarcia@staffordsmith.com)
  2. Texas Metal Equipment Company, Mr. Andrew Harman, 6707 Mayard, Houston, Texas 77041, Phone: 713.466.8722, Email: [aharman@txmetalequip.com](mailto:aharman@txmetalequip.com)
  3. Kirby Restaurant Supply, Mr. Brian Kernan, 809 S. Eastman Road, Longview, Texas 75602, Phone: 903.757.2723, Email: [briank@kirbysupply.com](mailto:briank@kirbysupply.com)
  4. Mission Restaurant Supply, Mr. Brian Mosher, 1126 S. St. Mary's Street, San Antonio, Texas 78210, Phone: 210.354.0690, Email: [brianM@missionrs.com](mailto:brianM@missionrs.com)
  5. Kommercial Kitchens, Mr. Terry Woodard, 13544 East Fwy., Houston, TX 77015, Phone: 409.769.1199, Email: [terry@kommercialkitchens.com](mailto:terry@kommercialkitchens.com)
  6. Supreme Fixtures Co., Inc., Mr. Tim Hampel, 11900 Vinny Ridge Road, P.O. Box 193655, Little Rock, AR 72219, Phone: 501.455.2552, Email: [tim@supremefixture.com](mailto:tim@supremefixture.com)

7. Amundsen Commercial Kitchens, Mr. Lewis Beville, 105 Montie, Longview, TX 75604, Phone: 903.576.6354, E-mail: [lewis@afeok.com](mailto:lewis@afeok.com)

## 2.32 PRE-APPROVED STAINLESS-STEEL FABRICATION SUPPLIERS

- A. Only the following named Subcontractors and those approved later, if any, are approved for inclusion in the Contractor's Bid. Pre-approved fabricators shown below shall not sub-out fabrication.
- B. **Any supplier requesting inclusion within this bid must submit AIA form 305 at least 14 days before the bid date for review or as required by Architect.**
  1. Texas Metal Equipment Company, Mr. Andrew Harman, 6707 Mayard, Houston, Texas 77041, Phone: 713.466.8722, Email: [aharman@txmetalequip.com](mailto:aharman@txmetalequip.com)
  2. Kommercial Kitchens, Mr. Terry Woodard, 13544 East Fwy., Houston, TX 77015, Phone: 832.767.5287, Email: [terry@kommercialkitchens.com](mailto:terry@kommercialkitchens.com)
  3. Mission Restaurant Supply, Mr. Brian Mosher, 1126 S. St. Mary's Street, San Antonio, Texas 78210, Phone: 210.354.0690, Email: [brianM@missionrs.com](mailto:brianM@missionrs.com)
  4. CSS Manufacturing, Mr. Jared Woodard, 7430 Fairbanks North Houston Rd., Houston, Texas 77040, Phone: 832.444.6311, Email: [jared.woodard@css-mfg.com](mailto:jared.woodard@css-mfg.com)

## PART 3 - EXECUTION

### 4.1 DELIVERY AND INSTALLATION

- A. Supervision: Provide a skilled and proficient foreman or supervisor who shall remain on the job during the entire installation.
- B. Delivery: Coordinate with the progress of construction and Owner's operation schedules. Unless otherwise instructed and documented by Owner or General Contractor, the following procedures apply:
  1. Field-Assembled Fixed Equipment integrated into the structure (e.g., walk-in assemblies, exhaust hoods, drain trench/grate assemblies, conveyor systems, ceiling-mounted utensil racks, etc.) are to be sent to the job site when directed by the General Contractor and installed/protected accordingly.
  2. All other Fixed Equipment: delivered after completion of work on adjacent finished ceilings, lighting, finished floor and wall systems, including painting.
  3. Major Movable Equipment: delivered, when possible, to inventory in a secured area for interim job-site storage or, if the secured area is unavailable when fixed equipment installation/clean-up has been completed.
  4. Minor appliances and loose items (e.g., pans, covers, flatware containers, etc.) should be delivered only when the Owner is prepared to receive and inventory such items.
- C. Installation: performed by the manufacturer of custom fabricated fixtures.
  1. Assemble, square, level, and ready all items for the final utility connections.
  2. Cut neatly around obstructions to provide sanitary conditions.

3. Where gaps of  $\frac{1}{4}$ " or less occur adjacent to or between equipment, insert rope backing and smoothly apply General Electric construction sealant Series SE-1200 silicone mastic (silver color). Mask both sides of the gap for neat sealant application and remove excess. If space exceeds  $\frac{1}{4}$ ," neatly install 18-gauge stainless steel trim molding of proper shape with concealed attachment. Use epoxy cement or "Z" clips wherever possible to secure stainless steel trim. Exposed edges or corners of trim: eased and smooth.
  4. Refrigeration coil drain line runs to an indirect drain connection greater than 2" from the face of the wall or panel: Either of the following field procedures:
    - a. Trench the floor and provide a 6" wide x 2" deep 16-gauge stainless steel sloping (-1" to -2") trough from the face of the cooler/freezer wall to the body of the floor sink/floor drain. Trough: turned up 4" at the wall;  $\frac{3}{4}$ " flange with  $\frac{1}{2}$ " turndown at both long sides. Set trough in waterproof mastic and seal 1" OD drain tube penetration into floor sink/floor drain at -2 $\frac{1}{2}$ " BFF. Patch the floor to match adjacent material/surface.
    - b. Provide 12" x 6" x 2" deep 16-gauge stainless steel condensate pan mounted to cooler/freezer wall at 6" AFF clear. Trench the floor and install a 1" OD drain line from the bottom of the pan to the body of the floor sink/drain. Slope drain line  $\frac{1}{4}$ " per foot and seal all connections watertight. Patch the floor to match adjacent material/surface.
- D. Protection of Work:
1. Fabricated fixtures: Fiberboard or plywood taped to tops and exposed body panels/components.
  2. Manufactured Equipment: Fiberboard or plywood taped as required by equipment shape and installation-access requirements.
  3. Prohibited use of equipment: Tool and materials storage, workbench, scaffold, stacking area, etc.
  4. Damaged Equipment: Immediately documented and submitted to the Owner with the Contractor's recommendation of action for repair or replacement and its impact on the Project Schedule and Contract Amount, if any.

#### **4.2 CLEAN AND ADJUST**

- A. Clean up and remove all debris from this Work from the job site as the installation progresses.
- B. Lubricate and adjust drawer slides, hinges, and casters.
- C. Adjust pressure regulating valves, timed-delay relays, thermostatic controls, temperature sensors, exhaust hood grilles, etc.
- D. Clean or replace faucet aerators and line strainers.
- E. Touch-up damage to painted finishes.
- F. Start up and check the operation of all refrigeration systems for at least 72 hours before acceptance.

#### **4.3 EQUIPMENT START-UP/DEMONSTRATION**

- A. Carefully test, adjust, and regulate all equipment following the manufacturer's instructions and certify in writing to the Owner that the installation, adjustments, and performance are in full compliance.
- B. Provide the Owner or food service Operators with a thorough operational demonstration of all equipment and furnish instructions for general and specific care and maintenance. Coordinate and schedule selected equipment items and attendees with the Owner at least two weeks before the demonstration starts.

#### **4.4 FINAL OBSERVATION**

- A. Final observation will be made when the Contractor certifies that they have completed their work, thoroughly reviewed the installation/operation of each item in the contract and found it to comply with the Construction Documents.
- B. Repetitive final observations (more than two) and all costs associated with it which may be incurred due to the Contractor's failure to comply with the requirements of this Article will be invoiced to this Contractor on a \$70.00/hr and expense basis.

### **PART 4 - EQUIPMENT SCHEDULE**

**4.1 REGULARLY MANUFACTURED EQUIPMENT/COMPONENTS: Standard finishes and accessories unless specifically deleted or superseded by the Contract Documents.**

**4.2 FABRICATED AND FIELD-ASSEMBLED EQUIPMENT: Arrangement and configuration as shown on Plans, Elevations, Detail Drawings, and outlined in Specifications.**

**4.3 REFER TO DRAWINGS: For unit quantities and plumbing, electrical or mechanical provisions are required, including the manufacturer's optional voltages, wattages, burner capacities, etc.**

**4.4 REFER TO PART 2 – PRODUCTS: For accessories, fittings, requirements, and procedures related to the listed buy-out and fabricated equipment.**

**4.5 ALTERNATE MANUFACTURER REQUIREMENTS: A specific product manufactured by the listed pre-approved equals shown under Section 4.7 Food Service Equipment are acceptable only if the specific product can evidence compliance with the specified line items and the contract documents (Refer to Section 1.6; Sub-Section A.).**

#### **4.6 FOOD SERVICE EQUIPMENT**

- A. All equipment is to have a performance check from factory-authorized personnel. Warranties will begin on the day of the performance check.
- B. All equipment and internal components should be of domestic origin where possible.
- C. Architect to verify/coordinate the aesthetic options below (Food Service color, material, or signage selections) if these items are provided in this project:
  - 1. Countertops: Stone (stainless steel is provided unless otherwise specified)
  - 2. Tray slides: Corian or Stone (stainless steel is provided unless otherwise specified)
  - 3. Counter fronts: Ceramic tile, 3 Form, or Plastic Laminate

4. Sneeze Guards: Stone insets
  5. General color, material and graphic selections:
    - a. Display Air Screen Merchandisers – Color selection: Powder Coat or Plastic Laminate (stainless steel is provided unless otherwise specified)
    - b. Bakery Display Cases – Color selection: Powder Coat or Plastic Laminate (stainless steel is provided unless otherwise specified)
    - c. Pass Thru or Reach In Holding Cabinets - Color selection: Powder Coat (Mfg.: True) or Plastic Laminate (Mfg.: Traulsen) (Stainless steel is provided unless otherwise specified)
    - d. Hanging Heat Lamps – Track and Fixture color selection
    - e. Heated Merchandisers
    - f. Portable Guide Rails – Stanchion and Belt color selection
    - g. Popcorn machine – Signage selection
    - h. Bottle Cooler – Signage selection
    - i. Graphics Package information
    - j. Hot Food Well covers
- D. Architect to verify/coordinate the finishes below:
1. Walls: Ceramic Tile, Flat FRP, or Molded FRP (Smooth, Impervious, and easily cleanable as approved by local jurisdiction)
  2. Ceilings: Removable Vinyl Face Tile (Smooth, impervious, and easily cleanable as approved by local jurisdiction)
  3. Floors: Tile, Epoxy, or Rubberized flooring system (Smooth, impervious, easily cleanable and slip resistant as approved by local jurisdiction) (Coordinate floor tile transition at serving lines)
  4. Floors: Walk-in Assembly – Extend kitchen floor flush into Walk-in assembly with covered base
  5. Furr Downs above Serving Counters

**ITEM NO. 107                      DRY STORAGE SHELVING                      QUANTITY      2**

**Manufacturer:** Metro  
**Model:** MetroMax Q  
**Size and Shape:** Refer to drawings

1. Each unit to be five (5) tiers high with open grid shelving.
2. Four (4) 86" posts per unit.
3. Quantity Two (2) to equal One (1) Lot: all shelving shown within the dry storage room.

4. Refer to drawings for size, width and lengths.
5. Verify shelving requirements with approved submittal prior to ordering.

**ITEM NO. 109                      ICE MAKER WITH BIN - 500 LB CAPACITY                      QUANTITY      2**

**Manufacturer:**                      Manitowoc  
**Model:**                                      IYT-0450A/D570  
**Size and Shape:**                      Refer to drawings  
**Alternate:**                                      Scotsman

1. Energy Star Rated.
2. Stainless steel bin.
3. Stainless steel legs.
4. Provide bin adapter kit as required.
5. Easy Touch Controls, set filter reminders, get error messages/faults, program run/stop times, display serial/model information, view step-by-step cleaning/sanitizing prompts, view warranty expiration timer.
6. Provide Luminice II Virus and Bacteria Inhibitor.
7. Provide sizes and quantities as required: T&S model #HW-6VERIFY-48 water hose and disconnect from filter to Ice Machine. Alternate: Dormont
8. Cord and plug assembly, coordinate NEMA configuration with electrician.
9. One (1) pre-filter and water filter sized to manufactures recommendations. Provide two (2) sets of replacement filters. Mount on wall adjacent to ice machine in an easily accessible location.
10. Coordinate cord and cap with receptacle. Water supply to filter to be hard copper plumbed. 72" long flex hose from filter to ice maker with 48" wall restraint cable. Interconnection thru water filter to ice machine and final connection by Division 22. Water filter overflow tube to be strapped to back side of ice machine and extend to 1" above floor sink.

**ITEM NO. 110                      CLOTHES WASHER                      QUANTITY      2**

**Manufacturer:**                      Whirlpool  
**Model:**                                      Residential  
**Size and Shape:**                      Refer to drawings  
**Alternate:**                                      GE

1. Contractor to provide current model numbers at the time of delivery.
2. Top load washer.
3. 4.2 cu. Ft. capacity, minimum.
4. Six (6) cycle, two (2) speed washer.
5. White acrylic finish.
6. Cord and plug.
7. Water and drain connection hoses as required.

**ITEM NO. 110A                      CLOTHES DRYER                      QUANTITY      2**



**Manufacturer:** Whirlpool  
**Model:** Residential  
**Size and Shape:** Refer to drawings  
**Alternate:** GE

1. Front load dryer.
2. 3.4 cu. ft. capacity, minimum.
3. Seven (7) cycle-four (4) temperature, Dryer.
4. White acrylic finish.
5. Cord and plug.
6. Vent kit with dryer.
7. Contractor to provide current model numbers at the time of delivery.

**ITEM NO. 111W                      WALL MOUNTED OVERSHELF                      QUANTITY      2**

**Manufacturer:** Custom Fabricated  
**Model:**  
**Size and Shape:** Refer to drawings

1. #18 gauge stainless steel, 12" deep, wall mounted overshef. Size per plan.
2. 14 gauge s/s brackets.
3. Coordinate height with equipment below.
4. Special instructions: Shelving furnished and installed by 11 40 00. G.C. to provide wall blocking when required. 11 40 00 to coordinate size and location of wall blocking.

**ITEM NO. 122                      TWO COMPARTMENT SINK                      QUANTITY      2**

**Manufacturer:** Custom Fabricated  
**Model:** ---  
**Size and Shape:** Refer to drawings

1. Top: 14 gauge type 304 S/S marine edge with 2" turndown at free sides.
2. Open base construction.
3. Two (2) 24" x 26" x 15" deep sink compartments.
4. 10" high splash where adjacent to walls/fixtures.
5. Provide One (1) T&S model no. B-0133-01-44H pre-rinse W/Add-A-Faucet, two (2) B-0109-04 18" wall bracket (dealer cut to correct length), one (1) additional spray face model no. 108SFRK with ceramic cartridges.
6. Two (2) Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. Provide 18 gauge S/S bracket for drain handle welded to sink bottom.
7. 12" deep single post mounted perforated overshef at 18" above counter top.
8. 16 gauge S/S undershef per drawings.
9. 18 gauge butt joint wall panel from splash to underside of shelf.
10. 12" deep single post mountedovershef at 18" above counter top, punched to accommodate spray rinse.

11. Post mounted utensil rack, extend 1-5/8" diameter S/S post from back splash, turn forward 12" and weld full length x 2" x ¼" S/S bar with Component Hardware model no. V-77-4401 S/S sliding hooks at 8" on center. Verify height with owner.
12. One (1) Chicago model no. 305-VBRCF hose bibb and rack mounted on 12 gauge S/S bracket ground and polished to match top. Hose and spray nozzle by owner.
13. Two (2) "Richlite" ½" thick removable sink covers installed at each sink. Weld ¼" bar stock, set 5/8" below work surface at all four corners for support of sink covers. Two (2) finger holes per board.
14. Provide top and bottom c-channel support storage for sink covers at right or left end of counter.
15. One (1) Edlund model no. S-11 Manual can opener, mounted on raised platform.
16. Flanged feet at front only.
17. Seal at all splash penetrations.

**ITEM NO. 123                      DISPOSER-CONE MOUNT                      QUANTITY      2**

**Manufacturer:** Salvajor  
**Model:** 300-CA-18-ARSS -LD  
**Size and Shape:** Refer to drawings  
**Alternate:** In-Sink-Erator

1. Fixed nozzle.
2. Delete standard syphon breakers and provide T & S B-0456-04 vacuum breakers and mount 6" from tabletop to base of breaker.
3. Solenoid valve.
4. Flow control.
5. Model no. ARSS-LD control panel.
6. Auto-reverse.
7. Dejamming tool.
8. Install vacuum breaker in splash
9. S/S cone cover.
10. Perforated silver saver and disposer cone with scrap ring.
11. Two (2) Swirl inlet located in disposer cone at a 45 degree angle.
12. GC to pipe 1/2" cold water to disposer body and swirl inlets. Excess electrical cord to be secured to fabrication as required. Install into counter by section 114000.

**ITEM NO. 126                      WORKTABLE W. SINK                      QUANTITY      2**

**Manufacturer:** Custom Fabricated  
**Model:** ---  
**Size and Shape:** Refer to drawings

1. Top: 14 gauge type 304 S/S, 2" turn down at free sides, 10" high splash on rear or adjacent equipment/walls.
2. Open base construction.
3. 12" deep single post mounted overshef at 18" above counter top.



**ITEM NO. 158                      ISLAND EXHAUST HOOD                      QUANTITY      2**

**Manufacturer:**                      BY MECH. CONTRACTOR  
**Model:**  
**Size and Shape:**                      Refer to drawings

1. Refer to Mechanical Contractor's documentation for further information.

**ITEM NO. 161E                      CONVECTION OVEN – ELECTRIC                      QUANTITY      4**

**Manufacturer:**                      Vulcan  
**Model:**                                  VC44ED  
**Size and Shape:**                      Refer to drawings  
**Alternate:**                              Blodgett

1. S/S front, top and sides.
2. Two (2) 1/2 HP 2-speed motors.
3. SSI-M solid state infinite control with manual timer.
4. Five (5) oven racks per compartment.
5. Dual pane thermal windows.
6. Simultaneous door operation.
7. Heavy duty casters, two (2) with brakes.
8. Safety relief cable system, secured to wall.
9. Shunt trip breaker by Division 26.
10. Provide Eagle model CC-S, Stainless Steel Caster Cradle Stabilizing Device for all mobile production equipment under the exhaust hoods. Coordinate locations with the Owner prior to installation. Quantity One (1) equals One (1) lot. Alternate: Regency Stainless Steel Caster Placement System, model #600Safetyset.

**ITEM NO. 195                      REACH-IN FREEZER - 2DR                      QUANTITY      2**

**Manufacturer:**                      Traulsen  
**Model:**                                  ALT-232WUT  
**Size and Shape:**                      Refer to drawings  
**Alternate:**                              Utility

1. Anodized aluminum interior and S/S exterior.
2. Interior lights with bulbs.
3. Exterior digital thermometer.
4. Locking hardware.
5. Six (6) wire shelves per compartment.
6. 6" high adjustable S/S legs.
7. Furnish start-up and Six (6) years parts and labor warranty.
8. Seven (7) Year compressor warranty.
9. Cord and plug assembly, Coordinate NEMA configuration with electrician.
10. Half height stainless steel doors hinged as per plan.

11. Re-hinging feature.

**ITEM NO. 249                      THREE COMPARTMENT SINK NO DISPOSER                      QUANTITY      2**

**Manufacturer:**                      Custom Fabricated  
**Model:**                                      ---  
**Size and Shape:**                      Refer to drawings

1. Top: 14-gauge S/S 3" high 1-1/2" rolled rim at free sides, 10" high splash at walls.
2. Open base construction.
3. Omit rear rail at sink.
4. One (1) 30" x 26" x 15" deep sink compartment and Two (2) 244" x 26" x 15" deep sink compartments.
5. Two (2) T&S model no. B-0291, splash mount faucet, 18" swing nozzle, LL inlets, for ¾" hot and cold water connections.
6. Three (3) Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. Provide 18 gauge S/S bracket for drain handle welded to sink bottom.
7. 12" deep single post mounted overshef mounted at 18" above counter top.
8. 18-gaugebutt jointwall panel from splash to underside of shelf.
9. Post mounted utensil rack, extend 1-5/8" diameter S/S post from back splash, turn forward 12" and weld full length x 2" x ¼" S/S bar with Component Hardware model no. V-77-4401 S/S sliding hooks at 8" on center.
10. Provide One (1) T&S model no. B-0133-01-44H pre-rinse, two (2) B-0109-04 18" wall bracket (dealer cut to correct length), one (1) additional spray face model no. 108SFRK with ceramic cartridges.
11. One (1) Chicago model no. 305-VBRCF hose bibb and rack mounted on 12 gauge S/S bracket ground and polished to match top. Hose and spray rinse by owner.
12. Omit front rail at hose bibb and rear rail at disposer.
13. Coordinate installation of Item No. 123 Disposer.
14. Coordinate clear opening under drainboard with Item No. 640 Undercounter Dishwasher.
15. 16-gauge S/S removable undershef as per drawings.
16. Flanged feet at front only of counter.
17. Provide stainless steel corner filler panel sloped towards drainboard.
18. Anchor flanged feet to floor with non-corrosive bolts. Secure wall mounted equipment / components to in wall grounds or anchor plates. Coordinate installation with the general contractor.

**ITEM NO. 260                      HAND SINK    QUANTITY      9**

**Manufacturer:**                      Advance Tabco  
**Model:**                                      7-PS-50  
**Size and Shape:**                      Refer to drawings

1. 20 gauge stainless steel construction.

2. Basket drain and wall bracket.
3. Gooseneck faucet with wrist handles.
4. Soap and towel dispensers by Owner.
5. P-Trap assembly, delete open/close drain vavle.
6. Custom fabricated removable end splashes on sides as required by code. Height same as rear splash.
7. Trade contractor to provide temperature adjustment valves as required.

**ITEM NO. 640 UC DISHMACHINE ENERGY SAVER QUANTITY 2**

**Manufacturer:** CMA  
**Model:** 180UC  
**Size and Shape:** Refer to drawings

1. Energy Recovery/Steam elimination unit.
2. High Temp unit. Cold water connection only.
3. Cord and plug assembly.
4. ½" Pressure regulator valve.
5. Detergent and rinse aid pumps.
6. Drain water tempering kit.
7. Provide 8' drain hose.
8. Two (2) Peg racks and Two (2) combination rack.

**ITEM NO. 644 ELECTRIC CORD REEL QUANTITY 22**

**Manufacturer:** By Electrical Contractor  
**Model:** ---  
**Size and Shape:** Refer to drawings

1. Provided by Trade Contractor.

**ITEM NO. 673 5 QT. MIXER QUANTITY 10**

**Manufacturer:** Hobart  
**Model:** N50-60  
**Size and Shape:** Refer to drawings

1. Two (2) year parts warranty and One (1) year on-site labor warranty.
2. Cord and plug assembly, NEMA 5-15P/
3. Stainless steel bowl, flat beater, whip and ED Dough hook.

**ITEM NO. 801 MOBILE WORKTABLE QUANTITY 11**

**Manufacturer:** Custom Fabricated  
**Model:** ---  
**Size and Shape:** Refer to drawings  
**Alternate:** Tabco - SS-306

1. Top: 14 gauge type 304 S/S with 2" turndown at all sides.
2. Open base construction.
3. 16 gauge S/S undershelf per drawings.
4. One (1) 20" W x 20" L drawer assemblies. Component Hardware #S52-2020 drawer slides with delrin bearings - 200lb capacity. Component Hardware #S81-2020C drawer pan.
5. 5" N.S.F. approved non-marking swivel casters, two with brakes.

**ITEM NO. 802**                      **8 BURNER RANGE**    **QUANTITY**      **5**

**Manufacturer:**                      Vulcan  
**Model:**                                      EV48SS-8FP480  
**Size and Shape:**                      Refer to drawings

1. Infinite controls
2. Two (2) standard ovens each with 2 wire shelves.
3. 2 KW French hotplates.
4. Stainless steel front and sides.
5. 5" non-marking swivel casters, Two (2) with brakes.
6. 4" high stub back, stainless steel.

**ITEM NO. 803**                      **STUDENT WORK TABLE**    **QUANTITY**      **12**

**Manufacturer:**                      Eagle  
**Model:**                                      T3072SE-HA  
**Size and Shape:**                      Refer to drawings

1. Top: 14 gauge type 304 S/S with 2" turndown at all sides.
2. Open base construction.
3. 16 gauge S/S undershelf per drawings.
4. ADA/Ergonomic Height Adjustable Work Table.
5. 5" N.S.F. approved non-marking swivel casters, two with brakes.
6. Uni-lok gusset system.
7. Crank case located on left end of table.

**ITEM NO. 804**                      **MOBILE WORKTABLE**    **QUANTITY**      **10**

**Manufacturer:**                      Custom Fabricated  
**Model:**                                      ---  
**Size and Shape:**                      Refer to drawings

1. Top: 14 gauge type 304 S/S with 2" turndown at all sides.
2. Open base construction.
3. 16 gauge S/S undershelf per drawings.
4. Two (2) 20" W x 20" L drawer assemblies. Component Hardware #S52-2020 drawer slides with delrin bearings - 200lb capacity. Component Hardware #S81-2020C drawer pan.
5. 5" N.S.F. approved non-marking swivel casters, two with brakes.

**ITEM NO. 805                      4 BURNER RANGE    QUANTITY      3**

**Manufacturer:**                      Vulcan  
**Model:**                                      EV24S-4FP480  
**Size and Shape:**                      Refer to drawings

1. Infinite controls.
2. Standard ovens each with 2 wire shelves.
3. Four (4) 2 KW French hotplates.
4. 5" non-marking swivel casters, Two (2) with brakes.
5. 4" high stub back, stainless steel.
6. Stainless steel front and sides.
7. 480 volt three phase.

**ITEM NO. 806                      DEMO COUNTER    QUANTITY      2**

**Manufacturer:**                      CounterCraft  
**Model:**                                      ---  
**Size and Shape:**                      Refer to drawings  
**Alternate:**                                      Mod-U-Serve, Metal Fabricators

1. Stainless steel sides and rear. Notch around range.
2. 14 gauge stainless steel top with 18 gauge stainless steel sides and rear panels.
3. Counter top to extend at past front counter by 6" for a trayslide area, No. 4 finish.
4. 18 gauge stainless steel internal shelving compartments. All internal stainless steel fabrication to be fully welded.
5. One (1) load center, load center not to include range.
6. Counter front to have plastic laminate removable panels with stainless steel reveals. Coordinate color/pattern with Architect.
7. All electrical to be pre-wired to load center. Provide convenience outlets within counter's apron for instructor's use. Load center to be typed, not hand written.
8. 6" high adjustable stainless steel legs.
9. One (1) 10" x 14" x 10" deep sink compartment with soap dispenser, deck mounted T&S model no. B-0222 faucet. Sink to have side and back stainless steel splashes with a height of 12".
10. MF Clearvista single pose portable breath protectors.
11. Two (2) Delfield Two Pan Hot Food Well model no. N8731-ESP
12. All sneeze guards to be constructed with stainless steel posts and #8 high polished accents. Glass to be 3/8" Starphire tempered with high polished profiled edges and rounded corners

**ITEM NO. 807                      UTILITY TABLE    QUANTITY      2**

**Manufacturer:**                      Custom Fabricated  
**Model:**                                      ---  
**Size and Shape:**                      Refer to drawings

1. Top: 14 gauge type 304 S/S with 2" turndown at all sides.



2. Open base construction.
3. 16 gauge S/S undershelf per drawings.
4. Stainless steel adjustable feet.

**ITEM NO. 808                      S/S CORNER GUARD    QUANTITY    2**

**Manufacturer:**                      Custom fabricated  
**Model:**                                      ---  
**Size and Shape:**                      Refer to drawings

1. Quantity Two (2) represents Two (2) Lots. Guard to be located on every outside corner within the culinary arts classroom.
2. 3" x 3" x full height of wall from baseboard to finished ceiling.

**ITEM NO. 809                      CHAR BROILER W/ STAND    QUANTITY    3**

**Manufacturer:**                      Star Manufacturing  
**Model:**                                      5136CF  
**Size and Shape:**                      Refer to drawings

1. 208 Volt Three Phase
2. Infinite controls.
3. Heavy duty cast iron grates.
4. 2 3/4" high tapered splash guard.
5. 4" adjustable legs..
6. One (1) Vulcan Stand/C equipment stand with 5" non-marking casters, front Two (2) with brakes.

**ITEM NO. 810                      REACH-IN REFRIGERATOR - 3DR    QUANTITY    2**

**Manufacturer:**                      Traulsen  
**Model:**                                      AHT-332WUT  
**Size and Shape:**                      Refer to drawings  
**Alternate:**                                      Utility

1. Anodized aluminum interior and S/S exterior.
2. Interior lights with bulbs.
3. Exterior digital thermometer.
4. Locking hardware.
5. Six (6) wire shelves per compartment.
6. 6" high adjustable S/S legs.
7. Furnish start-up and Six (6) years parts and labor warranty.
8. Seven (7) Year compressor warranty.
9. Cord and plug assembly, Coordinate NEMA configuration with electrician.
10. Half height stainless steel doors hinged as per plan.
11. Re-hinging feature.

**ITEM NO. 811                      GRIDDLE W/ STAND    QUANTITY      3**

**Manufacturer:**                      Vulcan  
**Model:**                                      RRE36E  
**Size and Shape:**                      Refer to drawings

1. 1/2" thick polished steel griddle plate.
2. stainless steel front, sides, front top ledge with cool bullnose, front grease trough.
3. 4" back with tapered side splashes.
4. 4" adjustable legs.
5. 480 volt.
6. One (1) Vulcan Stand/C stainless steel equipment stand with marine edge, undershelf with 5" non-marking swivel casters, front two with brakes.

**ITEM NO. 812                      FRYER W/ FILTER SYSTEM    QUANTITY      2**

**Manufacturer:**                      Vulcan  
**Model:**                                      1ER50DF  
**Size and Shape:**                      Refer to drawings

1. 480 volt.
2. 50 lb. capacity free standing solid state digital control with melt cyclers.
3. KleanScreen Plus filter system.
4. Twin baskets.
5. Stainless steel cabinet
6. Four (4) stainless steel legs.

**END OF SECTION 11 40 00**

## **SECTION 11 46 83 - ICE MACHINES**

### **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: Requirements including but not limited to:
  - 1. Commercial ice machines
  - 2. Appliance coordination including service connections, supply lines, and power
  - 3. Accessories necessary for a complete installation
- B. Related Sections:
  - 1. Division 22: Domestic water supply.
  - 2. Division 26: Electrical connection.

#### **1.3 REFERENCE STANDARDS**

#### **1.4 SUBMITTALS**

- A. Product Data: Technical data including product specifications, installation, and maintenance instructions.
- B. Product Certificates: Submit certificate from product manufacturer stating compliance with requirements and intended use of product.
- C. Operation and Maintenance Data: Submit for each residential appliance to include in operation and maintenance manuals.

#### **1.5 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  - 2. UL and NEMA: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.
  - 3. Energy Ratings: Provide energy efficient appliances that carry labels indicating energy cost analysis (estimated annual operating costs) and efficiency information.
  - 4. Accessibility Requirements: Comply with applicable requirements.
    - a. United States Access Board Americans with Disabilities Act Accessibility Guidelines (ADAAG) (2010 ADA Standards for Accessible Design).
    - b. ICC A117.1 Accessible and Useable Building and Facilities.
    - c. Texas Accessibility Standards (2012 TAS).
- B. Product Options: Information on Drawings and in Specifications establishes requirements for product's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
- C. Source Limitations: Obtain light commercial appliances from single source and each type of light commercial appliance from single manufacturer.
- D. Preinstallation Conference: Conduct conference at site.

#### **1.6 WARRANTY**

- A. Warranties: Written warranty signed by manufacturer in which manufacturer of the specific appliance specified agrees to repair or replace appliances or components that fail in materials or workmanship within specified warranty period.

1. Provide appliance and equipment rated for light commercial grade or higher. Residential appliances are not acceptable unless manufacturer warrants residential units in a commercial application and only with Architect's approval.
- B. Ice maker, Sealed System: Full warranty, including parts and labor, for onsite service on the product.
  1. Warranty Period for Sealed Refrigeration System: Five years from date of Substantial Completion.
  2. Warranty Period for Other Components: Two years from date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Follett.
- B. Koolaire.
- C. Manitowak.
- D. Scotsman.

### **2.2 APPLIANCES**

- A. Ice Machine:
  1. Basis of Design:
    - a. Model: KDT0400A 30" Full Cube Ice Machine Head manufactured by Koolaire.
  2. Ice Type: Full Cube.
  3. Production: 440 lb per day.
  4. Finish: As selected by the Architect.
- B. Appliances, Equipment, and Fixtures: Coordinate equipment, fixtures, appliances regardless which party provides or furnishes. Ensure adequate power supply and properly locate plumbing lines and hook ups, water and drain connections and accessories.
- C. Accessories: Provide accessories necessary for a working installation.

### **2.3 FINISHES**

- A. Comply with NAAMM 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. Stainless Steel Finish: Provide appliances with standard finish complying with manufacturer's written instructions for surface preparation including ground and polished stainless steel surfaces for uniform, directionally textured finish.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine conditions for compliance with requirements for installation tolerances and conditions affecting performance of work. Coordinate installation of equipment, appliances, fixtures, and other items.
  1. Examine roughing in for piping systems and verify actual locations of piping connections before equipment installation.
  2. Examine electrical circuits and rating and verify locations and sufficient ratings for items requiring electrical power.
  3. Examine space to receive items and verify the space is of sufficient size and configuration for items.
- B. Proceed with installation after correcting unsatisfactory conditions.

### **3.2 INSTALLATION**

- A. Comply with manufacturer's written instructions. Install fixtures level and plumb according to roughing in drawings.
- B. Power Supply: Coordinate power supply, grounding, outlets, and electrical wiring with locations indicated for appliances and equipment.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- D. Utilities: Refer to plumbing and electrical sections for plumbing and electrical requirements.
- E. Connections and Hook ups: Coordinate location of services.
  - 1. Grounding: Ground equipment in accordance with applicable standards and code requirements.
  - 2. Wiring: Connect wiring in accordance with manufacturer recommendations.
  - 3. Provide necessary electrical outlets.

### **3.3 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections with the assistance of a factory authorized service representative:
  - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturer written recommendations. Certify compliance with each manufacturer appliance performance parameters.
  - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After installation, start units to confirm proper operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- B. An appliance will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Test each equipment item to verify proper operation. Make necessary adjustments. Replace malfunctioning appliances and components, then retest. Repeat procedure until units operate properly.

### **3.4 CLEANING**

- A. Clean equipment with manufacturers' recommended cleaning methods and materials. After completing installation of equipment and fixtures, inspect exposed finishes and repair damaged finishes. Remove packing materials from site.

### **3.5 PROTECTION**

- A. Provide protective covering for installed appliances. Do not allow use of equipment items for temporary facilities.

### **3.6 DEMONSTRATION**

- A. Engage a factory authorized service representative to train School District's maintenance personnel to adjust, operate, and maintain equipment.

**END OF SECTION 11 46 83**

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## **SECTION 11 90 00 - MISCELLANEOUS EQUIPMENT**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Wall-mounted gas cylinder brackets.
- B. Related Sections:
  - 1. Section 06 10 00 - Rough Carpentry: Blocking.

#### **1.2 REFERENCE STANDARDS**

- A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASME BPVC - Boiler and Pressure Vessel Code; 2023.
- C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- F. ASTM A879/A879M - Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface; 2022.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- H. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- I. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
- J. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

#### **1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination: Coordinate installation of laboratory equipment with laboratory casework and Owner-furnished, Owner-installed laboratory equipment.
- B. Preinstallation Meeting: Convene one week before starting work of this section.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

#### **1.4 SUBMITTALS**

- A. Refer to Section 01 40 00 - Quality Requirements for submittal procedures.
- B. Product Data: Provide equipment dimensions and construction; equipment capacities; physical dimensions; utility and service requirements, clearances, and locations; required accessories and optional features; and point loads.
- C. Shop Drawings: Indicate equipment locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, and installation and servicing clearances required.
- D. Samples: Submit two samples of exposed finish surfaces, a minimum of 6 by 6 inches (150 by 150 mm) in size illustrating color and finish.
- E. Operation Data: Include description of equipment operation and required adjusting and testing .

- F. Maintenance Data: Identify system maintenance requirements, servicing cycles, lubrication types required and local spare part sources.
- G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in School District's name and registered with manufacturer.

### **1.5 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in manufacturing the types of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience and approved by manufacturer.
- C. Preconstruction Testing: Factory-test each type of equipment.

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

- A. Package each piece of equipment to ensure protection from damage during shipment and delivery. Legibly indicate on the exterior of each container or crate, the shipping address and a brief description of its contents. Outside of the container, fasten a waterproof envelope containing a packing list and complete instructions for uncrating and setting the equipment in place.
- B. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

### **1.7 WARRANTY**

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Correct defective Work within a two year period after Date of Substantial Completion.
- C. Provide ten year manufacturer warranty for materials, parts, and labor for sterilizer chamber.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work
  - 1. CFS Products, Inc.: <https://www.cfsbinds.com>.
  - 2. fischer scientific, Part of Thermo Fisher Scientific: [www.fischersci.com](http://www.fischersci.com).
  - 3. Labconco Corporation: [www.labconco.com](http://www.labconco.com).
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

### **2.2 EQUIPMENT**

- A. General Conditions:
  - 1. Securely affix a plate which includes the manufacturer's name, address, and catalog or serial number to each equipment item. If applicable, include pressure vessels bearing the ASME stamp and pressure rating, indicating compliance with applicable code requirements.
  - 2. Installation Accessories: Provide all rough-in frames, anchors, supports, accessories and closure trim required for complete installation.
  - 3. Use corrosion-resistant materials for all rivets, bolts, nuts, studs, spacers, and welding metal.
  - 4. Fully assemble equipment in factory, except for those items which cannot be moved to their final locations as single item.
- B. Gas Cylinder Support Bracket:
  - 1. Basis of Design: Justrite Gas Cylinder Support Bracket manufacturer by fisher scientific.
  - 2. Capacity: 2 cylinders, 4 to 12 inch diameter each.



3. Material: Steel.
4. Finish: Powder-coat.
  - a. Color: Gray.
5. Accessories:
  - a. Polymer protective edging.
  - b. Support chain.
6. Mounting: Wall.

## **2.3 MATERIALS**

- A. Aluminum Sheet: ASTM B209/B209M, 5005-H32 minimum; alloy and temper recommended by aluminum producer and finisher for use and finish indicated.
  1. Finish: AAMA 2603.
- B. Galvanized Steel Sheet: ASTM A653/A653M, G90 (Z275) coating.
- C. Steel Sheet: ASTM A1008/A1008M uncoated, cold rolled, Type CS (commercial steel), exposed or ASTM A879/A879M electrolytic zinc coating over ASTM A1008/A1008M steel sheet substrate.
- D. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304 and 316, stretcher-leveled standard of flatness.
- E. Laminated Safety Glass: ASTM C1172.
- F. 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.
- G. Fasteners: Stainless-steel, or other corrosion-resistant materials, standard with the manufacturer.
- H. Welding Materials: Comply with ASME BPVC SEC II-C.
- I. Metal Finishes: Comply with NAAMM AMP 500-06.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that utility connections, rough-in frames, anchors and supports are accurately placed and deliver building services at specified characteristics and/or within acceptable functional ranges.
- B. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Provide rough-in frame and anchors for placement by Section 01 25 13 - Product Substitution Procedures.

### **3.3 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with standards required by authority having jurisdiction.
- C. Large Components: Ensure that large components can be moved into final position without damage to other construction.
- D. Mounting: Anchor equipment securely in place.
  1. Mount equipment in compliance with SMACNA (SRM) requirements.
- E. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner, and their locations are coordinated with equipment rough-in requirements.
  1. Require manufacturer's installer to supervise connection to utilities being performed by mechanical and electrical trades.

2. Make connections between ferrous and nonferrous metallic pipe with dielectric waterways and flanges having temperature and pressure rating equal to or greater than that specified for the connecting piping. Use dielectric waterways internally lined with an insulator specifically designed to prevent current flow between dissimilar metals.
  3. Connect steam lines on equipment to building source only after building steam lines have been cleaned of preservatives and materials that may be harmful to the equipment.
- F. Touch-up minor damaged surfaces caused during installation. Replace damaged components as directed by Architect.

### **3.4 FIELD QUALITY CONTROL**

- A. Refer to Section 01 40 00 - Quality Requirements for additional requirements.
- B. Perform functional testing in accordance with referenced specification requirements. Test one item or similar model, as necessary or appropriate, to ensure that it is operational and installation complies with specification requirements.

### **3.5 ADJUSTING**

- A. Adjust operating equipment to efficient operation.

### **3.6 CLOSEOUT ACTIVITIES**

- A. Refer to Section 01 77 00 - Closeout Procedures for closeout submittals.
- B. Refer to Section 01 79 00 - Demonstration and Training for additional requirements.
- C. Final Acceptance: Remove labels, fingerprints, and clean all surfaces both inside and out. Repair any marred or damaged surfaces that affect appearance, such as both interior and exterior of cabinets in a manner acceptable to School District. Replace any parts that cannot be repaired in such a manner.

**END OF SECTION 11 90 00**

## **SECTION 12 21 13 - HORIZONTAL LOUVER BLINDS**

### **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 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
    - a. Manufacturer's installation instructions.
      - 1) Shop Drawings: Indicate size, material, and finish. Show location and installation procedures. Include details, attachments and clearances for Architect's approval.
      - 2) Samples or color charts showing manufacturer's full range of colors for Architect's selection. For each exposed product and for each color and texture specified, 12 inches (300 mm) long. Slat: Not less than 12 inches (300 mm) long.
      - 3) Product Test Reports: For horizontal louver blinds with polymer slats that have been tested for compliance with NFPA 701, for tests performed by.
      - 4) Maintenance Data: Submit data to include in maintenance manuals.

#### **1.3 QUALITY ASSURANCE**

- A. Source Limitations: Obtain horizontal louver blinds from single source from single manufacturer.
  - 1. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 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 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver blinds in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

#### **1.5 WARRANTY**

- A. Warrant the work specified herein for lifetime, without charge to the original purchaser, any part found defective in workmanship or material as long as the blind remains in the same window for which it was purchased.

### **PART 2 PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
  - 1. Hunter Douglas, Inc.; [www.hunterdouglas.com/#sle](http://www.hunterdouglas.com/#sle).
  - 2. Levelor Home Fashions Contract Division; [www.levelor.com/#sle](http://www.levelor.com/#sle).
  - 3. Springs Window Fashions Division, Inc.; [www.springswindowfashions.com/#sle](http://www.springswindowfashions.com/#sle).
  - 4. SWF Contract, a Springs Window Fashions brand; [www.swfcontract.com/#sle](http://www.swfcontract.com/#sle).
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

## 2.2 MATERIALS

- A. Horizontal blinds shall consist of the following:
1. Basis of Design: "Riviera Contract 1 inch Blind" manufactured by Levelor Home Fashions Contract Division.
  2. Steel Channel Headrail: "U"-shaped, 1 inch high x 1-1/2 inch deep, fabricated from 0.025 inch thick phosphate-treated steel with rolled edges at top with a prime coat of vinyl primer and finish coat of polyester baked enamel to match bottom rail and slats.
  3. Head Channel Hardware: Metal hardware shall be electroplated. Provide lift cords and braided ladders.
  4. Enclosed Metal Bottom Rail: Tubular shape, 0.030 inch thick phosphate-treated steel with prime coat of vinyl primer and finish coat of polyester baked enamel matching headrail and slat color.
  5. Slats: Slats shall be virgin aluminum alloyed for maximum strength, flexibility and resistance to internal and external corrosion. Slats shall be nominal 1 inch wide. Slats shall have a pre-coating treatment to bond the polyester baked enamel finished coating. Total coating thickness shall be 1.0 mil. Color to be selected by Architect from manufacturer's full range of colors.
  6. Tilter: Wand-type shall be operated by a length of transparent extruded plastic rod with a multi-sided cross-section measuring approximately 3/8 inch across points for comfortable grip. Plastic wand shall be easily detachable by means of a wand link and sliding crystal sleeve. Tilter shall be snap-fitted to headrail using no rivets or metal cleats.
  7. Braided Ladders:
    - a. Distance between end ladder and end of slats shall not exceed six (6) inches.
    - b. Distance between ladders shall not exceed 22 inches.
    - c. Material shall be polyester yarn. Vertical component shall be not less than 0.045 inch diameter nor greater than 0.066 inch diameter.
  8. Cord Lock and Tilter Operation Locations: Tilter at left, cord lock at right (standard).
  9. Installation Brackets: End support, hinged cover brackets 0.042 inch thick treated steel with prime coat of epoxy primer and finish coat of polyester baked enamel in color to match headrail. Brackets shall be marked left and right to facilitate installation and shall have a 1-1/4 inch extra-wide top to accommodate power screwdriver.
  10. Intermediate Support Brackets: Brackets shall be furnished for blinds over 60 inches wide. Maximum spacing for intermediate support brackets shall be 48 inches.
  11. Install valance brackets and double blade stacked slats at top of all blinds.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances, operational clearances and other conditions affecting performance of the Work.
- B. Proceed with installation after correcting unsatisfactory conditions.

### 3.2 INSTALLATION

- A. Install blinds at locations scheduled, noted on the drawings, or as directed by the Architect in accordance with manufacturer's installation procedures, except as otherwise specified herein.
- B. Install intermediate support and extension brackets as needed to prevent deflection in headrail.
- C. Install blinds with adequate clearance to permit smooth operation of blinds and any sash operators. Hold blinds 1/4 inch clear from each side of window opening on inside mount, unless other clearance is indicated.
- D. Set tilt and locking controls.

### 3.3 CLEANING AND DEMONSTRATION

- A. Clean blinds in accordance with manufacturer's instructions.

- B. Demonstrate blinds to be in smooth uniform working order.

**END OF SECTION 12 21 13**

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## **SECTION 12 36 00 - COUNTERTOPS**

### **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:
- B. Related Sections:
  - 1. Section 11 53 13 - Laboratory Fume Hoods: Work surfaces inside fume hoods.
  - 2. Section 12 35 53.19 - Wood Laboratory Casework: Laboratory countertops.
  - 3. Section 22 40 00 - Plumbing Fixtures: Sinks.

#### **1.3 PRICE AND PAYMENT PROCEDURES**

- A. Refer to Section 01 21 00 - Allowances, for cash allowances affecting this section.
- B. Refer to Section 01 23 00 - Alternates, for product alternates affecting this section.

#### **1.4 REFERENCE STANDARDS**

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- D. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
- E. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- G. AWI (QCP) - Quality Certification Program; Current Edition.
- H. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- I. AWMAC (GIS) - Guarantee and Inspection Services Program; Current Edition.
- J. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- K. IAPMO Z124 - Plastic Plumbing Fixtures; 2022.
- L. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- M. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.
- N. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- O. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.
- P. NSF 51 - Food Equipment Materials; 2023.
- Q. NSI (DSDM) - Dimensional Stone Design Manual, Version VIII; 2016.
- R. PS 1 - Structural Plywood; 2023.
- S. SEFA 2 - Installations; 2010.
- T. SEFA 3 - Laboratory Work Surfaces; 2020.
- U. WI (CCP) - Certified Compliance Program (CCP); Current Edition.
- V. WI (CSIP) - Certified Seismic Installation Program (CSIP); Current Edition.

W. WI (MCP) - Monitored Compliance Program (MCP); Current Edition.

### 1.5 PERFORMANCE REQUIREMENTS

- A. Countertops 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:
1. All deadloads.
  2. 500 pound live load placed on the countertop and vanity.
  3. Deflection at Midspan: L/1000 times span or 1/8 inch whichever is less.

### 1.6 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- 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. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.
- F. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- G. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- H. Installer's qualification statement.
- I. Installation Instructions: Manufacturer's installation instructions and recommendations.
- J. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- B. Quality Certification:
1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: [www.awiqcp.org/#sle](http://www.awiqcp.org/#sle).
    - a. This AWI (QCP) project is registered as project number \_\_\_\_\_.
  2. Comply with AWMAC (GIS) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
  3. Comply with WI (CCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: [www.woodworkinstitute.com/#sle](http://www.woodworkinstitute.com/#sle).
  4. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
  5. Provide designated labels on shop drawings as required by certification program.
  6. Provide designated labels on installed products as required by certification program.
  7. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.



## **1.8 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.

## **1.9 FIELD 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.

## **1.10 WARRANTY**

- A. Warranty the work specified herein for five (5) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include but not be limited to the following:
  - 1. Rough or difficult operation, or loose or missing parts.
  - 2. Delamination of surfaces.
  - 3. Noticeable deterioration of finish.
  - 4. Warped or misaligned surfaces or telegraphing of subsurface imperfections.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

### **2.2 COUNTERTOPS**

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Quality Standard: SEFA 3 for laboratory worksurfaces.
- C. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
  - 1. Laminate Sheet: NEMA LD 3, Grade HGS, 0.048 inch (1.2 mm) nominal thickness.
    - a. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
    - b. NSF approved for food contact.
    - c. Wear Resistance: In addition to specified grade, comply with NEMA LD 3 High Wear Grade requirements for wear resistance.
    - d. Laminate Core Color: Same as decorative surface.
    - e. Finish: Matte or suede, gloss rating of 5 to 20.
    - f. Surface Color and Pattern: PL-2.
  - 2. Exposed Edge Treatment: Square, substrate built up to minimum 1-1/4 inch (32 mm) thick; covered with matching laminate.
  - 3. Back and End Splashes: Same material, same construction.
  - 4. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Custom Grade.
  - 5. Fabricate in accordance with manufacturer's standard requirements.
- D. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
  - 1. Flat Sheet Thickness: 1/2 inch (12 mm), minimum.

2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
  - a. Manufacturers:
    - 1) American Bath Group: [www.americanbathgroup.com/#sle](http://www.americanbathgroup.com/#sle).
    - 2) Avonite Surfaces: [www.avonitesurfaces.com/#sle](http://www.avonitesurfaces.com/#sle).
    - 3) Dupont: [www.corian.com/#sle](http://www.corian.com/#sle).
    - 4) Formica Corporation: [www.formica.com/#sle](http://www.formica.com/#sle).
    - 5) LG Hausys America, Inc: [www.lghausysusa.com/#sle](http://www.lghausysusa.com/#sle).
    - 6) Meganite, Inc: [www.meganite.com/#sle](http://www.meganite.com/#sle).
    - 7) Relang International, LLC: [www.duraseinusa.com/#sle](http://www.duraseinusa.com/#sle).
    - 8) Wilsonart: [www.wilsonart.com/#sle](http://www.wilsonart.com/#sle).
  - b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
  - c. NSF approved for food contact.
  - d. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
  - e. Color and Pattern: Wilsonart Cool Basalt 9251SS.
3. Other Components Thickness: 1/2 inch (12 mm), minimum.
4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch (32 mm) thick; radiused edge.
5. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.
6. Skirts: As indicated on Drawings.
7. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.
8. Fabricate in accordance with manufacturer's standard requirements.

## 2.3 MATERIALS

- A. Wood-Based Components:
  1. Wood fabricated from old growth timber is not permitted.
  2. Provide sustainably harvested wood, certified or labeled; refer to Section 01 60 00 - Product Requirements.
  3. Provide wood harvested within a 500 mile (805 km) radius of the project site.
  4. Wood fabricated from timber recovered from riverbeds or otherwise abandoned is permitted, unless otherwise noted, provided it is clean and free of contamination; identify source; provide lumber re-graded by an inspection service accredited by the American Lumber Standard Committee, Inc.
- B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- C. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf (20 kg/cu m) minimum density; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- D. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.
- E. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- F. Cove Molding for Top of Splashes: Rubber with semi-gloss finish and T-spline to fit between splash and wall; 1/2 inch (12 mm) by 1/2 inch (12 mm).
  1. Color: As indicated on drawings.
  2. Color: As selected by Architect from manufacturer's full line.
- G. Joint Sealant: Mildew-resistant silicone sealant, white.
- H. Polyester Protective Film: Scratch-, heat-, and acid-resistant optically clear removable polyester film for bonding to stone counters.
  1. Thickness: 4 mil, 0.004 inch (0.1 mm), minimum.

2. Finish: Gloss.
3. Construction: Multi-ply laminate.
4. Adhesive Type: Pressure sensitive acrylic.
5. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84 (Class A).
6. NSF approved for food contact per NSF 51.
7. Products:
  - a. Stoneguard USA; \_\_\_\_\_: [www.stoneguardusa.com/#sle](http://www.stoneguardusa.com/#sle).
  - b. Surface Shields, Inc; \_\_\_\_\_: [www.surfaceshields.com/#sle](http://www.surfaceshields.com/#sle).
  - c. TuffSkin Surface Protection LLC; TuffSkin: [www.tuffskin.com/#sle](http://www.tuffskin.com/#sle).
  - d. \_\_\_\_\_.
  - e. Substitutions: See Section 01 60 00 - Product Requirements.
- I. Sealer: Stain and acid protection for natural stone counters.
  1. NSF approved for food contact per NSF 51.
  2. Products:
    - a. Custom Building Products; \_\_\_\_\_: [www.custombuildingproducts.com/#sle](http://www.custombuildingproducts.com/#sle).
    - b. Rockstar Sealing, a division of TuffSkin Surface Protection LLC; Natural Finish Stone Sealer: [www.rockstarsealing.com/#sle](http://www.rockstarsealing.com/#sle).
    - c. STONETECH, a division of LATICRETE International, Inc; \_\_\_\_\_: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
    - d. \_\_\_\_\_.
    - e. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.4 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
  1. Join lengths of tops using best method recommended by manufacturer.
  2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
    - a. Rout a 1/8 inch (3 mm) drip groove at underside of exposed overlapping edges, set back 1/2 inch (13 mm) from face of edge.
  3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash where indicated on Drawings.
  1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
  2. Height: 4 inches (102 mm), unless otherwise indicated.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.3 INSTALLATION

- A. Install vanities in accordance with manufacturer's instructions and approved shop drawings

- B. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- C. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch (16 mm).
- D. Seal joint between back/end splashes and vertical surfaces.
  - 1. Where indicated use rubber cove molding.
  - 2. Where applied cove molding is not indicated use specified sealant.

**3.4 TOLERANCES**

- A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.
- B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.
- C. Field Joints: 1/8 inch (3 mm) wide, maximum.

**3.5 CLEANING**

- A. Clean countertops surfaces thoroughly.

**3.6 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

**END OF SECTION 12 36 00**

## SECTION 22 05 17 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Sleeves.
  - 2. Stack-sleeve fittings.
  - 3. Sleeve-seal systems.
  - 4. Sleeve-seal fittings.
  - 5. Grout.
  - 6. Silicone sealants.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.4 INFORMATIONAL SUBMITTALS

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, LLC.
  - 2. CALPICO, Inc.
  - 3. GPT; an EnPro Industries company.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
- C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, with plain ends and integral welded waterstop collar.

## SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

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- D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- E. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.
- F. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- G. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

## 2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Jay R. Smith Mfg Co; a division of Morris Group International.
  - 2. Zurn Industries, LLC.
- B. Description: Manufactured, galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with setscrews.

## 2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, LLC.
  - 2. CALPICO, Inc.
  - 3. GPT; an EnPro Industries company.
  - 4. Metraflex Company (The).
  - 5. Proco Products, Inc.
- B. Description:
  - 1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - 2. Designed to form a hydrostatic seal of 20 psig minimum.
  - 3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 4. Pressure Plates: Carbon steel .
  - 5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633 of length required to secure pressure plates to sealing elements.

## SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

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## 2.4 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, LLC.
  2. CALPICO, Inc.
  3. GPT; an EnPro Industries company.
  4. Metraflex Company (The).
  5. Proco Products, Inc.
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.
- C. Plastic or rubber waterstop collar with center opening to match piping OD.

## 2.5 GROUT

- A. Description: Nonshrink, 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.

## 2.6 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. GE Construction Sealants; Momentive Performance Materials Inc.
    - b. Permathane®/Acryl-R®; ITW Polymers Sealants North America.
    - c. Polymeric Systems, Inc.
    - d. Sherwin-Williams Company (The).
    - e. The Dow Chemical Company.
  2. Verify sealant has a VOC content of 250 g/L or less.
  3. Verify sealant complies 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." Verify formaldehyde emissions do not exceed 9 mcg/cu. m or 7 ppb, whichever is less.

## SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

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- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. May National Associates, Inc.; a subsidiary of Sika Corporation.
  2. Verify sealant has a VOC content of 250 g/L or less.
  3. Verify sealant complies 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." Verify formaldehyde emissions do not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Smooth-On.
  2. Verify sealant has a VOC content of 250 g/L or less.
  3. Verify sealant complies 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." Verify formaldehyde emissions do not exceed 9 mcg/cu. m or 7 ppb, whichever is less.

## 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. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  2. Cut sleeves to length for mounting flush with both surfaces.

## SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

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- a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  3. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces.
  2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 84 13 "Penetration Firestopping."

### 3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 07 62 00 "Sheet Metal Flashing and Trim."
  3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
  4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  5. Use silicone sealant to seal the space around outside of stack-sleeve fittings.
- B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 07 84 13 "Penetration Firestopping."

### 3.3 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

## SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

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between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.4 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. Use grout or silicone sealant to seal the space around outside of sleeve-seal fittings.

### 3.5 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.
- C. Prepare test and inspection reports.

### 3.6 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 pipe sleeves Steel pipe sleeves .
    - b. Piping NPS 6 and Larger: Steel pipe sleeves .
  - 2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6 : 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.
    - b. Piping NPS 6 and Larger: 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 : 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.
    - b. Piping NPS 6 and Larger: 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.

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4. Concrete Slabs above Grade:
  - a. Piping Smaller Than NPS 6 : Steel pipe sleeves .
  - b. Piping NPS 6 and Larger: Steel pipe sleeves .
5. Interior Partitions:
  - a. Piping Smaller Than NPS 6 : Steel pipe sleeves .
  - b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves .

END OF SECTION 22 05 17

## SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

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## SECTION 22 05 18 - ESCUTCHEONS FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Escutcheons.
2. Floor plates.

#### 1.3 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. BrassCraft Manufacturing Co.; a Masco company.
  2. Dearborn Brass.
  3. Jones Stephens Corp.
  4. Keeney Manufacturing Company (The).
  5. Mid-America Fittings, Inc.
  6. ProFlo; a Ferguson Enterprises, Inc. brand.

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## 2.2 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
- C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip fasteners.
- E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

## 2.3 FLOOR PLATES

- A. Split Floor Plates: Cast brass with concealed hinge.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
    - b. Chrome-Plated Piping: One-piece cast brass with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
    - d. Insulated Piping: One-piece cast brass with finish.
    - e. Insulated Piping: One-piece stamped steel with polished, chrome-plated finish.
    - f. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with finish.
    - g. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
    - h. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel with polished, chrome-plated finish.
    - i. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with finish.

## ESCUTCHEONS FOR PLUMBING PIPING

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- j. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
  - k. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel with polished, chrome-plated finish.
  - l. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated finish.
  - m. Bare Piping in Unfinished Service Spaces: One-piece stamped steel with polished, chrome-plated finish.
  - n. Bare Piping in Equipment Rooms: One-piece cast brass with polished, chrome-plated finish.
  - o. Bare Piping in Equipment Rooms: One-piece stamped steel with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping : One-piece, floor plate.

### 3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 22 05 18

## ESCUTCHEONS FOR PLUMBING PIPING

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## SECTION 22 05 23.12 - BALL VALVES FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Bronze ball valves.

#### 1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. RPTFE: Reinforced polytetrafluoroethylene.
- C. WOG: Water, oil, gas.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, and soldered ends.
  - 3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection.
  - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

## BALL VALVES FOR PLUMBING PIPING

22 05 23.12 - 1

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Standards:

- 1. Domestic water valves intended to convey or dispense water for human consumption must comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or must be certified to be in compliance with NSF 61 and NSF 372 (by an ANSI-accredited third-party certification body) that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

- B. ASME Compliance:

- 1. ASME B1.20.1 for threads for threaded end valves.
- 2. ASME B16.1 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. ASME B16.18 for cast copper solder-joint connections.
- 6. ASME B16.22 for wrought copper and copper alloy solder-joint connections.
- 7. ASME B16.34 for flanged and threaded end connections
- 8. ASME B31.9 for building services piping valves.

- C. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

- E. Valve Sizes: Same as upstream piping unless otherwise indicated.

- F. Valve Actuator Type:

- 1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
- 2. Hand Lever: For quarter-turn valves smaller than NPS 4 .

- G. Valves in Insulated Piping:

- 1. Provide 2-inch extended neck stems.
- 2. Extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.

## BALL VALVES FOR PLUMBING PIPING

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3. Memory stops that are fully adjustable after insulation is applied.

## 2.3 BRONZE BALL VALVES

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

#### 3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.
- B. Provide support to piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access.
- D. For valves in horizontal piping, install valves with stem at or above center of pipe.
- E. Install valves in position to allow full valve actuation movement.
- F. Valve Tags: Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- G. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

### BALL VALVES FOR PLUMBING PIPING

22 05 23.12 - 3

### 3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves exhibiting leakage.

### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, provide the same types of valves with higher CWP ratings.
- B. Select valves with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
  - 2. For 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.

### 3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE - 150 PSIG OR LESS

- A. Pipe NPS 2 and Smaller:
  - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
  - 2. Bronze ball valves, two piece with full port, and bronze or brass trim.
  - 3. Bronze ball valves, two piece with regular port, and bronze trim.
- B. Pipe NPS 2-1/2 and Larger:
  - 1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
  - 2. Steel ball valves, Class 150 with full port.
  - 3. Iron ball valves, Class 150.

### 3.6 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
  - 1. Bronze ball valves, two piece with full port, and bronze or brass trim. Provide with threaded -joint ends.
  - 2. Bronze ball valves, two piece with regular port, and bronze trim.
- B. Pipe NPS 2-1/2 and Larger:
  - 1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.

END OF SECTION 22 05 23.12

## BALL VALVES FOR PLUMBING PIPING 22 05 23.12 - 4

## SECTION 22 05 23.14 - CHECK VALVES FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Bronze, lift check valves.
  2. Bronze, swing check valves.

#### 1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer.
- C. NBR: Nitrile butadiene rubber (also known as Buna-N).

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
  2. Protect threads, flange faces, grooves, press connections, and weld ends.
  3. Set check valves in either closed or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
  2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use stems or other components as lifting or rigging points unless specifically indicated for this purpose in manufacturer's instructions.

## CHECK VALVES FOR PLUMBING PIPING

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## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Standards:

- 1. Domestic water piping check valves intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372, or to be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

- B. 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 for metric standard piping.
- 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- 5. ASME B16.18 for cast-copper solder joint.
- 6. ASME B16.22 for wrought copper solder joint.
- 7. ASME B16.51 for press joint.
- 8. ASME B31.9 for building services piping valves.

- C. AWWA Compliance: Comply with AWWA C606 for groove-end connections.

- D. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.

- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

- F. Valve Sizes: Same as upstream piping unless otherwise indicated.

- G. Valve Bypass and Drain Connections: MSS SP-45.

### 2.3 BRONZE, LIFT CHECK VALVES

- A. Bronze, Lift Check Valves with Bronze Disc, Class 125:

## CHECK VALVES FOR PLUMBING PIPING

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. A.Y. McDonald Mfg. Co.
  - b. American Valve, Inc.
  - c. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - d. Crane Valves; a Crane Co. brand.
  - e. Flomatic Corporation.
  - f. Jenkins Valves; a Crane Co. brand.
  - g. Jomar Valve.
  - h. Keckley Company.
  - i. Metraflex Company (The).
  - j. Milwaukee Valve Company.
  - k. NIBCO INC.
  - l. Stockham; a Crane Co. brand.
  - m. Val-Matic Valve & Manufacturing Corp.
  - n. Victaulic Company.
  - o. WATTS.
2. Description:
  - a. Standard: MSS SP-80, Type 1.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Vertical flow.
  - d. Body Material: ASTM B61 or ASTM B62, bronze.
  - e. Ends: Threaded or soldered. See valve schedule articles.
  - f. Disc: Bronze.

## 2.4 BRONZE SWING CHECK VALVES

### A. Bronze, Swing Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Crane Valves; a Crane Co. brand.
  - c. Jenkins Valves; a Crane Co. brand.
  - d. Jomar Valve.
  - e. Keckley Company.
  - f. Lance Valves.
  - g. Milwaukee Valve Company.
  - h. NIBCO INC.
  - i. Red-White Valve Corp.
  - j. Shurjoint; a part of Aalberts Integrated piping Systems.
  - k. Stockham; a Crane Co. brand.
  - l. Val-Matic Valve & Manufacturing Corp.
  - m. Victaulic Company.
2. Description:
  - a. Standard: MSS SP-80, Type 3.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B62, bronze.

## CHECK VALVES FOR PLUMBING PIPING

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- e. Ends: Threaded or soldered. See valve schedule articles.
- f. Disc: Bronze.

## 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. Examine press fittings to verify they have been properly press.
- F. Do not attempt to repair defective valves; replace with new valves.

### 3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.
- D. Install valves so that stems are horizontal or slope upward from centerline of pipe.
- E. Install valves in position that does not project into aisles or block access to other equipment.
- F. Install valves in position to allow full stem and manual operator movement.
- G. Verify that joints of each valve have been properly installed and sealed to assure there is no leakage or damage.
- H. Check Valves: Install check valves for proper direction of flow.
  - 1. Swing Check Valves: In horizontal position with hinge pin level.
  - 2. Check Valves: In horizontal or vertical position, between flanges.

## CHECK VALVES FOR PLUMBING PIPING

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3. Lift Check Valves: With stem upright and plumb.

- I. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- J. Adhere to manufacturer's installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Pump-Discharge Check Valves:
    - a. NPS 2 and Smaller: Bronze, swing check valves with bronze disc.
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- C. End Connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded, soldered, or press-end connections.
  - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flange or threaded.
  - 3. For Copper Tubing, NPS 5 and Larger: Flange.
  - 4. For Steel Piping, NPS 2 and Smaller: Threaded.
  - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flange or threaded.
  - 6. For Steel Piping, NPS 5 and Larger: Flange.
  - 7. For Groove-End Copper Tubing and : Groove.

3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE - (150 PSIG OR LESS

- A. Pipe NPS 2 and Smaller:
  - 1. Vertical, Upflow Applications Only: Bronze lift check valves with bronze disc, Class 125, with threaded end connections.
  - 2. Horizontal and Vertical Applications: Bronze swing check valves with bronze disc, Class 125 , with threaded end connections.

CHECK VALVES FOR PLUMBING PIPING

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3.6 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze, swing check valves with bronze disc, Class 125 , with threaded end connections.

END OF SECTION 22 05 23.14

CHECK VALVES FOR PLUMBING PIPING

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## SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Thermal hanger-shield inserts.
6. Fastener systems.
7. Pipe stands.
8. Pipe-positioning systems.
9. Equipment supports.

- B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 22 05 16 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.

#### 1.3 ACTION SUBMITTALS

- A. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

## HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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## 1.5 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7 .
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
  - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

### 2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
  - 3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel .

### 2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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## 2.4 FIBERGLASS PIPE HANGERS

### A. Clevis-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 1 steel pipe hanger, except hanger is made of fiberglass or fiberglass-reinforced resin.
2. Hanger Rods: Continuous-thread rod, washer, and nuts made of fiberglass .
3. Flammability: ASTM D 635, ASTM E 84, UL 94.

## 2.5 METAL FRAMING SYSTEMS

### A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ABB, Electrification Business.
  - b. Cooper B-line; brand of Eaton, Electrical Sector.
  - c. Flex-Strut Inc.
  - d. G-Strut.
  - e. Haydon Corporation.
  - f. Rocket Rack; Robroy Industries.
  - g. Unistrut; Atkore International.
  - h. Wesanco, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
4. Channels: Continuous slotted carbon-steel channel with inturred lips.
5. Channel Width: Selected for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel .
8. Metallic Coating: Plain Hot-dip galvanized .
9. Paint Coating: Green epoxy, acrylic, or urethane .
10. Plastic Coating: PVC .
11. Combination Coating: .

## 2.6 THERMAL HANGER-SHIELD INSERTS

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

1. Buckaroos, Inc.
2. CADDY; brand of nVent Electrical plc.
3. Carpenter & Paterson, Inc.
4. National Pipe Hanger Corporation.
5. Pipe Shields Inc.

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6. Piping Technology & Products, Inc.
  7. Rilco Manufacturing Co., Inc.
  8. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate with 100-psig 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.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Hilti, Inc.
    - b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
    - c. MKT Fastening, LLC.
    - d. Simpson Strong-Tie Co., Inc.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cooper B-line; brand of Eaton, Electrical Sector.
    - b. Empire Tool and Manufacturing Co., Inc.
    - c. Hilti, Inc.
    - d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
    - e. MKT Fastening, LLC.
  2. Indoor Applications: Zinc-coated steel.
  3. Outdoor Applications: Stainless steel.

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## 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. Low-Profile, Single-Base, Single-Pipe Stand:
1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
  2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
  3. Vertical Members: Two galvanized -steel, continuous-thread, 1/2-inch rods.
  4. Horizontal Member: Adjustable horizontal, galvanized -steel pipe support channels.
  5. Pipe Supports: Roller .
  6. Hardware: Galvanized steel.
  7. Accessories: Protection pads.
  8. Height: 12 inches above roof .
- C. High-Profile, Single-Base, Single-Pipe Stand:
1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  2. Base: Single vulcanized rubber or molded polypropylene.
  3. Vertical Members: Two galvanized -steel, continuous-thread, 1/2-inch rods.
  4. Horizontal Member: One adjustable-height, galvanized- -steel, pipe-support slotted channel or plate.
  5. Pipe Supports: Clevis hanger .
  6. Hardware: Galvanized steel.
  7. Accessories: Protection pads , 1/2-inch , continuous-thread, galvanized-steel rod .
  8. Height: 36 inches above roof .
- D. High-Profile, Multiple-Pipe Stand:
1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
  2. Bases: Two or more; vulcanized rubber .
  3. Vertical Members: Two or more, galvanized -steel channels.
  4. Horizontal Members: One or more, adjustable-height, galvanized -steel pipe support.
  5. Pipe Supports: Strut clamps Clevis hanger .
  6. Hardware: Galvanized steel.
  7. Accessories: Protection pads , 1/2-inch , continuous-thread rod.
  8. Height: 36 inches above roof .
- E. 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.

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## 2.9 PIPE-POSITIONING SYSTEMS

- A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## 2.10 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

## 2.11 MATERIALS

- A. Aluminum: ASTM B 221.
- B. Carbon Steel: ASTM A 1011/A 1011M.
- C. Structural Steel: ASTM A 36/A 36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A 240/A 240M.
- E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb .

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

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- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- F. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Pipe Stand Installation:
  - 1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 07 72 00 "Roof Accessories" for curbs.
- H. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

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- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.
- N. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- P. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
  - 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
  - 6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.

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- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches .

### 3.6 PAINTING

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 09 91 13 "Exterior Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

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### 3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- F. Use stainless-steel pipe hangers fiberglass pipe hangers and corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal hanger-shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  - 4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  - 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  - 6. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  - 7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  - 8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.

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9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  10. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
  11. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
  12. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

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9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

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- a. Horizontal (MSS Type 54): Mounted horizontally.
  - b. Vertical (MSS Type 55): Mounted vertically.
  - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners [or] mechanical-expansion anchors instead of building attachments where required in concrete construction.
- S. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29

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## SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Warning tape.
4. Pipe labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

##### B. Related Requirements:

1. Section 22 61 13 "Compressed-Air Piping for Laboratory and Healthcare Facilities" for labeling requirements, complying with NFPA 99, for medical, compressed-air system piping and associated components in healthcare facilities.
2. Section 22 62 13 "Vacuum Piping for Laboratory and Healthcare Facilities" for labeling requirements, complying with NFPA 99, for medical surgical, healthcare laboratory, and dental vacuum system piping, waste anesthetic gas and oral evacuation system piping, and associated components in healthcare facilities.
3. Section 22 63 13 "Gas Piping for Laboratory and Healthcare Facilities" for labeling requirements, complying with NFPA 99, for medical carbon dioxide, laboratory carbon dioxide, medical helium, laboratory helium, medical nitrogen, laboratory nitrogen, medical nitrous oxide, laboratory nitrous oxide, medical oxygen, and laboratory oxygen.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve-numbering scheme.
- E. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

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## PART 2 - PRODUCTS

### 2.1 EQUIPMENT LABELS

#### A. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Brady Corporation.
  - b. Brimar Industries, Inc.
  - c. Carlton Industries, LP.
  - d. Champion America.
  - e. emedco.
  - f. Kolbi Pipe Marker Co.
  - g. LEM Products Inc.
  - h. Marking Services, Inc.
2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
4. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- #### B. Label Content:
- Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

### 2.2 WARNING SIGNS AND LABELS

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

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Champion America.
5. emedco.
6. LEM Products Inc.
7. Marking Services Inc.
8. National Marker Company.
9. Seton Identification Products; a Brady Corporation company.

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10. Stranco, Inc.

- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E , and other applicable codes and standards.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 WARNING TAPE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation.
  - 2. Brimar Industries, Inc.
  - 3. Craftmark Pipe Markers.
  - 4. National Marker Company.
  - 5. Seton Identification Products; a Brady Corporation company.
- B. Material: Vinyl.
- C. Minimum Thickness: 0.005 inch.
- D. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.
- E. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.
- F. Maximum Temperature: 160 deg F.

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- G. Minimum Width: 4 inches.

## 2.4 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
  - 2. Brady Corporation.
  - 3. Brimar Industries, Inc.
  - 4. Carlton Industries, LP.
  - 5. Champion America.
  - 6. emedco.
  - 7. Kolbi Pipe Marker Co.
  - 8. LEM Products Inc.
  - 9. Marking Services Inc.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
  - 1. Pipe size.
  - 2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
  - 3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

## 2.5 STENCILS

- A. Stencils for Piping:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brimar Industries, Inc.
    - b. Craftmark Pipe Markers.
    - c. Kolbi Pipe Marker Co.
    - d. Marking Services Inc.

### IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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2. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.
3. Stencil Material: Aluminum, brass, or fiberboard.
4. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior, alkyd enamel in colors in accordance with ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
6. Letter and Background Color: As indicated for specific application under Part 3.

## 2.6 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
  2. Brady Corporation.
  3. Brimar Industries, Inc.
  4. Carlton Industries, LP.
  5. Champion America.
  6. emedco.
  7. Kolbi Pipe Marker Co.
  8. LEM Products Inc.
  9. Marking Services Inc.
- B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  1. Tag Material: Brass, 0.04-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
  2. Fasteners: Brass or beaded chain or S-hook.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  1. Include valve-tag schedule in operation and maintenance data.

## 2.7 WARNING TAGS

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

### IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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2. Brimar Industries, Inc.
3. Champion America.
4. emedco.
5. Kolbi Pipe Marker Co.
6. LEM Products Inc.
7. Marking Services Inc.
8. Seton Identification Products; a Brady Corporation company.

B. Description: Preprinted accident-prevention tags of plasticized card stock.

1. Size: Approximately 4 by 7 inches .
2. Fasteners: Brass grommet and wire .
3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Letter and Background Color: As indicated for specific application under Part 3.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

#### 3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

#### 3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
1. White letters on an ANSI Z535.1 safety-green background .
- C. Locate equipment labels where accessible and visible.

### IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

### 3.4 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.
- C. Locate tape so as to be readily visible from the point of normal approach.

### 3.5 INSTALLATION OF PIPE LABELS

- A. Piping Color Coding: Painting of piping is specified in Section 09 91 23 "Interior Painting."
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. Stenciled Pipe Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.
- D. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Within 3 ft. of each valve and control device.
  - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 3. Within 3 ft. of equipment items and other points of origination and termination.
  - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
- E. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- F. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

## IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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G. Pipe-Label Color Schedule:

1. Low-Pressure Compressed-Air Piping: White letters on an ANSI Z535.1 safety-blue background .
2. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background .
3. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background
4. Domestic Hot-Water Return Piping White letters on an ANSI Z535.1 safety-green background .
5. .

3.6 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
1. Valve-Tag Size and Shape:
    - a. Domestic Cold Water: 1-1/2 inches , round .
    - b. Domestic Hot Water: 1-1/2 inches , round .
    - c. Domestic Hot-Water Return: 1-1/2 inches , round .
    - d. Low-Pressure Compressed Air: 1-1/2 inches , round .
    - e. .
  2. Valve-Tag Colors:
    - a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

3.7 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background .
- B. Attach warning tags, with proper message, to equipment and other items where indicated on Drawings .

END OF SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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## SECTION 22 05 93 - TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

### 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. TAB of domestic water system.
  - 2. TAB of plumbing equipment:
    - a. Domestic water booster pumps.
    - b. Domestic hot-water in-line circulation pumps.
    - c. General-duty air compressors.
    - d. Sanitary sewage pumps.
    - e. Drainage pumps.
    - f. Laboratory air compressors.
  - 3. Pipe-leakage test verification.

#### 1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

## TESTING, ADJUSTING, AND BALANCING FOR PLUMBING 22 05 93 - 1

## 1.5 QUALITY ASSURANCE

- A. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.
- B. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

## PART 2 - PRODUCTS (Not Applicable)

## PART 3 - EXECUTION

### 3.1 TAB SPECIALISTS

### 3.2 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine approved submittals for plumbing systems and equipment.
- D. Examine design data, including plumbing system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.
- E. Examine equipment performance data, including pump curves.
  - 1. Relate performance data to Project conditions and requirements, including pump system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate pump system-effect factors to reduce performance ratings of plumbing equipment when installed under conditions different from the conditions used to rate equipment performance. Compare results with the design data and installed conditions.
- F. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.

## TESTING, ADJUSTING, AND BALANCING FOR PLUMBING 22 05 93 - 2

- H. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- I. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainers are installed and clean.
- J. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.
- K. Examine system pumps to ensure absence of entrained air in the suction piping.
- L. Examine operating safety interlocks and controls on plumbing equipment.
- M. 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.

### 3.3 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 plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
  - 1. Domestic Water System:
    - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
    - b. Water heaters are installed and functioning.
    - c. Piping is complete and all points of outlet are installed.
    - d. Water treatment is complete.
    - e. Systems are flushed, filled, and air purged.
    - f. Strainers are clean.
    - g. Control valves are functioning in accordance with the sequence of operation.
    - h. Shutoff and balance valves are 100 percent open.
    - i. hot-water circulating pumps are operational and proper rotation is verified.
    - j. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
    - k. Variable-frequency controllers' startup is complete and safeties are verified.
    - l. Suitable access to balancing devices and equipment is provided.
  - 2. Sanitary Sewage/Drainage System:



- a. Leakage and pressure tests on sanitary sewage/drainage systems have been completed in accordance with applicable code and authority having jurisdiction requirements.
  - b. Piping is complete.
  - c. Sanitary sewage pumps/drainage pumps are operational.
  - d. Control valves are functioning in accordance with the sequence of operation.
  - e. Shutoff valves are 100 percent open.
  - f. Suitable access to equipment is provided.
3. Compressed-Air System:
- a. Leakage and pressure tests on compressed air distribution system have been satisfactorily completed in accordance with Division 22 requirements.
  - b. Piping is complete and all points of outlet are installed.
  - c. Systems are flushed, filled, and air purged.
  - d. Strainers are clean.
  - e. Control valves are functioning in accordance with the sequence of operation.
  - f. Shutoff and balance valves are 100 percent open.
  - g. Compressors are operational and of proper rotation.
  - h. Gauge connections are installed directly at compressor inlet and outlet flanges prior to valves or strainers.
  - i. Variable-frequency controllers' startup is complete and safeties are verified.
  - j. Suitable access to balancing devices and equipment is provided,

#### 3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.
- B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
  1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.
  2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 22 07 16 "Plumbing Equipment Insulation" and Section 22 07 19 "Plumbing Piping Insulation."
- C. Mark equipment and balancing devices, including valve position indicators 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.

#### TESTING, ADJUSTING, AND BALANCING FOR PLUMBING 22 05 93 - 4

### 3.5 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

- A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:
  - 1. Domestic water in-line pumps.
  - 2. Domestic water heaters.
  - 3. Air compressors.

### 3.6 PROCEDURES FOR DOMESTIC WATER SYSTEMS

- A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:
  - 1. Check expansion tank for proper setting.
  - 2. Check water heater for proper discharge temperature setting.
  - 3. Check remotest point of outlet for adequate pressure.
  - 4. Check flow-control valves for proper position.
  - 5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
  - 6. Verify that motor controllers are equipped with properly sized thermal protection.
  - 7. Check that air has been purged from the system.
- D. Measure and record upstream and downstream pressure of each piece of equipment.
- E. Measure and record upstream and downstream pressure of pressure-reducing valves.
- F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
- G. Check settings and operation of each safety valve. Record settings.

### 3.7 PROCEDURES FOR COMPRESSED-AIR SYSTEMS

- A. Prepare test reports for air compressors, and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare compressed-air systems for testing and balancing as follows:

## TESTING, ADJUSTING, AND BALANCING FOR PLUMBING 22 05 93 - 5

1. Check remotest point of outlet for adequate pressure.
  2. Check pressure-control valves for proper position.
  3. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
  4. Verify that motor controllers are equipped with properly sized thermal protection.
- D. Measure and record upstream and downstream pressure of pressure-reducing valves.
- E. Check settings and operation of pressure-reducing valves. Record final settings.
- F. Check settings and operation of each safety valve. Record settings.

### 3.8 PROCEDURES FOR DOMESTIC HOT-WATER CIRCULATING INLINE PUMP

- A. Balance system with manual or automatic balancing valves by setting at design flow.
1. Measure flow in main and branch pipes.
  2. Adjust main and branch balance valves for design flow.
  3. Re-measure each main and branch after all have been adjusted.
- B. Adjust pump to deliver total design flow.
1. Measure pump TDH as follows:
    - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
    - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
    - c. Convert pressure to head and correct for differences in gauge heights.
    - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
  2. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
  3. Mark final settings and verify that all memory stops have been set.
  4. Verify final system conditions as follows:
    - a. Re-measure and confirm that total flow is within design.
    - b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
    - c. Mark final settings.

### 3.9 PROCEDURES FOR WATER HEATERS

- A. Electric Water Heaters:
1. Measure and record entering- and leaving-water temperatures.
  2. Measure and record water flow.
  3. Measure and record pressure drop.
  4. Measure and Record relief valve(s) pressure setting.

5. Capacity: Calculate in Btu/h of heating output.
6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.

### 3.10 TOLERANCES

- A. Set plumbing system's flow rates within the following tolerances:
1. Domestic Water Flow Rate: Plus or minus 10 percent . If design value is less than 10 gpm, within 10 percent.
  2. Compressed-Air Flow Rate: Plus or minus 10 percent . If design value is less than 10 gpm, within 10 percent.

### 3.11 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. Manufacturers' test data.
  3. Field test reports prepared by system and equipment installers.
  4. 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. Notes to explain why certain final data in the body of reports vary from indicated values.
  14. Test conditions for pump performance forms, including the following:
    - a. Variable-frequency controller settings for variable-flow hydronic systems.
    - b. Settings for pressure controller(s).
    - c. Other system operating conditions that affect performance.
- D. Electric Water Heater Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Model number and unit size.
    - d. Manufacturer's serial number.
    - e. Output capacity in Btu/h.
    - f. Number of stages.
    - g. Connected volts, phase, and hertz.
    - h. Rated amperage.
  2. Test Data (Indicated and Actual Values):
    - a. Heat output in Btu/h.
    - b. Entering-water temperature in deg F.
    - c. Leaving-water temperature in deg F.
    - d. High-temperature-limit setting in deg F.
    - e. Operating set point in deg F.
    - f. Voltage at each connection.
    - g. Amperage for each phase.
- E. Instrument Calibration Reports:
1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

END OF SECTION 22 05 93

## SECTION 22 07 19 - PLUMBING PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
  - 1. Domestic cold-water piping.
  - 2. Domestic hot-water piping.
  - 3. Domestic recirculating hot-water piping.
  - 4. Sanitary waste piping exposed to freezing conditions.
- B. Related Sections:
  - 1. Section 22 07 16 "Plumbing Equipment Insulation" for equipment insulation.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

#### 1.3 INFORMATIONAL SUBMITTALS

#### 1.4 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. Comply with the following applicable standards and other requirements specified for miscellaneous components:
  - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size, as well as ASTM standard designation and maximum use temperature.

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## 1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

## 1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
  - 1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. All Insulation Installed Indoors; Outdoors-Installed Insulation in Contact with Airstream: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 3. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

### 2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.

## PLUMBING PIPING INSULATION 22 07 19 - 2

- C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Owens Corning.
    - 2. Preformed Pipe Insulation, Type II, Class 2: With factory-applied ASJ+ jacket.
    - 3. Fabricated shapes in accordance with ASTM C450, ASTM C585, and ASTM C1639.
    - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I for tubular materials.
  - 1. Manufacturers: Subject to compliance with requirements, undefined:
    - a. Aeroflex USA.
    - b. Armacell LLC.
    - c. K-Flex USA.
- H. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Knauf Insulation.
    - c. Manson Insulation Inc.
    - d. Owens Corning.
  - 2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ+ jacket .
  - 3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
  - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Mineral Wool, Preformed Pipe: Mandrel-wound mineral wool fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. Comply with ASTM C547.



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Owens Corning.
  2. Preformed Pipe Insulation: Type II, Grade A with factory-applied ASJ .
  3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
- J. Phenolic: Fabricated pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C1126, Type III.
1. Manufacturers: Subject to compliance with requirements, undefined:
    - a. Polyguard Products, Inc.
    - b. Resolco Inc.
  2. Pre-fabricated Pipe Insulation: Type III , with factory-applied ASJ .
  3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
  4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

## 2.3 INSULATING CEMENTS

- A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.
1. Manufacturers: Subject to compliance with requirements, undefined:
    - a. Ramco Insulation, Inc.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.
1. Manufacturers: Subject to compliance with requirements, undefined:
    - a. Ramco Insulation, Inc.
- C. Glass-Fiber and Mineral Wool Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.
1. Manufacturers: Subject to compliance with requirements, undefined:
    - a. Ramco Insulation, Inc.

## 2.4 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
1. Manufacturers: Subject to compliance with requirements, undefined:
    - a. Foster Brand; H. B. Fuller Construction Products.

- C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
  - 1. Manufacturers: Subject to compliance with requirements, undefined:
    - a. Aeroflex USA.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. K-Flex USA.
  - 2. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
  - 3. Wet Flash Point: Below 0 deg F.
  - 4. Service Temperature Range: 40 to 200 deg F.
  - 5. Color: Black .
  
- D. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Manufacturers: Subject to compliance with requirements, undefined:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Mon-Eco Industries, Inc.
  
- E. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
  - 1. Manufacturers: Subject to compliance with requirements, undefined:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
  
- F. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Mon-Eco Industries, Inc.
  
- G. PVC Jacket Adhesive: Compatible with PVC jacket.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. P.I.C. Plastics, Inc.
    - c. Proto Corporation.

## 2.5 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.

1. 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 Construction Products.
    - c. Knauf Insulation.
    - d. Mon-Eco Industries, Inc.
  2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  3. Service Temperature Range: 0 to plus 180 deg F .
  4. Comply with MIL-PRF-19565C, Type II, for permeance requirements , with supplier listing on DOD QPD - Qualified Products Database.
  5. Color: White .
- C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Mon-Eco Industries, Inc.
  2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  3. Service Temperature Range: 0 to 180 deg F.
  4. Color: White .
- D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, undefined:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
  2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  3. Service Temperature Range: Minus 50 to plus 220 deg F.
  4. Color: White .
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Knauf Insulation.
    - d. Mon-Eco Industries, Inc.
  2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
  3. Service Temperature Range: 0 to plus 180 deg F .
  4. Color: White .

## 2.6 SEALANTS

- A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Mon-Eco Industries, Inc.
    - d. Owens Corning.
  2. Permanently flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 58 to plus 176 deg F .
  4. Color: White or gray.
- C. FSK and Metal Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Mon-Eco Industries, Inc.
  2. Fire- and water-resistant, flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 40 to plus 250 deg F.
  4. Color: Aluminum.
- D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, undefined:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
  2. Fire- and water-resistant, flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 40 to plus 250 deg F.
  4. Color: White.

## 2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136 Types I, II, III, IV, and VII.
5. PSK Jacket: Aluminum foil fiberglass reinforced scrim with polyethylene backing, complying with ASTM C1136, Type II.

## 2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.

B. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Johns Manville; a Berkshire Hathaway company.
2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  - a. Sheet and roll stock ready for shop or field sizing .
  - b. Finish and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper .
  - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper .
  - e. Factory-Fabricated Fitting Covers:
    - 1) Same material, finish, and thickness as jacket.
    - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 3) Tee covers.
    - 4) Flange and union covers.
    - 5) End caps.
    - 6) Beveled collars.
    - 7) Valve covers.
    - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

## 2.9 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Mesh: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

1. Manufacturers: Subject to compliance with requirements, undefined:
  - a. Childers Brand; H. B. Fuller Construction Products.

## 2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. 3M Industrial Adhesives and Tapes Division.
  - b. Avery Dennison Corporation, Specialty Tapes Division.
  - c. Ideal Tape Co., Inc., an American Biltrite Company.
  - d. Knauf Insulation.
2. Width: 3 inches .
3. Thickness: 11.5 mils .
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. 3M Industrial Adhesives and Tapes Division.
  - b. Avery Dennison Corporation, Specialty Tapes Division.
  - c. Ideal Tape Co., Inc., an American Biltrite Company.
  - d. Knauf Insulation.
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.

## 2.11 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Johns Manville; a Berkshire Hathaway company.
2. Stainless Steel: ASTM A240/A240M, Type 304 ; 0.015 inch thick, 3/4 inch wide with closed seal.
3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch 3/4 inch wide with closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. C & F Wire.
  - b. Johns Manville; a Berkshire Hathaway company.

## 2.12 PROTECTIVE SHIELDING GUARDS

### A. Protective Shielding Pipe Covers, :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Buckaroos, Inc.
  - b. Just Manufacturing.
  - c. McGuire Manufacturing.
  - d. MVG Molded Products.
  - e. Plumberex Specialty Products, Inc.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  1. Verify that systems to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents , unless otherwise approved by the engineer-of-record.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
  - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.



- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
  - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Cleanouts.

### 3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

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2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  3. Insulate tee fittings with preformed fitting insulation or of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate valves using preformed fitting insulation sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation conforms to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.

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2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

#### A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

#### B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

#### C. Insulation Installation on Pipe Fittings and Elbows:

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1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered or routed sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

### 3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.7 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

#### A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

#### B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

#### C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

#### D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### 3.8 INSTALLATION OF PHENOLIC INSULATION

#### A. General Installation Requirements:

1. Secure single-layer insulation with stainless steel bands at 12-inch intervals, and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless steel bands at 12-inch intervals.

#### B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

#### C. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.

#### D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.

#### E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

### 3.9 INSTALLATION OF FIELD-APPLIED JACKETS

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

### 3.10 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

### 3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.12 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
  - 1. NPS 1 and Smaller: Insulation is one of the following:
    - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch 1 inch thick.
    - b. Phenolic: 1 inch thick.
  - 2. NPS 1-1/4 and Larger: Insulation is one of the following:
    - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
    - b. Phenolic: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
  - 1. NPS 1-1/4 and Smaller: Insulation is one of the following:
    - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
    - b. Phenolic: 1 inch thick.
  - 2. NPS 1-1/2 and Larger: Insulation is one of the following:
    - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

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- b. Phenolic: 1 inch thick.
  - C. Sanitary Waste Piping Where Heat Tracing Is Installed:
    - 1. All Pipe Sizes: Insulation is one of the following:
      - a. Phenolic: 1-1/2 inches thick.
  - D. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
    - 1. All Pipe Sizes: Insulation is one of the following:
      - a. Cellular Glass: 1-1/2 inches thick.
  - E. Hot Service Drains:
    - 1. All Pipe Sizes: Insulation is one of the following:
      - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - F. Hot Service Vents:
    - 1. All Pipe Sizes: Insulation is one of the following:
      - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- 3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE
- A. Domestic Water Piping:
    - 1. All Pipe Sizes: Insulation is one of the following:
      - a. Phenolic: 2 inches thick.
  - B. Sanitary Waste Piping Where Heat Tracing Is Installed:
    - 1. All Pipe Sizes: Insulation is one of the following:
      - a. Phenolic: 2 inches thick.
- 3.15 INDOOR, FIELD-APPLIED JACKET SCHEDULE
- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
  - B. If more than one material is listed, selection from materials listed is Contractor's option.
  - C. Piping, Exposed:
    - 1. PVC : 20 mils thick.
    - 2. .

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3.16 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Exposed:
  - 1. PVC: 30 mils thick.
  - 2. .

END OF SECTION 22 07 19

## SECTION 22 11 16 - DOMESTIC WATER PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Piping joining materials.
3. Encasement for piping.
4. Transition fittings.
5. Dielectric fittings.

B. Related Requirements:

1. Section 33 14 15 "Site Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. Pipe and tube.
2. Fittings.
3. Joining materials.
4. Transition fittings.

#### 1.3 INFORMATIONAL SUBMITTALS

#### 1.4 FIELD CONDITIONS

#### 1.5 WARRANTY

A. Polypropylene Piping (PP-R) Manufacturer's Warranty: Manufacturer agrees to repair or replace PP-R pipe and fittings that fail in materials or workmanship within 10 years from date of Substantial Completion.

1. Warranty is to cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system due to defects in materials or manufacturing.

## DOMESTIC WATER PIPING 22 11 16 - 1

2. Warranty is to be in effect only upon submission by the Contractor to the manufacturer of valid pressure/leak documentation indicating that the system was tested and passed the manufacturer's pressure/leak test.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

### 2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B88, Type K ASTM B88, Type L .
- B. Annealed-Temper Copper Tube: ASTM B88, Type K ASTM B88, Type L .
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

### 2.3 PIPING JOINING MATERIALS

- A. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- B. Solder Filler Metals: ASTM B32, lead-free alloys.
- C. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

### 2.4 ENCASEMENT FOR PIPING

- A. Standard: ASTM A674 or AWWA C105/A21.5.
- B. Form: Sheet or tube.
- C. Color: Black or natural .

### 2.5 TRANSITION FITTINGS

- A. General Requirements:
  1. Same size as pipes to be joined.
  2. Pressure rating at least equal to pipes to be joined.
  3. End connections compatible with pipes to be joined.

- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

## 2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A.Y. McDonald Mfg. Co.
    - b. Capitol Manufacturing Company.
    - c. Central Plastics Company.
    - d. HART Industrial Unions, LLC.
    - e. Jomar Valve.
    - f. Matco-Norca.
    - g. WATTS.
    - h. Wilkins.
    - i. Zurn Industries, LLC.
  - 2. Standard: ASSE 1079.
  - 3. Pressure Rating: 250 psig .
  - 4. End Connections: Solder-joint copper alloy and threaded ferrous.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller , shall be one of the following:
  - 1. Annealed-temper copper tube, ASTM B88, Type K ; wrought-copper, solder-joint fittings; and brazed joints.
- E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger , shall be one of the following:

## DOMESTIC WATER PIPING 22 11 16 - 3

1. Annealed-temper copper tube, ASTM B88, Type K ; wrought-copper, solder-joint fittings; and brazed joints.
- F. Under-building-slab, domestic water piping, NPS 2 and smaller , shall be one of the following:
1. Drawn-temper or copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
- G. Aboveground domestic water piping, NPS 2 and smaller , shall be the following:
1. Drawn-temper copper tube, ASTM B88, Type L ; or wrought-copper, solder-joint fittings; and soldered joints.
- H. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 , shall be one of the following:
1. Drawn-temper copper tube, ASTM B88, Type L ; wrought-copper, solder-joint fittings; and soldered joints.

### 3.2 EARTHWORK

- A. Comply with requirements in Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

### 3.3 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install underground copper tube in PE encasement according to ASTM A674 or AWWA C105/A21.5.
- D. Install valves according to the following:
1. Section 22 05 23.12 "Ball Valves for Plumbing Piping."
  2. Section 22 05 23.13 "Butterfly Valves for Plumbing Piping."
  3. Section 22 05 23.14 "Check Valves for Plumbing Piping."
  4. Section 22 05 23.15 "Gate Valves for Plumbing Piping."
- E. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 22 11 19 "Domestic Water Piping Specialties."

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- F. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- G. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- I. 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.
- J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- K. Install piping to permit valve servicing.
- L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- P. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- Q. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 22 11 23 "Domestic Water Pumps."
- R. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

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- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

### 3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
- G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- J. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Square cut Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.



- K. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- L. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
- M. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### 3.5 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
  - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings unions.

### 3.6 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings .
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 : Use dielectric .

### 3.7 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for copper and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Install vinyl-coated hangers for and piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches of each fitting.

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- E. Support vertical runs of copper [**and**] tubing and piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- F. Support vertical runs of and piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
  - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.9 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### 3.10 ADJUSTING

- A. Perform the following adjustments before operation:
  - 1. Close drain valves, hydrants, and hose bibbs.
  - 2. Open shutoff valves to fully open position.
  - 3. Open throttling valves to proper setting.
  - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    - b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.11 FIELD QUALITY CONTROL

#### A. Perform the following tests and inspections:

1. Piping Inspections:
  - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
  - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
    - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
    - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
  - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
  - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
  - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
  - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
  - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  - e. Hydrostatic testing and documentation of test results for polypropylene piping to be in accordance with the manufacturer's instructions and submitted to the manufacturer upon successful completion per warranty requirements.
  - f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
  - g. Prepare reports for tests and for corrective action required.

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- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.12 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
  - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Repeat procedures if biological examination shows contamination.
    - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
  - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  - 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 22 11 16

## DOMESTIC WATER PIPING 22 11 16 - 10

## SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers for domestic water piping.
7. Hose bibbs.
8. Wall hydrants.
9. Water-hammer arresters.
10. Trap-seal primer device.
11. Flexible connectors.

##### B. Related Requirements:

1. Section 22 05 19 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gauges, and flow meters in domestic water piping.
2. Section 22 11 16 "Domestic Water Piping" for water meters.
3. Section 22 32 00 "Domestic Water Filtration Equipment" for water filters in domestic water piping.
4. Section 22 43 00 "Healthcare Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
5. Section 22 45 00 "Emergency Plumbing Fixtures" for water tempering equipment.
6. Section 22 47 16 "Pressure Water Coolers" for water filters for water coolers.
7. Section 22 47 23 "Remote Water Coolers" for water filters for water coolers.
8. Section 23 09 23.18 "Leak Detection Instruments" for leak detection devices related to HVAC applications.
9. Section 33 14 15 "Site Water Distribution Piping" for fire water-service backflow prevention devices.

#### 1.2 DEFINITIONS

- A. AMI: Advanced Metering Infrastructure.
- B. AMR: Automatic Meter Reading.
- C. FKM: A family of fluoroelastomer materials defined by ASTM D1418.

## DOMESTIC WATER PIPING SPECIALTIES 22 11 19 - 1

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

1.5 CLOSEOUT SUBMITTALS

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Cash Acme, A Division of Reliance Worldwide Corporation.
  - c. FEBCO; A WATTS Brand.
  - d. WATTS.
  - e. Zurn Industries, LLC.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze .

- B. Hose-Connection Vacuum Breakers :

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

- a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
- b. Cash Acme, A Division of Reliance Worldwide Corporation.
- c. Champion - Arrowhead.
- d. Legend Valve & Fitting, Inc.
- e. MIFAB, Inc.
- f. WATTS.
- g. Woodford Manufacturing Company.
- h. Zurn Industries, LLC.
2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Rough bronze.

C. Pressure Vacuum Breakers :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. FEBCO; A WATTS Brand.
  - c. WATTS.
  - d. Zurn Industries, LLC.
2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Accessories:
  - a. Valves: Ball type, on inlet and outlet.

D. Laboratory-Faucet Vacuum Breakers :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. WATTS.
  - c. Zurn Industries, LLC.
2. Standard: ASSE 1035.
3. Size: NPS 1/4 or NPS 3/8 matching faucet size.
4. Body: Bronze.
5. End Connections: Threaded.
6. Finish: Chrome plated.

E. Spill-Resistant Vacuum Breakers :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. WATTS.
  - c. Zurn Industries, LLC.
2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Accessories:

- a. Valves: Ball type, on inlet and outlet.

## 2.4 BACKFLOW PREVENTERS

### A. Reduced-Pressure-Principle Backflow Preventers :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Fire & Waterworks; A WATTS Brand.
  - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - c. Caleffi North America.
  - d. FEBCO; A WATTS Brand.
  - e. WATTS.
  - f. Zurn Industries, LLC.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Body: Bronze for NPS 2 and smaller; stainless steel for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight-through flow.
8. Accessories:
  - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
  - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
  - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

### B. Double-Check, Backflow-Prevention Assemblies :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Fire & Waterworks; A WATTS Brand.
  - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - c. FEBCO; A WATTS Brand.
  - d. WATTS.
  - e. Zurn Industries, LLC.
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Body: Bronze stainless steel for NPS 2 and smaller; or stainless steel for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight-through flow.
8. Accessories:
  - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
  - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.



C. Beverage-Dispensing-Equipment Backflow Preventers :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. WATTS.
  - c. Zurn Industries, LLC.
2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel or non-metallic .
6. End Connections: Threaded or flare.

D. Hose-Connection Backflow Preventers :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. WATTS.
  - c. Woodford Manufacturing Company.
  - d. Zurn Industries, LLC.
2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

E. Backflow-Preventer Test Kits :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Fire & Waterworks; A WATTS Brand.
  - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - c. FEBCO; A WATTS Brand.
  - d. WATTS.
  - e. Zurn Industries, LLC.
2. Description: Factory calibrated, with gauges, fittings, hoses, and carrying case with test-procedure instructions.

## 2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Cash Acme, A Division of Reliance Worldwide Corporation.
  - c. WATTS.
  - d. Zurn Industries, LLC.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze with chrome-plated finish for NPS 2 and smaller; bronze for NPS 2-1/2 and NPS 3.
5. Valves for Booster Heater Water Supply: Include integral bypass.
6. End Connections: Threaded or solder for NPS 2 and smaller; flanged or solder for NPS 2-1/2 and NPS 3.

B. Water-Control Valves :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. CLA-VAL.
  - c. Flomatic Corporation.
  - d. OCV Control Valves.
  - e. WATTS.
  - f. Zurn Industries, LLC.
2. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless steel body.
  - a. Pattern: Angle -valve design.
  - b. Trim: Stainless steel.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

## 2.6 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Bell & Gossett; a Xylem brand.
  - b. IMI Hydronic Engineering Inc.
  - c. Nexus Valve, Inc.; Aalberts Hydronic Flow Control.
  - d. NIBCO INC.
  - e. WATTS.
2. Type: Ball valve with two readout ports and memory-setting indicator.
3. Body: bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Memory-Stop Balancing Valves :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Crane; a Crane Co. brand.
  - c. Hammond Valve.
  - d. Jenkins Valves; a Crane Co. brand.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Red-White Valve Corp.
  - h. Stockham; a Crane Co. brand.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass or stainless steel.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

## 2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

### A. Primary, Thermostatic, Water Mixing Valves :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acorn Engineering Company; a Division of Morris Group International.
  - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - c. Caleffi North America.
  - d. Cash Acme, A Division of Reliance Worldwide Corporation.
  - e. Lawler Manufacturing Company, Inc.
  - f. Leonard Valve Company.
  - g. POWERS; A WATTS Brand.
  - h. Symmons Industries, Inc.
  - i. WATTS.
  - j. Zurn Industries, LLC.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed-mounted , thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Finish: Rough bronze.
9. Piping Finish: Copper.
10. Cabinet: Factory fabricated, stainless steel, for surface mounting and with hinged, stainless steel door.

### B. Individual-Fixture, Water Tempering Valves :

## DOMESTIC WATER PIPING SPECIALTIES 22 11 19 - 7

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acorn Engineering Company; a Division of Morris Group International.
  - b. Lawler Manufacturing Company, Inc.
  - c. Leonard Valve Company.
  - d. POWERS; A WATTS Brand.
  - e. Zurn Industries, LLC.
2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Material: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Connections: Threaded inlets and outlet.
7. Finish: Chrome plated.

## 2.8 STRAINERS FOR DOMESTIC WATER PIPING

### A. Y-Pattern Strainers :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Keckley Company.
  - b. Titan Flow Control, Inc.
  - c. WATTS.
  - d. Zurn Industries, LLC.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze for NPS 2 and smaller; cast iron for NPS 2-1/2 and larger.
4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
5. Screen: Stainless steel with round perforations unless otherwise indicated.
6. Perforation Size:
  - a. Strainers NPS 2 and Smaller: 0.062 inch .
  - b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch .
  - c. Strainers NPS 5 and Larger: 0.125 inch .
7. Drain: Factory-installed, hose-end drain valve.

## 2.9 HOSE BIBBS

### A. Hose Bibbs :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. MIFAB, Inc.
  - c. Prier Products, Inc.
  - d. WATTS.
  - e. Woodford Manufacturing Company.
  - f. Zurn Industries, LLC.
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 .
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 Operating key.
14. Operation for Finished Rooms: 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.

## 2.10 WALL HYDRANTS

### A. Nonfreeze Wall Hydrants :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. Prier Products, Inc.
  - e. WATTS.
  - f. Woodford Manufacturing Company.
  - g. Zurn Industries, LLC.
2. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet, Concealed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Polished nickel bronze .
10. Outlet, Exposed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze .
12. Operating Keys(s): One Two with each wall hydrant.

## 2.11 WATER-HAMMER ARRESTERS

### A. Water-Hammer Arresters :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Jay R. Smith Mfg Co; a division of Morris Group International.
  - c. Josam Company.
  - d. MIFAB, Inc.
  - e. Precision Plumbing Products.
  - f. Sioux Chief Manufacturing Company, Inc.
  - g. WATTS.
  - h. Zurn Industries, LLC.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Piston .
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## 2.12 TRAP-SEAL PRIMER DEVICE

### A. Supply-Type, Trap-Seal Primer Device :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. Precision Plumbing Products.
  - e. Sioux Chief Manufacturing Company, Inc.
  - f. WATTS.
  - g. Zurn Industries, LLC.
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, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. MIFAB, Inc.
  - c. Precision Plumbing Products.
  - d. Zurn Industries, LLC.
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.

## 2.13 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flex-Hose Co., Inc.
  2. Mason Industries, 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 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 .
  2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
  3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
  2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
  3. Do not install bypass piping around backflow preventers.
- B. Water Regulators: Install with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gauges on inlet and outlet.
- C. Water Control Valves: Install with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gauges on inlet and outlet.
- D. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.

## DOMESTIC WATER PIPING SPECIALTIES 22 11 19 - 11

- E. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Y-Pattern Strainers: For water, install on supply side of each control valve water pressure-reducing valve solenoid valve and pump.
- G. Nonfreeze, Sanitary Yard Hydrants: Set with riser pipe in concrete or pavement. Do not encase canister in concrete.
- H. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.
- I. 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.
- J. 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.

### 3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

### 3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

### 3.4 CONTROL CONNECTIONS

- A. Connect control wiring in accordance with Section 26 05 23 "Control-Voltage Electrical Power Cables."

## DOMESTIC WATER PIPING SPECIALTIES 22 11 19 - 12



### 3.5 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Vacuum breakers.
  - 2. Backflow preventers.
  - 3. Water pressure-reducing valves.
  - 4. Balancing valves.
  - 5. Temperature-actuated, water mixing valves.
  - 6. Wall hydrants.
  - 7. Trap-seal primer device.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### 3.6 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
- D. Adjust each pressure vacuum breaker reduced-pressure-principle backflow preventer double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections.
  - 1. Test each pressure vacuum breaker reduced-pressure-principle backflow preventer double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
  - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- C. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 22 11 19

**DOMESTIC WATER PIPING SPECIALTIES**  
**22 11 19 - 14**

## SECTION 22 11 23.21 - INLINE, DOMESTIC-WATER PUMPS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Horizontally mounted, in-line, separately coupled centrifugal pumps.

- B. Related Requirements:

- 1. Section 22 11 23.13 "Domestic-Water Packaged Booster Pumps" for booster systems.
- 2. Section 33 11 13 "Potable Water Supply Wells" for well pumps.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction materials, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

#### 1.4 INFORMATIONAL SUBMITTALS

#### 1.5 CLOSEOUT SUBMITTALS

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written instructions for handling.

## INLINE, DOMESTIC-WATER PUMPS

### 22 11 23.21 - 1

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: UL 778 for motor-operated water pumps.
- C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

### 2.2 HORIZONTALLY MOUNTED, IN-LINE, SEPARATELY COUPLED CENTRIFUGAL PUMPS

- A. Description: Factory-assembled and -tested, in-line, single-stage, separately coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shafts mounted horizontal.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Bell & Gossett; a Xylem brand.
  - 2. Marshall Engineered Products Co.
  - 3. Taco Comfort Solutions.
  - 4. Thrush Co. Inc.
- C. Pump Construction:
  - 1. Casing:
    - a. Radially split stainless steel with threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections.
    - b. Built to permit servicing of pump internals without disturbing the casing or the suction and discharge piping.
    - c. Gauge port tapings at suction and discharge nozzles.
  - 2. Impeller: stainless steel, statically and dynamically balanced, closed, and keyed to shaft.
  - 3. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
  - 4. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
  - 5. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket .
  - 6. Bearings: permanently lubricated ball type.
  - 7. Minimum Working Pressure: 175 psig .

## INLINE, DOMESTIC-WATER PUMPS

22 11 23.21 - 2

- D. Motor: Single speed, with permanently lubricated ball bearings; and resiliently or rigidly mounted to pump casing.

## 2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 22 05 13 "Common Motor Requirements for Plumbing Equipment."

- 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

## 2.4 CONTROLS

- A. Timers: Electric, for control of hot-water circulation pump.
  - 1. Type: Programmable, seven-day clock with manual override on-off switch.
  - 2. Enclosure: NEMA 250, Type 1 , suitable for wall mounting.
  - 3. Operation of Pump: On or off.
  - 4. Transformer: Provide if required.
  - 5. Power Requirement: 120 V ac .
  - 6. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days .

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for domestic-water-piping system to verify actual locations of piping connections before pump installation.

### 3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Mount pumps in orientation complying with manufacturer's written instructions.
- C. Install pressure switches in water-supply piping.
- D. Install thermostats in hot-water return piping.
- E. Install timers in equipment room wall in readily accessible area .
- F. Install time-delay relays in piping between water heaters and hot-water storage tanks.

## INLINE, DOMESTIC-WATER PUMPS

22 11 23.21 - 3

### 3.3 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to inline, domestic-water pumps, allow space for service and maintenance.
- C. Connect domestic-water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
  - 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
    - a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
    - b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
    - c. Vertically mounted, in-line, close-coupled centrifugal pumps.
    - d. Comply with requirements for flexible connectors specified in Section 22 11 16 "Domestic Water Piping."
- D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for strainers specified in Section 22 11 19 "Domestic Water Piping Specialties." Comply with requirements for valves specified in the following:
  - 1. Section 22 05 23.12 "Ball Valves for Plumbing Piping."
  - 2. Section 22 05 23.13 "Butterfly Valves for Plumbing Piping."
  - 3. Section 22 05 23.14 "Check Valves for Plumbing Piping."
  - 4. Section 22 05 23.15 "Gate Valves for Plumbing Piping."
  - 5. Install pressure gauge at suction of each pump and pressure gauge at discharge of each pump. Install at integral pressure-gauge tapings where provided or install pressure-gauge connectors in suction and discharge piping around pumps. Comply with requirements for pressure gauges and snubbers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

### 3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between temperature controllers and devices.
- C. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

## INLINE, DOMESTIC-WATER PUMPS

### 22 11 23.21 - 4

### 3.5 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for identification of pumps.

### 3.6 ADJUSTING

- A. Adjust inline, domestic-water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 22 11 23.21

## INLINE, DOMESTIC-WATER PUMPS

22 11 23.21 - 5

## SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. PVC pipe and fittings.
  - 2. Specialty pipe fittings.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.4 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:
  - 1. Notify Architect Construction Manager 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 written permission.

#### 1.5 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:

## SANITARY WASTE AND VENT PIPING

### 22 13 16 - 1



1. Soil, Waste, and Vent Piping: 10 ft. head of water .

## 2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

## 2.3 PVC PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Charlotte Pipe and Foundry Company.
  2. JM Eagle; J-M Manufacturing Co., Inc.
  3. Mueller Industries, Inc.
  4. National Pipe and Plastic, Inc.
  5. North America Pipe Corporation.
- B. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.
- C. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.
- D. Cellular-Core PVC Pipe: ASTM F891, Schedule 40.
- E. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- F. Adhesive Primer: ASTM F656.
  1. Verify adhesive primer has a VOC content of 550 g/L or less.
  2. Verify adhesive primer complies 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." Verify formaldehyde emissions do not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
- G. Solvent Cement: ASTM D2564.
  1. Verify solvent cement has a VOC content of 510 g/L or less.

## 2.4 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:

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1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:
  - a. Standard: ASTM C1173.
  - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - c. End Connections: Same size as and compatible with pipes to be joined.
  - d. Sleeve Materials:
    - 1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
    - 2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
    - 3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
  - a. Standard: ASTM C1460.
  - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - c. End Connections: Same size as and compatible with pipes to be joined.
5. Pressure Transition Couplings:
  - a. Standard: AWWA C219.
  - b. Description: Metal sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
  - c. Center-Sleeve Material: Manufacturer's standard .
  - d. Gasket Material: Natural or synthetic rubber.
  - e. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:
  - a. Description:
    - 1) Standard: ASSE 1079.
    - 2) Pressure Rating: 125 psig minimum at 180 deg F 150 psig .
    - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges:
  - a. Description:
    - 1) Standard: ASSE 1079.
    - 2) Factory-fabricated, bolted, companion-flange assembly.
    - 3) Pressure Rating: 150 psig .
    - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric-Flange Insulating Kits:
  - a. Description:

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- 1) Nonconducting materials for field assembly of companion flanges.
  - 2) Pressure Rating: 150 psig .
  - 3) Gasket: Neoprene or phenolic.
  - 4) Bolt Sleeves: Phenolic or polyethylene.
  - 5) Washers: Phenolic with steel backing washers.
5. Dielectric Nipples:
- a. Description:
    - 1) Standard: IAPMO PS 66.
    - 2) Electroplated steel nipple.
    - 3) Pressure Rating: 300 psig at 225 deg F .
    - 4) End Connections: Male threaded or grooved.
    - 5) Lining: Inert and noncorrosive, propylene.

## 2.5 ENCASEMENT 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: tube.
- D. Color: Black .

## PART 3 - EXECUTION

### 3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earth Moving."

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
  1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
  2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

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- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
  - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
  - 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
    - a. Straight tees, elbows, and crosses may be used on vent lines.
  - 3. Do not change direction of flow more than 90 degrees.
  - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Waste: Two percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Sanitary Waste Piping: Two percent downward in direction of flow.
  - 3. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.
- M. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

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- N. Install steel piping in accordance with applicable plumbing code.
- O. Install stainless-steel piping in accordance with ASME A112.3.1 and applicable plumbing code.
- P. Install aboveground copper tubing in accordance with CDA's "Copper Tube Handbook."
- Q. Install aboveground ABS piping in accordance with ASTM D2661.
- R. Install aboveground PVC piping in accordance with ASTM D2665.
- S. Install underground PVC piping in accordance with ASTM D2321.
- T. 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.
- U. 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 22 13 19 "Sanitary Waste Piping Specialties."
  - 2. Install drains in sanitary waste gravity-flow piping.
    - a. Comply with requirements for drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
- V. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- W. Install sleeves for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs.
  - 1. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors.

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1. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

### 3.3 JOINT CONSTRUCTION

- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.
- C. Hubless, Cast-Iron Soil Piping Coupled Joints:
  1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1.
  1. Cut threads full and clean using sharp dies.
  2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
    - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
    - c. Do not use pipe sections that have cracked or open welds.
- E. Join stainless-steel pipe and fittings with gaskets in accordance with ASME A112.3.1.
- F. Join copper tube and fittings with soldered joints in accordance with ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.
- G. Grooved Joints: Cut groove ends of pipe in accordance with AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- H. 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.
- I. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
  1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
  2. ABS Piping: Join in accordance with ASTM D2235 and ASTM D2661 appendixes.

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3. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.

J. Joint Restraints and Sway Bracing:

1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
  - a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
  - b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
  - c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

### 3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:
  - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
  - b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples .
3. Dielectric Fittings for NPS 2-1/2 to NPS 4 : Use dielectric flange kits .
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

### 3.5 VALVE INSTALLATION

A. General valve installation requirements for general-duty valve installation are specified in the following Sections:

1. Section 22 05 23.12 "Ball Valves for Plumbing Piping."
2. Section 22 05 23.13 "Butterfly Valves for Plumbing Piping."
3. Section 22 05 23.14 "Check Valves for Plumbing Piping."
4. Section 22 05 23.15 "Gate Valves for Plumbing Piping."

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.

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2. Install full-port ball valve for piping NPS 2 and smaller.
  3. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
  2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
  3. Install backwater valves in accessible locations.
  4. Comply with requirements for backwater valve specified in Section 22 13 19 "Sanitary Waste Piping Specialties."

### 3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment" .
1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  2. Install 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 Ft. and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Ft.: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Ft. if Indicated: MSS Type 49, spring cushion rolls.
  7. Multiple, Straight, Horizontal Piping Runs 100 Ft. or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
  8. Base of Vertical Piping: MSS Type 52 spring hangers.
- B. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping and tubing within 12 inches of each fitting , valve, and coupling.
- D. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

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### 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. 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 in accordance with the following unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### 3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### 3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

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- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
    - a. Close openings in piping system and fill with water to point of overflow, but not less than 10 ft. head of water.
    - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    - c. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
    - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1 inch wg.
    - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    - d. Inspect plumbing fixture connections for gas and water leaks.
  - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 6. Prepare reports for tests and required corrective action.
- E. Test force-main piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  - 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
    - a. Isolate test source and allow to stand for four hours.
    - b. Leaks and loss in test pressure constitute defects that must be repaired.
  - 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 4. Prepare reports for tests and required corrective action.

## SANITARY WASTE AND VENT PIPING

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### 3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

### 3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

END OF SECTION 22 13 16

## SANITARY WASTE AND VENT PIPING

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## 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. Air-admittance valves.
3. Miscellaneous sanitary drainage piping specialties.

- B. Related Requirements:

1. Section 07 62 00 "Sheet Metal Flashing and Trim" for metal roof flashing assemblies.
2. Section 07 72 00 "Roof Accessories" for preformed flashings.
3. Section 07 84 13 "Penetration Firestopping" for through-penetration firestop assemblies.
4. Section 22 13 23 "Sanitary Waste Interceptors" for metal and concrete interceptors outside the building, grease interceptors, grease-removal devices, oil interceptors, and solids interceptors.

#### 1.3 DEFINITIONS

- A. ABS: Acrylonitrile butadiene styrene.
- B. PVC: Polyvinyl chloride.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

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1.5 INFORMATIONAL SUBMITTALS

1.6 CLOSEOUT SUBMITTALS

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.

2.2 CLEANOUTS

A. Cast-Iron Exposed Floor Cleanouts :

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. Sioux Chief Manufacturing Company, Inc.
  - e. WATTS.
  - f. Zurn Industries, LLC.
- 2. Standard: ASME A112.36.2M for adjustable housing cleanout.
- 3. Size: Same as connected branch.
- 4. Type: Heavy-duty, adjustable housing .
- 5. Body or Ferrule: Cast iron.
- 6. Clamping Device: Not required .
- 7. Outlet Connection: Threaded.
- 8. Closure: Cast-iron plug Plastic plug.
- 9. Adjustable Housing Material: Cast iron with threads .
- 10. Frame and Cover Material and Finish: Painted cast iron .
- 11. Frame and Cover Shape: Round .
- 12. Top-Loading Classification: Heavy Duty.
- 13. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.

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; a division of Morris Group International.
  - b. Josam Company.
  - c. MIFAB, Inc.

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- d. WATTS.
- e. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
  - a. Cast iron.
  - b. Countersunk 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, Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.
7. Wall Access, Frame and Cover: Round , stainless steel wall-installation frame and cover.

## 2.3 AIR-ADMITTANCE VALVES

### A. Fixture Air-Admittance Valves :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ayrlett, LLC.
  - b. Oatey.
  - c. ProVent Systems.
  - d. Studor, Inc.
2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected fixture or branch vent piping.

### B. Stack Air-Admittance Valves :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Oatey.
  - b. Sioux Chief Manufacturing Company, Inc.
  - c. Studor, Inc.
2. Standard: ASSE 1050 for vent stacks.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected stack vent or vent stack.

### C. Wall Box for Air-Admittance Valves :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Oatey.
  - b. Sioux Chief Manufacturing Company, Inc.
  - c. Studor, Inc.

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2. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
3. Size: Approximately 6 inches wide by 6 inches high by 4 inches deep.

## 2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

### A. Deep-Seal Traps :

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
  - a. NPS 2: 4-inch- minimum water seal.
  - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

### B. Floor-Drain, Inline Trap Seal :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Green Drain, Inc.
  - b. Jay R. Smith Mfg Co; a division of Morris Group International.
  - c. Josam Company.
  - d. MIFAB, Inc.
  - e. RectorSeal Plumbing; A CSW Industrials Company.
2. Description: Inline floor drain trap seal, forming a physical barrier to slow trap evaporation while not impeding flow from drain.
3. Material: Polymer.
4. Standard: Tested and certified in accordance with ASSE 1072.
5. Listing: ICC-ES or listed.
6. Size: Same as floor drain outlet or strainer throat.

### C. Air-Gap Fittings :

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

### D. 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 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.

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E. 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.

F. 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.

G. 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.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  2. Locate at each change in direction of piping greater than 45 degrees.
  3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install fixture air-admittance valves on fixture drain piping.
- E. Install stack air-admittance valves at top of stack vent and vent stack piping.
- F. Install air-admittance-valve wall boxes recessed in wall.
- G. Install deep-seal traps on floor drains and other waste outlets, if indicated.

## SANITARY WASTE PIPING SPECIALTIES

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- H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- I. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- J. Install vent caps on each vent pipe passing through roof.
- K. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- L. Install wood-blocking reinforcement for wall-mounting-type specialties.
- M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

### 3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

### 3.3 LABELING AND IDENTIFYING

- A. 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 22 05 53 "Identification for Plumbing Piping and Equipment."

### 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 13 19

## SANITARY WASTE PIPING SPECIALTIES

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## 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. Grease interceptors.
  - 2. Solids interceptors.
  - 3. Precast-concrete manhole risers.

#### 1.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.
- B. PP: Polypropylene.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of interceptor. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.

#### 1.5 INFORMATIONAL SUBMITTALS

#### 1.6 CLOSEOUT SUBMITTALS

#### 1.7 FIELD CONDITIONS

### PART 2 - PRODUCTS

#### 2.1 GREASE INTERCEPTORS

- A. Precast-Concrete Grease Interceptors: Comply with ASTM C913 .

## SANITARY WASTE INTERCEPTORS

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1. Structural Design Loads:
  - a. Heavy-Traffic Load: Comply with ASTM C890, A-16.
2. Resilient Pipe Connectors: ASTM C923, cast or fitted into interceptor walls, for each pipe connection.
3. Steps: Individual FRP steps, FRP ladder, or ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP , wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 60 inches .
4. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
5. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch- minimum-width flange and 26-inch- diameter cover.
  - a. Ductile Iron: ASTM A536, Grade 60-40-18, unless otherwise indicated.
  - b. Gray Iron: ASTM A48/A48M, Class 35, unless otherwise indicated.
  - c. Include indented top design with lettering cast into cover, using wording equivalent to " GREASE INTERCEPTOR ."

## 2.2 SOLIDS INTERCEPTORS

### A. Precast Concrete Solids Interceptors: Comply with ASTM C913 .

1. Structural Design Loads:
  - a. Heavy-Traffic Load: Comply with ASTM C890, A-16.
2. Resilient Pipe Connectors: ASTM C923, cast or fitted into interceptor walls, for each pipe connection.
3. Steps: Individual FRP steps, FRP ladder, or ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP , wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 60 inches .
4. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
5. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch- minimum-width flange and 26-inch- diameter cover.
  - a. Ductile Iron: ASTM A536, Grade 60-40-18, unless otherwise indicated.
  - b. Gray Iron: ASTM A48/A48M, Class 35, unless otherwise indicated.
  - c. Include indented top design with lettering cast into cover, using wording equivalent to " SOLIDS INTERCEPTOR ."

## 2.3 PRECAST-CONCRETE MANHOLE RISERS

### A. Precast Concrete Manhole Risers: ASTM C478 , with rubber-gasket joints.

1. Structural Design Loads:
  - a. Heavy-Traffic Load: Comply with ASTM C890, A-16.
2. Length: From top of underground concrete structure to grade.
3. Riser Sections: 3-inch minimum thickness and 36-inch diameter.

## SANITARY WASTE INTERCEPTORS

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4. Top Section: Eccentric cone unless otherwise indicated. Include top of cone to match grade ring size.
  5. Gaskets: ASTM C443, rubber.
  6. Steps: Individual FRP steps, FRP ladder, or ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP , wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals.
- B. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, diameter matching manhole frame and cover, and height as required to adjust the manhole frame and cover to indicated elevation and slope.
- C. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum-width flange and 26-inch- diameter cover.
1. Ductile Iron: ASTM A536, Grade 60-40-18, unless otherwise indicated.
  2. Gray Iron: ASTM A48/A48M, Class 35, unless otherwise indicated.
  3. Include indented top design with lettering cast into cover, using wording equivalent to the following:
    - a. Grease Interceptors in Sanitary Sewerage System: " GREASE INTERCEPTOR ."
    - b. Solids Interceptors in Sanitary Sewerage System: " SOLIDS INTERCEPTOR ."

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 31 20 00 "Earth Moving."

### 3.2 INSTALLATION

- A. Equipment Mounting:
1. Install on cast-in-place concrete equipment base(s).
  2. Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
- B. Install precast concrete interceptors according to ASTM C891.
- C. Set interceptors level and plumb.
- D. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.
- E. Set tops of manhole frames and covers flush with finished surface in pavements.

## SANITARY WASTE INTERCEPTORS

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1. Set tops 3 inches above finish surface elsewhere unless otherwise indicated.
- F. Set tops of grating frames and grates flush with finished surface.
- G. Set interceptors level and plumb.
- H. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
  1. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
  2. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- I. Install solids interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.

### 3.3 PIPING CONNECTIONS

- A. Piping installation requirements are specified in Section 22 13 16 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Make piping connections between interceptors and piping systems.

### 3.4 IDENTIFICATION

- A. Identification materials and installation are specified in Section 31 20 00 "Earth Moving."
  1. Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.
  2. Use warning tapes or detectable warning tape over ferrous piping.
  3. Use detectable warning tape over nonferrous piping and over edges of underground structures.
- B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  1. Grease interceptors.
  2. Solids interceptors.

### 3.5 PROTECTION

- A. Protect sanitary waste interceptors from damage during construction period.
- B. Repair damage to adjacent materials caused by sanitary waste interceptor installation.

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Sigma HN Engineers, PLLC  
PBK Project No. 20217  
Issue for Construction

CTE Barrientes  
Edinburg CISD  
June 4, 2024

END OF SECTION 22 13 23

## SANITARY WASTE INTERCEPTORS

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## SECTION 22 15 13 - GENERAL-SERVICE COMPRESSED-AIR PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes piping and related specialties for general-service compressed-air systems, as follows:
  - 1. Pipes, tubes, and fittings.
  - 2. Joining materials.
  - 3. Valves.
  - 4. Dielectric fittings.
  - 5. Flexible pipe connectors.
  - 6. Specialties.
  - 7. Quick couplings.
  - 8. Hose assemblies.
- B. Related Requirements:
  - 1. Section 22 15 19 "General-Service Packaged Air Compressors and Receivers" for general-service air compressors and accessories.

#### 1.2 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. HDPE: High-density polyethylene plastic.
- D. High-Pressure, Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures between 150 and 200 psig.
- E. Low-Pressure, Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.
- F. NBR: Nitrile butadiene rubber.
- G. PE: Polyethylene plastic.

#### 1.3 ACTION SUBMITTALS

- A. Product Data:
  - 1. Plastic pipes, fittings, and valves.

### GENERAL-SERVICE COMPRESSED-AIR PIPING

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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.

#### 1.4 INFORMATIONAL SUBMITTALS

##### A. Certificates:

1. Brazing and welding certificates.

#### 1.5 CLOSEOUT SUBMITTALS

#### 1.6 QUALITY ASSURANCE

##### A. Installer Qualifications:

1. Extruded-Tee Outlet Procedure: Qualify operators according to training provided by respective manufacturer, for making branch outlets.
2. Press-Seal Joining Procedure for Copper Tubing: Qualify operators according to training provided by respective manufacturer.
3. Pressure-Seal Joining Procedure for Steel Piping. Qualify operators according to training provided by respective manufacturer.
4. Joining Procedures for Aluminum Piping Systems: Qualify installers according to training provided by respective manufacturer.

##### B. Brazing: Qualify processes and operators in accordance with ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or with AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

##### C. Welding: Qualify processes and operators in accordance with ASME Boiler and Pressure Vessel Code: Section IX.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

##### A. ASME Compliance:

### GENERAL-SERVICE COMPRESSED-AIR PIPING

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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.

## 2.2 PIPES, TUBES, AND FITTINGS

### A. Schedule 40, Steel Pipe: ASTM A53/A53M, Type E or S, Grade B, black or hot-dip zinc coated with ends threaded in accordance with ASME B1.20.1.

1. Steel Nipples: ASTM A733, made of ASTM A53/A53M or ASTM A106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.
3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.
4. Steel Flanges, Threaded: ASME B16.5, Class 150 or 300, carbon steel, threaded.
5. Wrought-Steel, Butt-Welding Fittings: ASME B16.9, Schedule 40.
6. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.
7. Grooved-End Fittings and Couplings, Steel:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
    - 2) Star Pipe Products.
    - 3) Victaulic Company.
    - 4) Ward Manufacturing, Inc.
  - b. Grooved-End Fittings: ASTM A47/A47M, malleable-iron castings or ASTM A536, ductile-iron castings; with grooves in accordance with AWWA C606 and dimensions matching steel pipe.
  - c. Grooved-End Couplings: AWWA C606 or UL 213, for steel-pipe dimensions and rated for 300 psig minimum working pressure. Include ferrous housing sections, gasket suitable for compressed air, and bolts and nuts. Provide EDPM gaskets for oil-free compressed air. Provide NBR gaskets if compressed air contains oil or oil vapor.

### B. Schedule 5, Steel Pipe: ASTM A135, carbon steel with plain ends and zinc-plated finish.

1. Press-Type, Schedule 5 Steel, Fittings: Listed and labeled by qualified testing agency and FM Global-approved, carbon-steel, pressure-seal housing with O-ring end seals suitable for compressed-air piping and rated for 300 psig minimum working pressure. Provide EDPM seals for oil-free compressed air. Provide NBR seals if compressed air contains oil or oil vapor.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
    - 2) Victaulic Company.

## GENERAL-SERVICE COMPRESSED-AIR PIPING

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- 3) Viega LLC.
- C. 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.
  4. Press-Type, Copper Tube, Fittings, NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Apollo Valves; a part of Aalberts Integrated Piping Systems.
      - 2) NIBCO INC.
      - 3) Viega LLC.
  5. Press-Type, Copper Tube, Fittings, NPS 2-1/2 to NPS 4: Bronze fitting with stainless steel grip ring and EPDM O-ring seal in each end.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) NIBCO INC.
      - 2) Viega LLC.
  6. Grooved-End Fittings and Couplings, Copper:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
      - 2) Victaulic Company.
    - b. Grooved-End Fittings: ASTM B75/B75M, copper tube or ASTM B584, bronze castings.
    - c. Grooved-End Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for compressed air, and bolts and nuts. Provide EDPM gasket for oil-free compressed air. Provide NBR gasket if compressed air contains oil or oil vapor.
- D. 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.
- E. Aluminum Piping System: Aluminum pipe, Alloy Grade AA 6035-T5, for push-connect bite ring couplings, and roll-groove couplings.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Applied System Technologies.
    - b. Gardner Denver, Inc.
    - c. Ingersoll-Rand.
  2. Pressure and Temperature Range: Aluminum piping and related specialties for general-service compressed-air systems operating at 220 psig or less, across a temperature range of minus 4 to plus 176 deg F.
  3. Tubing, 14 to 273 mm: Aluminum pipe, Alloy Grade AA 6063-T5.

#### GENERAL-SERVICE COMPRESSED-AIR PIPING

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4. Pipe Coating: Powder-coated paint that is certified nontoxic to AAMA 603 and AAMA 605, blue for compressed air.
  5. Provide tubing that is quality controlled to comply with tolerances specified by roll-groove or push-to-connect coupling manufacturer. Tubing manufacturer follows ISO 9001:2000 quality standards.
  6. Pipe Identification: Decal with maximum working pressure and temperature on each length of pipe.
  7. Push-Connect Bite Ring Couplings, 14 to 63 mm: Solid-brass and nickel-plated body, NBR O-ring seal in excess of 36 percent, and AISI Type 304 stainless steel clamping washer.
  8. Fittings: Solid brass and nickel plated.
  9. Roll-Groove Couplings, 73 to 273 mm: Solid ductile-iron, galvanized, ASTM A536 Grade 65-45-12, NBR standard seals, and fluoroelastomer seals for high-temperature applications.
  10. Ball Valves, 20 to 63 mm: NPT ends, or push-connect bite ring ends.
  11. Butterfly Valves, 73 to 273 mm: Tube to tube, with two roll-groove end couplings.
  12. Flanges, 73 to 273 mm: ASME B16.5, Class 150.
- F. Blue ABS Piping System: Made of ASTM D3965, ABS-resin modified to provide shatter-resistant pipe for compressed-air service. Pipe and fittings are light blue and sizes are in millimeters.
1. Transition Fittings, 20 to 63 mm: Composite union with ABS socket end, CR O-ring, and malleable-iron union nut and threaded end; with construction similar to MSS SP-107, transition union.
  2. Transition Fittings, 90 to 110 mm: Flange assembly with ABS flange, CR gasket, and metal flange of material matching piping to be connected.
  3. Valves, 20 to 63 mm: ABS union ball valve with socket ends.
  4. Valves, 90 to 110 mm: ABS butterfly valve with lever handle.
- G. Green ABS Piping System: Made of ASTM D3965, ABS-resin modified to provide shatter-resistant pipe for compressed-air service. Pipe and fittings are dark green with SDR of 9.0 and same OD as ASTM A53/A53M, steel pipe.
1. Transition Fittings, NPS 1/2 to NPS 2: Composite union with ABS socket end, CR O-ring, ABS union nut, and brass solder-joint end; with construction similar to MSS SP-107, transition union.
  2. Transition Fittings, NPS 2-1/2 to NPS 4: ABS flange, CR gasket, and metal flange of material matching piping to be connected.
  3. Valves, NPS 1/2 to NPS 2: Union ball valve with socket ends.
  4. Valves, NPS 2-1/2 to NPS 4: Union ball valve with flanged ends. Include safety exhaust feature in "Valve Applications" Article if required.
- H. HDPE Piping System: Made of ASTM D1248, HDPE resin to provide shatter-resistant pipe for compressed-air service. Pipe and fittings are dark blue with pipe dimensions about the same OD as ASTM D3035, PE pipe.
1. Transition Fittings, NPS 1/2 to NPS 2: HDPE adapter with one socket end and one end with threaded brass insert.

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2. Transition Fittings, NPS 2-1/2 to NPS 4: HDPE flange, CR gasket, and metal flange of material matching piping to be connected.
3. Valves, NPS 1/2 to NPS 3: HDPE union ball valve with socket ends.

## 2.3 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. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.
- D. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux in accordance with ASTM B813.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.
- F. 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.
- G. Solvent Cements for Joining Plastic Piping:
  1. ABS Piping: ASTM D2235.

## 2.4 VALVES

- A. Metal Ball, Butterfly, Check, and Gate Valves: Comply with requirements in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," Section 22 05 23.14 "Check Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping."

## 2.5 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
  1. Description:
    - a. Standard: ASSE 1079.

### GENERAL-SERVICE COMPRESSED-AIR PIPING

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- b. Pressure Rating: 250 psig.
- c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

- 1. Description:
  - a. Standard: ASSE 1079.
  - b. Factory-fabricated, bolted, companion-flange assembly.
  - c. Pressure Rating: 300 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. 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.

## 2.6 FLEXIBLE PIPE CONNECTORS

A. 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 250 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.

B. 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: 250 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.

## 2.7 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.

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- B. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250 psig inlet pressure, unless otherwise indicated.
  - 1. Type: Pilot operated.
- C. Air-Line Pressure Regulators, Bronze Body: pilot operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200 psig minimum inlet pressure, unless otherwise indicated.
- D. Air-Line Pressure Regulators, Aluminum Alloy or Plastic Body: 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.
- E. Automatic Drain Valves: Stainless steel body and internal parts, rated for 200 psig minimum working pressure, capable of automatic discharge of collected condensate.
- F. 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.
- G. Mechanical Filters: Two-stage, mechanical-separation, air-line filters. Equip with deflector plates, resin-impregnated-ribbon filters with edge filtration, and drain cock.
- H. Air-Line Lubricators: With drip chamber and sight dome for observing oil drop entering airstream; with oil-feed adjustment screw and quick-release collar for easy bowl removal.
  - 1. Provide with automatic feed device for supplying oil to lubricator.

## 2.8 QUICK COUPLINGS

- A. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
- B. 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: Flow-sensor-bleeder, check-valve type with barbed outlet for attaching hose.
- C. Valveless 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.

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## 2.9 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 Piping between Air Compressors and Receivers: Use the following piping materials for each size range:
1. NPS 2 and Smaller, Threaded: Schedule 40, black -steel pipe; threaded, malleable-iron fittings; and threaded joints.
  2. NPS 2-1/2 to NPS 4 , Threaded: Schedule 40, black -steel pipe; threaded, malleable-iron fittings; and threaded joints.
  3. NPS 2-1/2 to NPS 4 , Grooved-End: Schedule 40, -steel pipe; grooved-end fittings; couplings; and grooved joints.
- B. Low-Pressure Compressed-Air Distribution Piping: Use the following piping materials for each size range:
1. NPS 2 and Smaller, Threaded: Schedule 40, black -steel pipe; threaded, malleable-iron fittings; and threaded joints.
  2. NPS 2-1/2 to NPS 4 , Threaded: Schedule 40, black -steel pipe; threaded, malleable-iron fittings; and threaded joints.
  3. NPS 2-1/2 to NPS 4 , Grooved-End: Schedule 40, -steel pipe; grooved-end fittings; couplings; and grooved joints.
- C. Drain Piping: Use the following piping materials:
1. NPS 2 and Smaller: Type M copper tube; wrought-copper fittings; and brazed or soldered joints.

## GENERAL-SERVICE COMPRESSED-AIR PIPING

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### 3.2 VALVE APPLICATIONS

- A. Metal General-Duty Valves: Comply with requirements and use valve types specified in "Valve Applications" Article in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," Section 22 05 23.14 "Check Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping," according to the following:
1. Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.
  2. High-Pressure Compressed Air: Valve types specified for high-pressure compressed air.
  3. Equipment Isolation NPS 2 and Smaller: Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.
  4. Grooved-end valves may be used with grooved-end piping and grooved joints.
- B. General-Duty Valves for Aluminum Piping System: Provide valves, made by piping system manufacturer, that are compatible with piping.
1. Ball Valves, NPS 2 and Smaller: NPT ends, or push-connect bite ring ends.
  2. Butterfly Valves, NPS 2-1/2 and Larger: Tube to tube, with two roll-groove end couplings.
- C. Plastic General-Duty Valves: Provide valves, made by piping manufacturer, that are compatible with piping. Do not use plastic valves between air compressors and receivers.
1. Blue ABS Piping System: Ball and butterfly valves.
  2. Green ABS Piping System: Ball valves.
  3. HDPE Piping System: Ball valves.

### 3.3 INSTALLATION OF PIPING, GENERAL

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless otherwise indicated.

## GENERAL-SERVICE COMPRESSED-AIR PIPING

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- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.
- E. Where installing piping adjacent to equipment and machines, allow space for service and maintenance.
- F. Install air and drain piping with 1 percent slope downward in direction of flow.
- G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating unless otherwise indicated.
- H. Equipment and Specialty Flanged Connections:
  - 1. Use steel companion flange with gasket for connection to steel pipe.
  - 2. Use cast-copper-alloy companion flange with gasket and brazed or soldered 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. Extended-tee outlets with brazed branch connection may be used for copper tubing, within extruded-tee connection diameter to run tube diameter ratio for tube type, in accordance with Extruded Tee Connections Sizes and Wall Thickness for Copper Tube (Inches) Table in ASTM F2014.
- J. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- K. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
- L. Install pressure gauge on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 22 05 19 "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 22 05 48 "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 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

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- S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

### 3.4 INSTALLATION OF ALUMINUM PIPING SYSTEMS

- A. Install aluminum piping systems in accordance with manufacturer's written instructions, using manufacturer's recommended tools, accessories, and methods.
- B. Install branch connections NPS 2-1/2 and larger, 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.
- C. Install branch connections NPS 2 and smaller, to compressed-air mains using aluminum piping system reducing outlet tee with water trapping capabilities. Provide drain leg and drain trap at end of each main and branch and at low points.
- D. Support aluminum pipe using manufacturer's hangers and supports, designed for use with the system.
- E. Allow for expansion and contraction of aluminum piping system.
- F. Do not use plastic components or plastic fittings of any kind within pressurized aluminum piping system. This limitation applies to main headers, branches, and drops.

### 3.5 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints for Steel Piping: Join in accordance with AWS D10.12/D10.12M.
- E. Brazed Joints for Copper Tubing: Join in accordance with AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Join in accordance with ASTM B828 or CDA's "Copper Tube Handbook."

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- G. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts in accordance with ASME B31.9 for bolting procedure.
- H. Grooved Joints: Assemble couplings with housing, gasket, lubricant, and bolts. Join in accordance with AWWA C606 for grooved joints. Do not apply lubricant to prelubricated gaskets.
- I. Heat-Fusion Joints for PE Piping: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join in accordance with ASTM D2657 for socket-fusion joints.
- J. Press-Sealed Joints: Join with tools recommended by fitting manufacturer, using operators qualified in accordance with "Quality Assurance" Article.
- K. Solvent-Cemented Joints for ABS Piping: Clean and dry joining surfaces. Join according to the following:
  - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. Join in accordance with ASME B31.9 for solvent-cemented joints and with ASTM D2235 Appendix.
- L. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

### 3.6 INSTALLATION OF VALVES

- A. General-Duty Valves: Comply with requirements in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," Section 22 05 23.14 "Check Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping."

### 3.7 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. NPS 2 and Smaller: Use dielectric unions.
- C. NPS 2-1/2 to NPS 4 : Use dielectric flanges.
- D. NPS 5 and Larger: Use dielectric flange kits.

### 3.8 INSTALLATION OF FLEXIBLE PIPE CONNECTORS

- 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.

## GENERAL-SERVICE COMPRESSED-AIR PIPING

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- C. Install stainless steel-hose flexible pipe connectors in steel compressed-air piping.

### 3.9 INSTALLATION OF SPECIALTIES

- 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 mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filters.
- E. Install air-line lubricators in branch piping to machine tools.
- F. Install quick couplings at piping terminals for hose connections.
- G. Install hose assemblies at hose connections.

### 3.10 PIPING CONNECTIONS

- A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.
- 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.

### 3.11 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment" for hangers, supports, and anchor devices.
- B. Install hangers for steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping within 12 inches of each fitting and coupling.
- D. Support vertical runs of steel piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Individual, Straight, Horizontal Piping Runs:
  - 1. 100 Ft. or Less: MSS Type 1, adjustable, steel clevis hangers.
  - 2. Longer Than 100 Ft.: MSS Type 43, adjustable roller hangers.

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- F. Multiple, Straight, Horizontal Piping Runs 100 Ft. or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- G. Base of Vertical Piping: MSS Type 52, spring hangers.

### 3.12 LABELING AND IDENTIFICATION

- A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

END OF SECTION 22 15 13

## 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, storage, domestic-water heaters.
  - 2. Thermostat-control, electric, tankless, domestic-water heaters.
  - 3. Domestic-water heater accessories.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

#### 1.4 INFORMATIONAL SUBMITTALS

- 1.5 Retain "Seismic Qualification Data" Paragraph below if required by seismic criteria applicable to Project. Coordinate with Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment." See ASCE/SEI 7 for certification requirements for equipment and components.

- A. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- B. Field quality-control reports.
- C. Sample Warranty: For special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric, domestic-water heaters to include emergency, operation, and maintenance manuals.

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## 1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including storage tank and supports.
    - b. Faulty operation of controls.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Periods: From date of Substantial Completion.
    - a. Commercial, Electric, Storage, Domestic-Water Heaters:
      - 1) Storage Tank: Five years.
      - 2) Controls and Other Components: Five years.
    - b. Electric, Tankless, Domestic-Water Heaters: Two year(s).
    - c. Expansion Tanks: Five years.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

### 2.2 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

- A. Commercial, Electric, Storage, Domestic-Water Heaters:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A. O. Smith Corporation.
    - b. Lochinvar, LLC.

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- c. Precision Boilers.
- d. PVI; A WATTS Brand.
- e. Rheem Manufacturing Company.
- f. State Industries.
2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
3. Standard: UL 1453.
4. Storage-Tank Construction: ASME-code, steel vertical arrangement.
  - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
    - 1) NPS 2 and Smaller: Threaded ends in accordance with ASME B1.20.1.
    - 2) NPS 2-1/2 and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges, and in accordance with ASME B16.24 for copper and copper-alloy flanges.
  - b. Pressure Rating: 150 psig .
  - c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
5. Factory-Installed, Storage-Tank Appurtenances:
  - a. Anode Rod: Replaceable magnesium.
  - b. Drain Valve: Corrosion-resistant metal with hose-end connection.
  - c. Insulation: Comply with ASHRAE/IES 90.1.
  - d. Jacket: Steel with enameled finish or high-impact composite material.
  - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
  - f. Temperature Control: Adjustable thermostat.
  - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
  - h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.
6. Special Requirements: NSF 5 construction.

## 2.3 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS

### A. Thermostat-Control, Electric, Tankless, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Bosch Thermotechnology Corp.
  - b. Bradford White Corporation.
  - c. Chromomite Laboratories, Inc; a division of Morris Group International.
  - d. Eemax, Inc.; a Rheem brand.
  - e. Stiebel Eltron, Inc.
2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.

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3. Standard: UL 499 for electric, tankless, (domestic-water-heater) heating appliance.
4. Construction: Copper piping or tubing complying with NSF 61 and NSF 372 barrier materials for potable water, without storage capacity.
  - a. Connections: ASME B1.20.1 pipe thread.
  - b. Pressure Rating: 150 psig .
  - c. Heating Element: Resistance heating system.
  - d. Temperature Control: Thermostat.
  - e. Safety Control: High-temperature-limit cutoff device or system.
  - f. Jacket: Aluminum or steel with enameled finish or plastic.
5. Support: Bracket for wall mounting.

## 2.4 DOMESTIC-WATER HEATER ACCESSORIES

### A. Domestic-Water Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. A. O. Smith Corporation.
  - b. AMTROL, Inc.
  - c. Flexcon Industries.
  - d. Honeywell International Inc.
  - e. Pentair Aurora.
  - f. State Industries.
  - g. Taco Comfort Solutions.
2. Source Limitations: Obtain domestic-water expansion tanks from single source from single manufacturer.
3. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
4. Construction:
  - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
  - b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
  - c. Air-Charging Valve: Factory installed.
5. Capacity and Characteristics:
  - a. Working-Pressure Rating: 150 psig .
  - b. Capacity Acceptable: 10 gal. minimum.
  - c. Air Precharge Pressure: .

- ### B. Manifold Kits: Domestic-water-heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and memory-stop balancing valves to provide balanced flow through each domestic-water heater.

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1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping."
  2. Comply with requirements for balancing valves specified in Section 22 11 19 "Domestic Water Piping Specialties."
- C. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.
- D. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- E. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.
- F. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

## 2.5 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. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 03 30 00 "Cast-in-Place Concrete."
  1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
  2. Maintain manufacturer's recommended clearances.

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3. Arrange units so controls and devices that require servicing are accessible.
  4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  7. Install anchor bolts to elevations required for proper attachment to supported equipment.
  8. Anchor domestic-water heaters to substrate.
- B. 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.
- C. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping."
- D. Install commercial, electric, domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 22 05 48.13 "Vibration Controls for Plumbing Piping and Equipment."
- E. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- F. Install pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- G. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for

## ELECTRIC, DOMESTIC-WATER HEATERS

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electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 22 11 19 "Domestic Water Piping Specialties."

- H. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- I. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- J. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- K. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 25 psig . Comply with requirements for pressure-reducing valves and water hammer arresters specified in Section 22 11 19 "Domestic Water Piping Specialties."
- L. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- M. Fill electric, domestic-water heaters with water.
- N. Charge domestic-water expansion tanks with air to required system pressure.
- O. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

### 3.2 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

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### 3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. 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.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial and tankless, electric, domestic-water heaters. Training shall be a minimum of two hour(s).

END OF SECTION 22 33 00

## SECTION 22 42 13.13 - COMMERCIAL WATER CLOSETS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Floor-mounted, bottom-outlet water closets.
2. Flushometer valves.
3. Toilet seats.

#### 1.2 DEFINITIONS

- A. Standard-Efficiency Flush Volume: 1.6 gal. per flush.
- B. High-Efficiency Flush Volume: 1.28 gal. or less per flush.
- C. WaterSense Fixture: Water closet and/or flushometer valve/tank certified by the EPA to meet the WaterSense performance criteria.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

#### 1.4 CLOSEOUT SUBMITTALS

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

##### A. Standards:

1. Comply with ASME A112.19.2/CSA B45.1 for water closets.
2. Comply with ASME A112.19.5/CSA B45.15 for flush valves and spuds for water closets and tanks.
3. Comply with ASSE 1037/ASME A112.1037/CSA B125.37 for flush valves.
4. Comply with IAMPO/ANSI Z124.5 for water-closet (toilet) seats.

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5. Comply with ASME A112.6.1M for water-closet supports.
6. Comply with ICC A117.1 for ADA-compliant water closets.
7. Comply with ASTM A1045 for flexible PVC gaskets used in connection of vitreous china water closets to sanitary drainage systems.
8. Comply with ASME A112.4.3 for plastic fittings used in connection of vitreous china water closets to sanitary drainage systems.

## 2.2 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

### A. Water Closets - Floor Mounted, Bottom Outlet, Top Spud: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard.
  - b. Kohler Co.
  - c. Mansfield Plumbing Products LLC.
  - d. Sloan Valve Company.
  - e. TOTO USA, INC.
  - f. Zurn Industries, LLC.
2. Source Limitations: Obtain water closets from single source from single manufacturer.
3. Bowl:
  - a. Material: Vitreous china.
  - b. Type: Siphon jet.
  - c. Style: Flushometer valve.
  - d. Height: Standard ADA compliant.
  - e. Rim Contour: Elongated.
  - f. Water Consumption: 1.28 gal. per flush.
  - g. Spud Size and Location: NPS 1-1/2; top.
  - h. Color: White .
4. Flushometer Valve: .
5. Toilet Seat: .

## 2.3 FLUSHOMETER VALVES

### A. Flushometer Valves - Diaphragm, Lever Handle: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Advanced Modern Technologies Corporation - AMTC.
  - b. Delany Products.
  - c. I-Con Systems, Inc.
  - d. Sloan Valve Company.
  - e. Zurn Industries, LLC.
2. Source Limitations: Obtain flushometer valve from single source from single manufacturer.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.

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5. Material: Brass body with corrosion-resistant components.
6. Style: Exposed.
7. Flushometer-Valve Finish: Chrome-plated.
8. Handle Finish: Chrome-plated .
9. Consumption: 1.28 gal. per flush.
10. Minimum Inlet: NPS 1.
11. Minimum Outlet: NPS 1-1/4.

## 2.4 TOILET SEATS

### A. Toilet Seats: .

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. American Standard.
  - b. Bemis Manufacturing Company.
  - c. Centoco Manufacturing Corporation.
  - d. Church Seats; Bemis Manufacturing Company.
  - e. Kohler Co.
  - f. TOTO USA, INC.
  - g. Zurn Industries, LLC.
2. Source Limitations: Obtain toilet seat from single source from single manufacturer.
3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front .
6. Hinge: Self-sustaining, check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White .
10. Surface Treatment: Not required.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before 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, GENERAL

- A. Water-Closet Installation:

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1. Install level and plumb.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
5. Measure support height installation from finished floor, not structural floor.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations easily reachable for people with disabilities.
5. Install new batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

### 3.3 PIPING CONNECTIONS

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

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- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

### 3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplate to be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."
  - 2. Nameplate to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

### 3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 26 05 23 "Control-Voltage Electrical Power Cables."

### 3.6 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 new batteries in battery-powered, electronic-sensor mechanisms.

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3.7 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 42 13.13

COMMERCIAL WATER CLOSETS

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## SECTION 22 42 13.16 - COMMERCIAL URINALS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Wall-hung urinals.
  - 2. Urinal flushometer valves.
  - 3. Supports.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for urinals.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

#### 1.4 CLOSEOUT SUBMITTALS

### PART 2 - PRODUCTS

#### 2.1 WALL-HUNG URINALS

- A. Urinals - Wall Hung, Back Outlet, Siphon Jet: Accessible .
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Standard.
    - b. Kohler Co.
    - c. Mansfield Plumbing Products LLC.
    - d. Zurn Industries, LLC.
  - 2. Fixture:

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- a. Standards: ASME A112.19.2/CSA B45.1 and  
ASME A112.19.5/CSA B45.15.
- b. Material: Vitreous china.
- c. Type: Siphon jet.
- d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
- e. Water Consumption: 0.5 gpf .
- f. Spud Size and Location: NPS 3/4; top.
- g. Outlet Size and Location: NPS 2; back.
- h. Color: White .
3. Flushometer Valve: .
4. Waste Fitting:
  - a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
  - b. Size: NPS 2.
5. Support: Type I urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.
6. Urinal Mounting Height: Standard Handicapped/elderly according to ICC A117.1.

## 2.2 URINAL FLUSHOMETER VALVES

### A. Lever-Handle, Diaphragm Flushometer Valves: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Advanced Modern Technologies Corporation - AMTC.
  - b. American Standard.
  - c. Sloan Valve Company.
  - d. Zurn Industries, LLC.
2. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed .
9. Consumption: 0.5 gal. per flush.
10. Minimum Inlet: NPS 3/4 .
11. Minimum Outlet: NPS 3/4 NPS 1-1/4.

## 2.3 SUPPORTS

### A. Type I Urinal Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. Wade Drains.

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- d. WATTS.
- e. Zurn Industries, LLC.
- 2. Standard: ASME A112.6.1M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.
- B. Examine walls and floors for suitable conditions where urinals will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

#### A. Urinal Installation:

- 1. Install urinals level and plumb according to rough-in drawings.
- 2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
- 3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
- 4. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC A117.1.
- 5. Install trap-seal liquid in waterless urinals.

#### B. Support Installation:

- 1. Install supports, affixed to building substrate, for wall-hung urinals.
- 2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
- 3. Use carriers without waste fitting for urinals with tubular waste piping.
- 4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

#### C. Flushometer-Valve Installation:

- 1. Install flushometer-valve water-supply fitting on each supply to each urinal.
- 2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
- 3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
- 4. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

#### D. Wall Flange and Escutcheon Installation:

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1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

E. Joint Sealing:

1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to urinal color.
3. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

### 3.3 PIPING CONNECTIONS

- A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to urinals, allow space for service and maintenance.

### 3.4 ADJUSTING

- A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

### 3.5 CLEANING AND PROTECTION

- A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed urinals and fittings.
- C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 13.16

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## SECTION 22 42 16.13 - COMMERCIAL LAVATORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Vitreous-china, wall-mounted lavatories.
2. Manually operated lavatory faucets.
3. Supply fittings.
4. Waste fittings.
5. Lavatory supports.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

#### 1.3 INFORMATIONAL SUBMITTALS

#### 1.4 CLOSEOUT SUBMITTALS

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

### PART 2 - PRODUCTS

#### 2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory - Rectangular, Vitreous China, Wall Mounted, with Back :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard.
  - b. Kohler Co.
  - c. Mansfield Plumbing Products LLC.
  - d. Sloan Valve Company.
  - e. Zurn Industries, LLC.

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2. Fixture:
  - a. Standard: ASME A112.19.2/CSA B45.1.
  - b. Type: For wall hanging.
  - c. Nominal Size: Rectangular, 20 by 18 inches .
  - d. Faucet-Hole Punching: Three holes, 4-inch centers.
  - e. Faucet-Hole Location: Top.
  - f. Color: White .
  - g. Mounting Material: Chair carrier.
3. Support: Type II, concealed-arm lavatory carrier ..
4. Lavatory Mounting Height: Standard Handicapped/elderly in accordance with ICC A117.1.

## 2.2 MANUALLY OPERATED LAVATORY FAUCETS

- A. Lavatory faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372, or be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI) accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Lavatory Faucets - Manual Type: Single-Control Mixing Two-Handle Mixing , Commercial , :
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Standard.
    - b. Chicago Faucets; Geberit Company.
    - c. Elkay.
    - d. Kohler Co.
    - e. Moen Incorporated.
    - f. 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 fixture receptor.
  4. Body Type: Centerset .
  5. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
  6. Finish: Polished chrome plate .
  7. Maximum Flow Rate: 0.5 gpm .
  8. Maximum Flow: 0.25 gal. per metering cycle.
  9. Mounting Type: Deck, exposed .
  10. Valve Handle(s): Wrist blade, 4 inches Push button .
  11. Spout: Rigid type.
  12. Spout Outlet: Aerator .
  13. Operation: Compression, manual .
  14. Drain: Not part of faucet .

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### 2.3 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key .
- F. Risers:
  - 1. NPS 3/8 NPS 1/2.
  - 2. Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces riser.

### 2.4 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
- C. Trap:
  - 1. Size: NPS 1-1/2 by NPS 1-1/4 .
  - 2. Material:
    - a. Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch- thick brass tube to wall ; and chrome-plated, brass or steel wall flange.

### 2.5 LAVATORY SUPPORTS

- A. Lavatory Carrier:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Mfg Co; a division of Morris Group International.
    - b. Josam Company.
    - c. MIFAB, Inc.
    - d. Wade; a subsidiary of McWane Inc.
    - e. WATTS.
    - f. Zurn Industries, LLC.
  - 2. Standard: ASME A112.6.1M.

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## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
- B. Examine counters and walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install lavatories level and plumb in accordance with roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, in accordance with ICC A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
- E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

### 3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

## COMMERCIAL LAVATORIES

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### 3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplate to be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."
  - 2. Nameplate to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

### 3.5 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Install new batteries in battery-powered, electronic-sensor mechanisms.

### 3.6 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 16.13

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## SECTION 22 42 16.16 - COMMERCIAL SINKS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Service sinks.
2. Handwash sinks.
3. Shampoo bowls.
4. Manually operated sink faucets.
5. Supply fittings.
6. Waste fittings.
7. Sink supports.
8. Grout.

- B. Related Requirements:

1. Section 11 40 00 "Foodservice Equipment" for NSF-compliant foodservice and handwash sinks.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics and furnished specialties and accessories.

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1.4 INFORMATIONAL SUBMITTALS

1.5 CLOSEOUT SUBMITTALS

PART 2 - PRODUCTS

2.1 SERVICE SINKS

A. Service Sinks - Terrazzo, Floor Mounted: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acorn Engineering Company; a Division of Morris Group International.
  - b. Fiat Products.
  - c. Florestone Products Co., Inc.
  - d. Krowne.
  - e. Stern-Williams Co., Inc.
2. Source Limitations: Obtain sinks from single source from single manufacturer.
3. Fixture:
  - a. Material: Marble chips cast in portland cement to produce a compressive strength of not less than 3000 psi, seven days after casting.
  - b. Shape: Square .
  - c. Nominal Size: 24 by 24 inches .
  - d. Height: 12 inches with dropped front .
  - e. Tiling Flange: Not required .
  - f. Rim Guard: On all top surfaces.
  - g. Color: Not applicable .
  - h. Drain: Grid with NPS 3 outlet.
4. Mounting: On floor and flush to wall.

2.2 HANDWASH SINKS

A. Handwash Sinks - Stainless Steel: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Advance Tabco.
  - b. AERO Manufacturing Company.
  - c. Amtekco Industries, Inc; a Wasserstrom Company.
  - d. Elkay.
  - e. Franke.
  - f. Griffin Products, Inc.
  - g. Just Manufacturing.
2. Source Limitations: Obtain sinks from single source from single manufacturer.
3. Fixture:
  - a. Standards:

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- 1) ASME A112.19.3/CSA B45.4.
- 2) NSF 61.
- b. Type: Wall-mounted stainless steel basin with radius corners, back for faucet, and support brackets.
- c. Material: 18 gauge , Type 304 stainless steel.
4. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
5. Waste Fittings: Comply with requirements in "Waste Fittings" Article.
6. Support: Type II sink carrier .
7. Mounting Height: .

## 2.3 SHAMPOO BOWLS

### A. Shampoo Bowl - Solid-Surface Material: .

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Willoughby Industries.
2. Source Limitations: Obtain bowls from single source from single manufacturer.
3. Fixture:
  - a. Material: Molded, cast polymer.
  - b. Bowl: Shaped for head rest.
  - c. Mounting Material: Bracket or devices for attaching to counter .
4. Faucet: Manufacturer's standard with vacuum breaker complying with ASME A112.18.3 and with hose spray head.
5. Waste Fittings: Comply with requirements in "Waste Fittings" Article except as follows:
  - a. Drain: Cup type with hair basket and NPS 1-1/2 tailpiece.
  - b. Trap Size: NPS 1-1/2.

## 2.4 MANUALLY OPERATED SINK FAUCETS

### A. Sink faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

### B. Commercial Sink Faucets - Manual Type: Two-handle mixing , .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard.
  - b. Elkay.
  - c. Gerber Plumbing Fixtures LLC.
  - d. Kohler Co.
  - e. T&S Brass and Bronze Works, Inc.
  - f. Zurn Industries, LLC.

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2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
3. Standard: ASME A112.18.1/CSA B125.1.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
5. Body Type: Centerset .
6. Body Material: Commercial, solid brass, or die-cast housing with brazed copper and brass waterway.
7. Finish: Polished chrome plate .
8. Maximum Flow Rate: 1.5 gpm .
9. Mounting Type: Deck, concealed Back/wall, exposed.
10. Valve Handle(s): 4-inch wrist blade .
11. Spout Type: Swivel gooseneck .
12. Vacuum Breaker: Required for hose outlet.
13. Spout Outlet: Hose thread in accordance with ASME B1.20.7 .

C. Commercial Service Sink Faucets - Manual Type: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard.
  - b. Chicago Faucets; Geberit Company.
  - c. Fiat Products.
  - d. Stern-Williams Co., Inc.
  - e. T&S Brass and Bronze Works, Inc.
  - f. Zurn Industries, LLC.
2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
3. Description: Wall/back mounted, brass body, with integral service stops, checks, spout with bucket/pail hook, 3/4-inch hose thread end, integral vacuum breaker, inlets 8 inches o.c., and two-handle mixing.
4. Faucet:
  - a. Standards:
    - 1) ASME A112.18.1/CSA B125.1.
    - 2) NSF 61 and NSF 372.
    - 3) ICC A117.1.
    - 4) ASSE 1001 (VB).
  - b. Finish: Rough chrome plated .
  - c. Handles: Lever 4-inch wrist blade .
  - d. Cartridges: One-fourth turn compression .
  - e. Brace: Adjustable top brace .

## 2.5 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.

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- 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. NPS 3/8 .
  - 2. ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.

## 2.6 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
- C. Trap:
  - 1. Size: NPS 1-1/2.
  - 2. Material:
    - a. Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 17-gauge brass tube to wall ; and chrome-plated brass or steel wall flange.

## 2.7 SINK SUPPORTS

- A. Sink Carrier:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Mfg Co; a division of Morris Group International.
    - b. Josam Company.
    - c. MIFAB, Inc.
    - d. Wade Drains.
    - e. WATTS.
    - f. Zurn Industries, LLC.
  - 2. Source Limitations: Obtain sink supports from single source from single manufacturer.
  - 3. Standard: ASME A112.6.1M.

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## 2.8 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 for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install sinks level and plumb in accordance with rough-in drawings.
- B. Install supports, affixed to building substrate, for wall-hung sinks.
- C. Install wall-mounted sinks at accessible mounting height in accordance with ICC A117.1.
- D. Set floor-mounted sinks in leveling bed of cement grout.
- E. Install water-supply piping with stop on each supply to each sink faucet.
  - 1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping" and Section 22 05 23.15 "Gate Valves for Plumbing Piping."
  - 2. Install stops in locations where they can be easily reached for operation.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
- G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

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- H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

### 3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

### 3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."
  - 2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

### 3.5 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Install new batteries in battery-powered, electronic-sensor mechanisms.

### 3.6 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

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- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 16.16

## COMMERCIAL SINKS

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## SECTION 22 45 00 - EMERGENCY PLUMBING FIXTURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Combination units.

#### 1.2 DEFINITIONS

- A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
- C. Portable, Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid supply.
- D. Tepid: Between 60 and 100 deg F.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

#### 1.4 INFORMATIONAL SUBMITTALS

#### 1.5 CLOSEOUT SUBMITTALS

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ANSI/ISEA Z358.1 for emergency plumbing fixtures including third-party certification of fixtures.
- B. Comply with ASSE 1071 for temperature-actuated mixing valves for plumbed emergency fixtures.
- C. Comply with ASME A112.18.1/CSA B125.1 for water-supply fittings.

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- D. Comply with ASME A112.18.2/CSA B125.2 for plumbing waste fittings.
- E. Comply with NSF 61 and NSF 372 for fixture materials that will be in contact with potable water.
- F. Comply with requirements in ICC A117.1 for plumbing fixtures for people with disabilities.
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.2 COMBINATION UNITS

- A. Combination Units - Emergency Shower with Eye/Face Wash, Accessible, Plumbed: .
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Acorn Safety; a Division of Morris Group International.
    - b. Bradley Corporation.
    - c. Encon Safety Products.
    - d. Guardian Equipment Co.
    - e. Haws Corporation.
    - f. Speakman Company.
    - g. Stingray Systems LLC.
    - h. WaterSaver Faucet Co.
  - 2. Source Limitations: Obtain combination units, emergency shower with eye/face wash, accessible, plumbed, from single manufacturer.
  - 3. Piping:
    - a. Material: Chrome-plated brass or stainless steel .
    - b. Unit Supply: NPS 1-1/2.
    - c. Unit Drain: Outlet at back or side near bottom.
  - 4. Shower:
    - a. Capacity: Not less than 20 gpm for at least 15 minutes.
    - b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.
    - c. Control-Valve Actuator: Pull rod .
    - d. Shower Head: 8-inch- minimum diameter, chrome-plated brass or stainless steel .
    - e. Mounting: Pedestal.
  - 5. Eye/Face Wash Unit:
    - a. Capacity: Not less than 3.0 gpm for at least 15 minutes.
    - b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
    - c. Control-Valve Actuator: Paddle.
    - d. Spray-Head Assembly: Two or four receptor-mounted spray heads.
    - e. Receptor: Chrome-plated brass or stainless steel bowl.
    - f. Mounting: Attached to shower pedestal.
    - g. Drench-Hose Option: May be provided instead of eye/face wash unit.
      - 1) Capacity: Not less than 3.0 gpm for at least 15 minutes.

## EMERGENCY PLUMBING FIXTURES

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- 2) Drench Hose: Handheld spray head with squeeze-handle actuator and hose.
  - 3) Mounting: Bracket on shower pedestal.
6. Accessories:
- a. 60-inch pull rod.
  - b. .

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF EMERGENCY PLUMBING FIXTURE

- A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
- B. Install fixtures level and plumb.
- C. Fasten fixtures to substrate.
- D. Install shutoff valves in water-supply piping to fixtures, to facilitate maintenance of equipment. Use ball or gate valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping" and Section 22 05 23.15 "Gate Valves for Plumbing Piping."
  1. Exceptions:
    - a. Omit shutoff valve on supply to group of plumbing fixtures that includes emergency equipment.
    - b. Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.
- E. Install shutoff valve and strainer in steam piping and shutoff valve in condensate return piping. Comply with requirements for steam and condensate piping specified in Section 23 22 13 "Steam and Condensate Heating Piping" and Section 23 22 16 "Steam and Condensate Heating Piping Specialties."
- F. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Section 22 11 16 "Domestic Water Piping."

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- G. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- H. Install trap and waste piping on drain outlet of emergency equipment receptors that are indicated to be directly connected to drainage system. Comply with requirements for waste piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- I. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be indirectly connected to drainage system. Comply with requirements for waste piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- J. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
- K. Fill self-contained fixtures with flushing fluid.

### 3.3 PIPING CONNECTIONS

- A. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment. Comply with requirements for cold-water piping specified in Section 22 11 16 "Domestic Water Piping."
- B. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for hot- and cold-water piping specified in Section 22 11 16 "Domestic Water Piping."
- C. Connect steam and cold-water-supply and condensate return piping to steam and cold water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for cold-water piping specified in Section 22 11 16 "Domestic Water Piping" and comply with requirements for steam and condensate piping specified in Section 23 22 13 "Steam and Condensate Heating Piping" and Section 23 22 16 "Steam and Condensate Heating Piping Specialties."
- D. Connect cold water and electrical power to electric heating water-tempering equipment. Comply with requirements for cold-water piping specified in Section 22 11 16 "Domestic Water Piping."
- E. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary waste and vent piping. Comply with requirements for waste piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- F. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary waste or storm drainage piping.
- G. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

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### 3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplate to be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."
  - 2. Nameplate to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

### 3.5 IDENTIFICATION

- A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### 3.6 FIELD QUALITY CONTROL

- A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.
- B. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection.
  - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 5. Emergency plumbing fixtures and water-tempering equipment will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

## EMERGENCY PLUMBING FIXTURES

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3.7 ADJUSTING

- A. Operate and adjust emergency plumbing fixtures and controls. Replace damaged and malfunctioning fixtures and controls.
- B. Adjust or replace fixture flow regulators for proper flow.
- C. Adjust equipment temperature settings.

3.8 CLEANING AND PROTECTION

- A. Clean emergency plumbing fixtures with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed emergency plumbing fixtures and fittings.
- C. Do not allow use of emergency plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 45 00

EMERGENCY PLUMBING FIXTURES

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## SECTION 22 47 16 - PRESSURE WATER COOLERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Pressure water coolers.
  - 2. Supports.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of pressure water cooler and bottle filling station.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

#### 1.4 CLOSEOUT SUBMITTALS

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Standards:
  - 1. Pressure water coolers and bottle filling stations intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 or NSF 372, or be certified in compliance with NSF 61 or NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
  - 2. Comply with ASHRAE 34 for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
  - 3. Comply with UL 399.

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4. Comply with ASME A112.19.3/CSA B45.4.
5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Comply with NSF 42 and NSF 53 for water filters for water coolers and bottle filling stations.
7. Comply with ICC A117.1 for accessible water coolers and bottle filling stations.

## 2.2 PRESSURE WATER COOLERS

### A. Pressure Water Coolers - Surface Wall-Mounted, Stainless Steel: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Elkay.
  - b. Halsey Taylor.
  - c. Murdock Manufacturing; A Division of Morris Group International.
  - d. Oasis International.
2. Source Limitations: Obtain surface wall-mounted, stainless steel, pressure water coolers from single source from single manufacturer.
3. Type: Vandal resistant and .
4. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
5. Control: Push button .
6. Glass filler.
7. Bottle Filler: Sensor activation , with : Fill rate 0.5 to 1.5 gpm .
8. Drain: Grid with NPS 1-1/4 tailpiece.
9. Supply: NPS 3/8 with shutoff valve.
10. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
11. Filter: One or more water filters with capacity sized for unit peak flow rate.
12. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
13. Support: Water-cooler carrier.
14. Water-Cooler Mounting Height: Standard Accessible in accordance with ICC A117.1 High/low - standard/accessible in accordance with ICC A117.1.
15. Capacities and Characteristics:
  - a. Cooled Water: 8 gph .
  - b. Ambient-Air Temperature: 90 deg F.
  - c. Inlet-Water Temperature: 80 deg F.
  - d. Cooled-Water Temperature: 50 deg F.

## 2.3 SUPPORTS

### A. Water-Cooler Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.

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- b. Josam Company.
  - c. MIFAB, Inc.
  - d. Wade Drains.
  - e. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Set freestanding, pressure water coolers on floor.
- C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- D. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers, and bottle filling stations to mounting frames.
- E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping"
- F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
- H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

## PRESSURE WATER COOLERS

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### 3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Install ball shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping"
- D. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

### 3.4 ELECTRICAL CONNECTIONS

- A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- C. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplates to be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."
  - 2. Nameplates to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

### 3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust pressure water-cooler temperature settings.

### 3.6 CLEANING

- A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.

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- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 47 16

## PRESSURE WATER COOLERS

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## SECTION 23 05 00 - MECHANICAL GENERAL REQUIREMENTS

### PART 1 - General

#### 1.1 General

- A. Drawings and general provisions apply to this Section.
- B. Examine all plans and specifications, visit the site(s) of the proposed project, and become fully informed as to the extent and character of the work required.

#### 1.2 Required Standards

- A. Laws and Regulations of the State of Texas.
- B. Local county and city codes and ordinances.

#### 1.3 Coordination

- A. Coordinate work under this Division to avoid conflicts and to attain satisfactory and complementary systems.
- B. Coordinate work under this Division with work under other Divisions to avoid conflicts and to allow for adequate installation, maintenance, and operating space. Obtain the Architect's approval for penetrations of other parts of the Work prior to effecting them.
- C. In resolving pipe, duct and conduit coordination, meet all requirements and be guided by these general orders of precedence:
  - 1. Accommodate gravity flow lines with required slopes before other lines.
  - 2. Accommodate lines with specific slope requirements (i.e., steam and refrigerant gas) before other lines.
  - 3. Accommodate work with a required reference elevation before other work.
  - 4. Accommodate mains before branches.
  - 5. Accommodate pipe and duct before conduit.
  - 6. Accommodate large lines before small lines.
  - 7. Accommodate pipe before duct.
  - 8. Accommodate high-pressure and high-velocity duct before low-pressure and low-velocity duct.
- D. Coordination of the work must occur between all project contractors and the requirements of access and priority shall be maintained regardless of the equipment installed "first." In resolving pipe, duct, and conduit coordination, meet all requirements and be guided by these general orders of precedence.

#### 1.4 Definitions

- A. Specific meanings used in Division 23 (variant forms are inferred):

MECHANICAL GENERAL REQUIREMENTS  
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- B. Work: This project, or the reference part.
  - C. Provide:
    - 1. Furnish and install, complete with necessary appurtenances.
    - 2. "Provide" is implied throughout this Division unless language is specific.
  - D. Required: Required by the contract Documents.
  - E. Necessary: Necessary in order to obtain a finished system in satisfactory operating condition, and meeting all requirements.
  - F. Furnish: Procure and deliver, ready for installation, necessary and/or required.
  - G. Install: Receive, place securely, ready for connection to work specified elsewhere, and bring into satisfactory operating condition, as necessary and/or required.
  - H. Connect: Connect properly to mechanical work. This includes non-physical "connections" such as indirect waste drains.
  - I. Architect, Project Architect or Architect/Engineer Team.
- 1.5 Scope of Work
- A. The work under this Division includes providing complete mechanical systems for the project.
  - B. All items of labor, material or equipment not required in detail by the specifications or plans, but incidental to, or necessary for the complete installation and proper operation of all phases of work described herein, or reasonably implied in connection therewith, shall be furnished as if called for in detail by the Contract Documents.
- 1.6 Workmanship
- A. All labor shall be performed in a workmanlike manner by mechanics skilled in their particular trades. All installations shall be complete in both effectiveness and appearance whether finally enclosed or left exposed. The architect reserves the right to direct the removal or replacement of any item which in his opinion shall not present a reasonable neat or workmanlike appearance, providing that same can be properly installed in an orderly way.
- 1.7 Manufacturer's Instructions
- A. Obtain written recommendations and installation and start-up instructions from material vendors and comply, unless otherwise required. Bring discrepancies between these instructions and project requirements to the attention of the Architect, and resolve prior to construction. Provide signed inspection report by manufacture's representative at system start-up to verify construction and warrantability.

1.8 OWNER'S INSTRUCTIONS

- A. Provide training to the Owner in the operation of all systems and equipment. All such training shall be videotaped, and the Owner shall be provided two copies of this material in a USB 3.0 flash drive.

1.9 Permits and Fees

- A. Permits: Obtain special permits necessary for this portion of the Work.
- B. Fees: Pay any fees associated with permits, required inspections, and permanent utility connections to this part of the work.

1.10 Licenses

- A. Work under this Division shall be performed by organizations and individuals holding a current license to perform such type of work by the authority having jurisdiction. "License" in this sense means any process, regardless of its appellation, which is normally mandated by the authority in order to perform such type of work within its jurisdiction.
- B. In the event that the licensed organization loses its license or is unable to obtain one, or the licensed individual performing the work becomes unlicensed or departs the organization, notify Architect immediately in writing.

1.11 Utility Coordination

- A. Permanent: In general, provide all ancillary work necessary to obtain utility connections. Pay connection fees. Arrange for connection in a timely manner. Coordinate time and arrangement of other work with the serving utility, and comply with utility standards.
- B. Temporary: Refer to Division 1.

1.12 Listing and Labeling

- A. Materials required to be listed shall be listed and labeled for the particular service if a listing is available. Obtain and comply with the terms of listings. Listed material include.
- B. NSF: Potable water and sanitary waste systems components.
- C. UL: Electrical materials.
- D. AMCA: Air moving devices and related accessory items.
- E. ARI: HVAC equipment.
- F. FM or UL: Hazardous fluid and fire protection system components.
- G. FIA, FM or AGA: Fuel gas system components.

1.13 Materials and Equipment

- A. All materials and equipment shall be new. Products shall be currently manufactured.
- B. All materials and equipment shall be clearly marked, stamped or labeled for identification. Do not obscure nameplates. Where manufactures nameplates do not meet the requirements of the mechanical identification specification provide nameplates in accordance with the specification.
- C. All products of similar type shall be provided by a single manufacturer throughout the project.

1.14 Submittals and Review

- A. Submittals shall be furnished in a USB 3.0 flash drive as one complete e-book in .PDF format organized with dividers indicating each specification section. All submitted data shall reference specification sections. Piece-mail electronic submittals via e-mail and/or hard copy submittals shall not be acceptable.
- B. Contractor shall furnish to the Architect, within a reasonable time after award of contract, and prior to commencing any work, complete brochures in quadruplicate (plus quantity required by the Contractor) of all materials and equipment which the contractor proposes to furnish on the project. Data shall include descriptive literature, performance data, diagrams, capacity information, etc., to substantiate that proposed equipment will meet all of the requirements of the plans and specifications.
- C. All data must be checked and any required changes noted thereon by the contractor, signed and dated prior to furnishing same to the Architect for approval. Contractor's attention is directed that it is mandatory that they thoroughly review data prior to furnishing same to assure that equipment is in accordance with plans and specifications and to assure prompt return of the data.
- D. Deviations: Specifically call to the attention of the Architect every proposed deviation from the Contract Document requirements. Failure to identify deviations as such constitutes a representation that all requirements are not met.
- E. Review: Review of submittals shall not be construed as releasing the Contractor from responsibility, but rather as a means to facilitate coordination of the work and the proper selection and installation of the products. All work shall be subject to final acceptance by the Architect at the completion of the project.
- F. If above information is not provided complete as specified above and within the allocated time, all equipment shall be furnished exactly as specified without any substitutions.

1.15 Substitutions

- A. Refer to the Conditions of the Contract.
- B. Where one vendor is indicated for a product, it is to establish a level of quality and performance; provide a product equal to that product in all respects from a vendor of equivalent performance.
- C. Where multiple vendors are indicated for a product, any of those vendors meeting the requirements may be submitted.

- D. Some product specifications in this Division are of the Acceptable Manufacturer type. Vendors listed as Acceptable Manufacturers are acceptable as vendors. However, the product submitted is subject to review as being fully equivalent in detail to the basis of design.
  - E. Where multiple vendors are listed with product model numbers, each model and vendor is acceptable, provide all requirements are met. Model numbers are indicated to the extent believe necessary to identify a type and are not necessary completely.
  - F. The architectural/engineering team has designed the facility using requirements of the Basis of Design equipment. Any substitutions from the basis of design, which will require additional A/E design and/or coordination, shall include the cost of necessary redesign by professionals licensed in the respective disciplines and the approval of the professional of record.
  - G. Additional submittal reviews beyond the first two (2) shall incur a cost paid by check to Sigma HN Engineers, PLLC. Payment shall be due upon receipt of submittal review comments from the licensed professional engineer. Cost for additional submittal reviews beyond the first two shall be on an hourly basis at \$250/hour.
- 1.16 Drawings and specifications
- A. These specifications are accompanied by Drawings. The Drawings and Specifications are complementary each to the other, and what is called for by one shall be as binding as if called for by both.
  - B. The Drawings are generally diagrammatic. Lay out work at the site to conform to existing conditions; architectural, structural, mechanical, and electrical conditions; to avoid all obstructions; and to conform to details of installation as required. Provide an integrated satisfactorily operating installation. All necessary offsets in piping, fittings, duct, etc., required to avoid interferences between piping, equipment, architectural, and structural elements shall be provided by the Contractor. Provide all necessary routing and offsets to avoid conflict.
  - C. Verify and arrange that sufficient space is provided for the installation of proposed products and that adequate access will exist for service and maintenance of equipment. For this work, adequate access shall be defined as meaning that service personnel can access and maintain a piece of equipment without having to alter permanent construction. Further, for equipment located above ceilings, access shall be available within 3 feet of ceiling opening or lay-in ceiling.
- 1.17 Complementary Documents
- A. Contract documents are complementary; requirements are not necessarily repetitively stated at each possible subject; consider that a requirement applies wherever applicable.
  - B. In the event of conflicting requirements in different parts of the Documents, the more expensive shall be presumed to apply, unless the Architect clarifies the requirement in a less expensive manner and waives the more expensive requirement in writing.
  - C. Since codes and standards are incorporated by reference, a particular conflict may appear in that a reference may use language that implies that a particular requirement in the Construction Documents is waived under the reference. This is not the case, unless specifically so clarified by the Architect. Generally, the specific Drawings and Specifications take precedence over waivers in multi-purpose reference documents.

- D. Because of licensure and workmanship requirements, persons performing the work are presumed to be familiar with applicable codes, ordinances, laws, regulations and standards. Therefore, details of materials, methods, arrangements and size contained in such publications are not necessarily replicated in the Contract Documents. This in no way deletes the requirement of the Contractor to comply. In the event of an apparent conflict between such publications and the Contract Documents, request clarification from the Architect prior to construction.

#### 1.18 Regulatory Meetings

- A. Comply with laws, rules and regulations, permit requirements, and ordinances. It is intended that the work of the Division be estimated and performed under the supervision of licensed master craftsman who are familiar with these requirements, whether illustrated or specifically detailed in the particular Contract Documents of this project or not. Therefore, regulatory requirements may not be so illustrated or detailed.

#### 1.19 Protection

- A. All work, equipment and materials shall be protected at all times to prevent damage or breakage either in transit, storage, installation or testing. All openings shall be closed with caps or plugs during installation. All materials and equipment shall be covered and protected against dirt, water, chemicals or mechanical injury.

#### 1.20 Cutting and Patching

- A. The work shall be carefully laid out in advance and the exact size and locations of openings arranged.

#### 1.21 Vibration and Noise

- A. Objectionable vibration and/or noise will not be tolerated.

#### 1.22 Demolition

- A. Coordinate with other divisions before commencing work.

#### 1.23 Record documents

- A. Drawings: The Contractor shall maintain and update daily a set of "blueline" prints in the Field Office for the sole purpose of recording "installed" conditions. Revise the drawings to reflect as-built conditions, including all addenda, change orders, final shop drawing reviews, and field routing. Underground utilities shall be dimensionally located relative to readily accessible and identifiable permanent reference points, with accurate slope and elevation indicated. Submit prints for review. Revise, certify accuracy, and provide two final sets to the Architect.
- B. Owner's Manual: Prior to final acceptance, provide two bound volumes to the Architect. Index by subject. Include corrected submittals and shop drawings that reflect final review comments;

installation, operation and maintenance instructions, parts lists, wiring diagrams, and piping diagrams; warranties.

1.24 Inspection, Observation, and Testing

- A. Cooperate with Architect's representative and authorities having jurisdiction. Provide complete access to the work at reasonable times.
- B. Cover-up: Prior to covering up work, or conducting observed tests, request observation as appropriate. Provide adequate advance notice defined as a minimum of five working days. In some cases the Architect's representative may waive observation; otherwise arrange for observed construction and testing prior to cover-up. Should the minimum required notice not be provided and the contractor covers up work requiring observation, such work shall be uncovered at contractor's expense.
- C. Pre-Testing: Self-inspect, pre-test, and remedy work prior to performing observed test.
- D. Sectional Work: In circumstances where a requirement for phased construction or other considerations dictate sectional construction and/or testing, notify the Architect when construction begins on the first section of a system, and when the first section will be ready for observed testing, as well as subsequent sections. Test in the largest practical sections.

1.25 Work performed under other divisions

- A. Refer to Division 2 for piped utilities beyond 5 feet from the building.
- B. Refer to Division 26 for power wiring systems external to equipment and control panels; starters in motor centers; safety switches not integral to equipment or starters provided under Division 23.
- C. Refer to Division 14 for kitchen, laboratory, medical and like equipment.

1.26 Reference to other divisions

- A. Refer to Division 26 for additional material requirements of electrical components provided under Division 23, such as loose starters, wiring and devices integral to equipment.
- B. Refer to Division 2 for additional requirements governing excavation and backfill, supplemental to the requirements stated in this Division 23.
- C. Comply with all requirements applicable to work required under this Division.

1.27 Testing Services

- A. Additional Testing: In addition to any specified testing, the Architect may cause additional testing to be performed by an independent testing laboratory or any other qualified party. If such testing reveals deficient work by the Contractor, the Contractor shall pay for both the testing and remedial work. If such testing does not reveal deficient work by the Contractor, the Owner shall pay for the testing and the cost of repairing any damage caused by such testing.

- B. Specified Testing Services: If independent testing services are specified regarding work under this Division, cooperate fully with the testing agency. Provide access to the work. Provide test holes and taps necessary. Remove work that is not tested on site, deliver to testing agency, and reinstall if undamaged; replace if damaged. Provide utilities, operational capability, and facilities for on-site testing as necessary.

END OF SECTION 23 05 00

## SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

#### 1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

### PART 2 - PRODUCTS

#### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.

#### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of **3300 feet** above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

#### 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.



- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F .
- I. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T .

#### 2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

- A. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
  - 2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

#### 2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 05 13

## 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 07 84 13 "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.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  1. Advance Products & Systems, LLC.
  2. CALPICO, Inc.
  3. GPT; an EnPro Industries company.
  4. Metraflex.

## SLEEVES AND SLEEVE SEALS FOR HVAC PIPING 23 05 17 - 1

- B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
- C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends and integral welded waterstop collar.
- D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- E. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.
- F. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- G. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

## 2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Jay R. Smith Mfg Co; a division of Morris Group International.
  - 2. Zurn Industries, LLC.
- B. Description: Manufactured, galvanized cast-iron sleeve with integral cast flashing flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with setscrews.

## 2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, LLC.
  - 2. Airex Manufacturing.
  - 3. CALPICO, Inc.
  - 4. GPT; an EnPro Industries company.
  - 5. Metraflex Company (The).
  - 6. Proco Products, Inc.
- B. Description:
  - 1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - 2. Designed to form a hydrostatic seal of 20-psig.
  - 3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
  - 4. Pressure Plates: Stainless steel .
  - 5. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

## 2.4 SLEEVE-SEAL FITTINGS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, LLC.
  2. CALPICO, Inc.
  3. GPT; an EnPro Industries company.
  4. Metraflex Company (The).
  5. Proco Products, Inc.
- B. Description:
1. Manufactured plastic, sleeve-type, waterstop assembly, made for imbedding in concrete slab or wall.
  2. Plastic or rubber waterstop collar with center opening to match piping OD.

## 2.5 GROUT

- A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-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.

## 2.6 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, use NT.
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## PART 3 - EXECUTION

### 3.1 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. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  - 2. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas **2 inches** above finished floor level.
  - 3. Using grout or silicone sealant, seal space outside of sleeves in 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 sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 84 13 "Penetration Firestopping."

### 3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  - 1. Install fittings that are large enough to provide **1/4-inch** annular clear space between sleeve and pipe or pipe insulation.
  - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 07 62 00 "Sheet Metal Flashing and Trim."
  - 3. Install section of cast-iron soil pipe to extend sleeve to **3 inches** above finished floor level.
  - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 5. Using waterproof silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.
- B. Fire-Resistance-Rated, Horizontal Assembly, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 07 84 13 "Penetration Firestopping."

### 3.3 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.

### 3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout or silicone sealant, seal space around outside of sleeve-seal fittings.

### 3.5 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.

### 3.6 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** : Steel pipe sleeves .
    - b. Piping **NPS 6** and Larger: Steel pipe sleeves .
  - 2. Exterior Concrete Walls Below Grade:
    - a. Piping Smaller Than **NPS 6** : 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.
    - b. Piping **NPS 6** and Larger: 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** : 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.
    - b. Piping **NPS 6** and Larger: 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.
4. Concrete Slabs Above Grade:
  - a. Piping Smaller Than **NPS 6** : Molded-PE or -PP 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 23 05 17

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## 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 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. BrassCraft Manufacturing Co.; a Masco company.
  - 2. Dearborn Brass.
  - 3. Jones Stephens Corp.
  - 4. Keeney Manufacturing Company (The).
  - 5. Mid-America Fittings, Inc.
  - 6. ProFlo; a Ferguson Enterprises, Inc. brand.

#### 2.2 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished brass finish and setscrew fastener.
- B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

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- C. One-Piece, Cast-Brass Type: With polished brass finish and setscrew fastener.
- D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
- E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

## 2.3 FLOOR PLATES

- A. Split Floor Plates: Steel with concealed hinge.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
    - b. Insulated Piping: One-piece stainless steel with polished stainless-steel finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. New Piping and Relocated Existing Piping: Split floor plate.
  - 2. Existing Piping to Remain: Split floor plate.

### 3.2 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 GAGES 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. Filled-system thermometers.
  - 2. Liquid-in-glass thermometers.
  - 3. Light-activated thermometers.
  - 4. Duct-thermometer mounting brackets.
  - 5. Thermowells.
  - 6. Dial-type pressure gages.
  - 7. Gage attachments.
  - 8. Test plugs.
  - 9. Test-plug kits.
  - 10. Flowmeters.
  - 11. Thermal-energy meters.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 FILLED-SYSTEM THERMOMETERS

A. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Ashcroft Inc.
  - b. Trerice, H. O. Co.
  - c. Weiss Instruments, Inc.
2. Standard: ASME B40.200.
3. Case: Sealed type, cast aluminum or drawn steel ; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F .
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic .
9. Ring: Stainless steel .
10. Connector Type(s): Union joint, back ; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
  - a. Design for Air-Duct Installation: With ventilated shroud.
  - b. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus 1 percent of scale range.

2.2 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:
  - a. Miljoco Corporation.
  - b. Trerice, H. O. Co.
  - c. Weiss Instruments, Inc.
2. Standard: ASME B40.200.
3. Case: Cast aluminum ; 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F .
7. Window: Glass or plastic .
8. Stem: Aluminum and of length to suit installation.
  - a. Design for Air-Duct Installation: With ventilated shroud.
  - b. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

### 2.3 LIGHT-ACTIVATED THERMOMETERS

#### A. Direct-Mounted, Light-Activated Thermometers:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Terice, H. O. Co.
  - b. Weiss Instruments, Inc.
  - c. Weksler Glass Thermometer Corp.
2. Case: Metal ; **7-inch** nominal size unless otherwise indicated.
3. Scale(s): Deg F and deg C.
4. Case Form: Adjustable angle .
5. Connector: **1-1/4 inches** , with ASME B1.1 screw threads.
6. Stem: Aluminum and of length to suit installation.
  - a. Design for Air-Duct Installation: With ventilated shroud.
  - b. Design for Thermowell Installation: Bare stem.
7. Display: Digital.
8. Accuracy: Plus or minus **1 deg F**.

### 2.4 DUCT-THERMOMETER MOUNTING BRACKETS

- #### A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

### 2.5 THERMOWELLS

#### A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion in piping tee fitting.
3. Material for Use with PP-R Pipe: Brass.
4. Material for Use with Copper Tubing: CNR Brass .
5. Material for Use with Steel Piping: Stainless Steel .
6. Type: Stepped shank unless straight or tapered shank is indicated.
7. External Threads: **NPS 1/2, NPS 3/4, or NPS 1**, ASME B1.20.1 pipe threads.
8. Internal Threads: **1/2, 3/4, and 1 inch**, with ASME B1.1 screw threads.
9. Bore: Diameter required to match thermometer bulb or stem.
10. Insertion Length: Length required to match thermometer bulb or stem.
11. Lagging Extension: Include on thermowells for insulated piping and tubing.
12. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

### 2.6 DIAL-TYPE 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:
  - a. Ashcroft Inc.

- b. Miljoco Corporation.
- c. Trerice, H. O. Co.
- d. Weiss Instruments, Inc.
2. Standard: ASME B40.100.
3. Case: Sealed type(s); cast aluminum ; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 , ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi .
8. Pointer: Dark-colored metal.
9. Window: Glass .
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of full scale range.

## 2.7 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 , ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2 , ASME B1.20.1 pipe threads.

## 2.8 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Miljoco Corporation.
  2. Trerice, H. O. Co.
  3. WATTS.
  4. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion in piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 1000 psig at 350 deg F .
- F. Core Inserts: EPDM self-sealing rubber.

## 2.9 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Miljoco Corporation.
  2. Trerice, H. O. Co.
  3. WATTS.

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4. Weiss Instruments, Inc.
- B. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, 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 **1- to 2-inch-** diameter dial and tapered-end sensing element. Dial range shall be at least **25 to 125 deg F** .
- D. Pressure Gage: Small, Bourdon-tube insertion type with **2- to 3-inch-** diameter dial and probe. Dial range shall be at least **0 to 200 psig** .
- E. Carrying Case: Metal or plastic, with formed instrument padding.

## 2.10 FLOWMETERS

- A. Inline Electromagnetic Flowmeters:
  1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. ISTECH Corporation.
    - b. ONICON.
    - c. Rosemount Inc.; Emerson Electric Company.
  2. Description: Inline electromagnetic flowmeter complete with NIST traceable, wet calibrated flow-measuring element, transmitter, visual display, ANSI Class 150 or 300 mounting flanges, and calibration certificate.
  3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
  4. Sensor: Electromagnetic velocity-measuring element; Inline type; for installing between pipe flanges and measuring flow directly in **gallons per minute**.
    - a. Design: Electromagnetic sensing (no moving parts). Electromagnetic sensing element shall utilize a minimum of two 316L stainless steel electrodes to measure the average flow rate velocity .
    - b. Construction: Flowmeter shall consist of epoxy painted carbon steel outer body, 304 stainless steel flow tube and integral liner to be selected based on operating temperature and fluid. Individual calibration tag shall be attached indicating calibration and programming information.
    - c. Maximum Pressure Rating: 580 psig .
    - d. Maximum Temperature Rating: 266 deg F .
    - e. Integral Transformer: For low-voltage power operation.
    - f. End Connections for NPS 1.0" and Larger: ANSI Class 150 Flange typical.
  5. Indicator: An integral part of sensor.
  6. Accuracy: Plus or minus 0.2 percent of rate from 1.6 to 33 ft/s velocity. Plus or minus 0.0033 ft/s at flow rates less than 1.6 ft/s .
  7. Calibration: Each flowmeter shall receive a wet calibration, within the expected operating range, against a primary volumetric standard directly traceable to international standards in accordance with ISO 9104:1991 and ISO 17025:2005.
  8. Transmitter Enclosure: Transmitter enclosure shall be cast aluminum, IP67 rated.
  9. Display: Menu driven via three (3) button programming keys and shall include 16 character, 8 line graphic LCD backlit display. Display shall provide instantaneous flow rate information, totalized

flow information, flow velocity, flow direction, short term trend data and shall be factory configured for a specific flowmeter application.

10. Operating Instructions: Include complete instructions with each flowmeter.
11. Warranty: Each flowmeter shall be covered by the manufacturer's three-year warranty.

## 2.11 THERMAL-ENERGY METERS

### A. Thermal-Energy Meters:

1. **Manufacturers:** Subject to compliance with requirements, provide products by the following:
  - a. ONICON Incorporated.
2. Description: System to be used withflow meter, temperature sensors, and connecting wiring. Provide an ONICON System-10 BTU Meter. The BTU meter shall provide the following points both at the integral LCD and as outputs to the building control system: Energy Total, Energy Rate, Flow Rate, Supply Temperature and Return Temperature. Output signals shall be either serial network (protocol conforming to BACnet<sup>®</sup>MS/TP or BACnet/IP) and/or via individual analog and pulse outputs. Each BTU meter shall be factory programmed for its specific application, and shall be re-programmable using the front panel keypad (no special interface device or computer required)

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install thermowells with socket extending 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 duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
- H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- I. Install remote-mounted pressure gages on panel.
- J. Install valve and snubber in piping for each pressure gage for fluids (except steam).
- K. Install valve and syphon fitting in piping for each pressure gage for steam.
- L. Install test plugs in piping tees.

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- M. Install flow indicators in piping systems in accessible positions for easy viewing.
- N. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.
- O. Install flowmeter elements in accessible positions in piping systems.
- P. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.
- Q. Install permanent indicators on walls or brackets in accessible and readable positions.
- R. Install connection fittings in accessible locations for attachment to portable indicators.
- S. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.
- T. Install thermometers in the following locations:
  - 1. Inlet and outlet of each hydronic zone.
  - 2. Two inlets and two outlets of each chiller.
  - 3. Inlet and outlet of each hydronic coil in air-handling units.
  - 4. Outside-, return-, supply-, and mixed-air ducts.
- U. Install pressure gages in the following locations:
  - 1. Discharge of each pressure-reducing valve.
  - 2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
  - 3. Suction and discharge of each pump.

### 3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow space for service and maintenance of meters, gages, machines, and equipment.
- B. Connect flowmeter-system elements to meters.
- C. Connect flowmeter transmitters to meters.
- D. Connect thermal-energy meter transmitters to meters.

### 3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

### 3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each hydronic zone shall be the following:

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1. Industrial-style, liquid-in-glass type.
  - B. Thermometers at inlets and outlets of each chiller shall be one of the following:
    1. Industrial-style, liquid-in-glass type. (Outdoors)
    2. Direct -mounted, light-activated type. (Indoors)
  - C. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be one of the following:
    1. Industrial-style, liquid-in-glass type. (Outdoors)
    2. Direct -mounted, light-activated type. (Indoors)
  - D. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be the following:
    1. Remote-mounted, metal -case, vapor-actuated type.
  - E. Thermometer stems shall be of length to match thermowell insertion length.
- 3.5 THERMOMETER SCALE-RANGE SCHEDULE
- A. Scale Range for Chilled-Water Piping: 0 to 100 deg F .
  - B. Scale Range for Air Ducts: 0 to 150 deg F .
- 3.6 PRESSURE-GAGE SCHEDULE
- A. Pressure gages at discharge of each pressure-reducing valve shall be one of the following:
    1. Sealed , direct -mounted, metal case.
    2. Test plug with EPDM self-sealing rubber inserts.
  - B. Pressure gages at inlet and outlet of each chiller chilled-water and condenser-water connection shall be one of the following:
    1. Sealed , direct -mounted, metal case.
    2. Test plug with EPDM self-sealing rubber inserts.
  - C. Pressure gages at suction and discharge of each pump shall be one of the following:
    1. Sealed , direct -mounted, metal case.
- 3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE
- A. Scale Range for Chilled-Water Piping: 0 to 100 psi .

END OF SECTION 23 05 19

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## SECTION 23 05 23.12 - BALL VALVES FOR HVAC PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Bronze ball valves.

#### 1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. RPTFE: Reinforced polytetrafluoroethylene.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
  2. Protect threads, flange faces, and weld ends.
  3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
  2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

### PART 2 - PRODUCTS

#### 2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. 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. ASME B16.18 for cast copper solder-joint connections.
  6. ASME B16.22 for wrought copper and copper alloy solder-joint connections.
  7. ASME B16.34 for flanged and threaded end connections.
  8. ASME B31.1 for power piping valves.
  9. ASME B31.9 for building services piping valves.
- B. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- C. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- D. Valve Sizes: Same as upstream piping unless otherwise indicated.
- E. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves **NPS 4** and larger.
  2. Hand Lever: For quarter-turn valves smaller than **NPS 4**.
- F. Valves in Insulated Piping:
1. Provide **2-inch** extended neck stems.
  2. Extended operating handles with nonthermal-conductive covering material, and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
  3. Memory stops that are fully adjustable after insulation is applied.
- G. Valve Bypass and Drain Connections: MSS SP-45.

## 2.3 BRONZE BALL VALVES

- A. Bronze Ball Valves, Two Piece with Full Port and Bronze or Brass Trim, Threaded or Soldered Ends:
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. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    - b. Milwaukee Valve Company.
    - c. NIBCO INC.
    - d. WATTS.
  2. Standard: MSS SP-110.
  3. SWP Rating: **150 psig**.
  4. CWP Rating: **600 psig**.
  5. Body Design: Two piece.

### BALL VALVES FOR HVAC PIPING 23 05 23.12 - 2

6. Body Material: Bronze.
7. Ends: Threaded or soldered.
8. Seats: PTFE.
9. Stem: Bronze.
10. Ball: Chrome-plated brass.
11. Port: Full.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

#### 3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.
- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full valve actuation movement.
- F. Valve Tags: Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for valve tags and schedules.
- G. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

### 3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves exhibiting leakage.

### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified SWP classes or CWP ratings are unavailable, provide the same types of valves with higher SWP classes or CWP ratings.
- B. Select valves with the following end connections:
  - 1. For Tubing, **NPS 2** and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.

### 3.5 CHILLED-WATER VALVE SCHEDULE

- A. Pipe **NPS 2** and Smaller: bronze ball valves, two piece, with bronze trim, full port, and threaded or solder -joint ends.
  - 1. Valves may be provided with solder-joint ends instead of threaded ends.

END OF SECTION 23 05 23.12

## SECTION 23 05 23.13 - BUTTERFLY VALVES FOR HVAC PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Iron, single-flange (lug-type) butterfly valves.
  2. Ductile-iron, grooved-end butterfly valves.
  3. Chainwheels.

#### 1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: ABS, Buna-N, or nitrile butadiene rubber.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
  2. Protect threads, flange faces, grooves, and weld ends.
  3. 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 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

#### A. ASME Compliance:

1. ASME B16.1 for flanges on iron valves.
2. ASME B16.5 for flanges on steel valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B31.1 for power piping valves.
5. ASME B31.9 for building services valves.

- B. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

- C. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

- D. Valve Sizes: Same as upstream piping unless otherwise indicated.

#### E. Valve Actuator Types:

1. Gear Actuator: For valves **NPS 8** and larger.
2. Hand Lever: For valves **NPS 6** and smaller.
3. Chainwheel: Device for attachment to gear, stem, or other actuator of size and with chain for mounting height, according to "Installation of Valves" Article.

- F. Valves in Insulated Piping: Provide with **2-inch** extended neck stems.

### 2.3 IRON, SINGLE-FLANGE (LUG-TYPE) BUTTERFLY VALVES

#### A. Iron, Single-Flange (Lug-Type) Butterfly Valves with Aluminum-Bronze Disc:

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Bray International, Inc.
  - c. DeZURIK.
  - d. NIBCO INC.
2. Standard: MSS SP-67, Type I.
3. CWP Rating: **200 psig**.
4. Body Design: Single flange (lug type), suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
5. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
6. Seat: EPDM .
7. Stem: One- or two-piece stainless steel.
8. Disc: Aluminum bronze.

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## 2.4 DUCTILE-IRON, GROOVED-END BUTTERFLY VALVES

### A. Ductile-Iron, Grooved-End Butterfly Valves, 300 CWP:

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. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
  - b. NIBCO INC.
  - c. Norriseal.
  - d. Victaulic Company.
2. Standard: MSS SP-67, Type I.
3. **NPS 8 and Smaller CWP Rating: 300 psig.**
4. **NPS 10 and Larger CWP Rating: 200 psig.**
5. Body Material: Coated, ductile iron.
6. Stem: Two-piece stainless steel.
7. Disc: Coated, ductile iron.
8. Seal: EPDM.

## 2.5 CHAINWHEELS

### A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries; Rotork.
3. Trumbull Industries.

### B. Description: Valve actuation assembly with sprocket rim, chain guides, chain , and attachment brackets for mounting chainwheels directly to hand wheels.

1. Sprocket Rim with Chain Guides: Ductile iron , of type and size required for valve. Include zinc or epoxy coating.
2. 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 mating flange faces for damage. 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.

- D. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

### 3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.
- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full valve actuation movement.
- F. Install chainwheels on manual actuators for butterfly valves **NPS 4** and larger and more than **96 inches** above floor. Extend chains to **60 inches** above finished floor.
- G. Valve Tags: Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

### 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. If leakage cannot be repaired, replace valve.

### 3.4 CHILLED-WATER VALVE SCHEDULE

- A. Pipe **NPS 2-1/2** and Larger:
  - 1. Iron, Single-Flange Butterfly Valves, **NPS 2-1/2 to NPS 12**: Aluminum-bronze disc, 200 CWP, and EPDM seat.
  - 2. Ductile-Iron, Grooved-End Butterfly Valves, **NPS 2-1/2 to NPS 12**: 300 CWP.

END OF SECTION 23 05 23.13

## SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment stands.
8. Equipment and pipe supports.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 23 05 48.13 "Vibration Controls for HVAC" for vibration isolation devices.
3. Section 23 31 13 "Metal Ducts" and Section 23 31 16 "Nonmetal Ducts" for duct hangers and supports.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

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1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7 .
1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
  3. Nonmetallic Coatings: Plastic coated, or epoxy powder-coated.
  4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel .
- B. Copper Pipe and Tube Hangers:
1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.
  2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel .

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural hot-dip galvanized steel shapes with MSS SP-58 stainless-steel hanger rods, nuts, saddles, and U-bolts.
1. Indoors: Carbon steel shapes with carbon steel hanger rods, nuts, saddles, and U-bolts.

2. Outdoors: Hot-dipped galvanized steel shapes with stainless steel hanger rods, nuts, saddles, and U-bolts.

## 2.4 METAL FRAMING SYSTEMS

### A. MFMA Manufacturer Metal Framing Systems:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Cooper B-line; brand of Eaton, Electrical Sector.
  - b. G-Strut.
  - c. MIRO Industries.
  - d. Unistrut; Atkore International.
2. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
4. Channels: Continuous slotted carbon-steel channel with inturred lips.
5. Channel Width: Selected for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel .
8. Metallic Coating: Hot-dip galvanized .

## 2.5 THERMAL-HANGER SHIELD INSERTS

- ### A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. Buckaroos, Inc.
  2. CADDY; brand of nVent Electrical plc.
  3. National Pipe Hanger Corporation.
  4. Pipe Shields Inc.
- ### B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psi minimum compressive strength and vapor barrier.
- ### C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- ### D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- ### E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.6 FASTENER SYSTEMS

- ### A. Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

- a. Cooper B-line; brand of Eaton, Electrical Sector.
- b. Hilti, Inc.
- c. MKT Fastening, LLC.
2. Indoor Applications: Zinc-coated or stainless steel.
3. Outdoor Applications: Stainless steel.

## 2.7 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand:
  1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Eberl Iron Works, Inc.
    - b. MIRO Industries.
    - c. PHP Systems/Design.
  2. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
  3. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
  4. Hardware: Galvanized steel or polycarbonate.
  5. Accessories: Protection pads.
- C. High-Profile, Multiple-Pipe Stand:
  1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Eberl Iron Works, Inc.
    - b. MIRO Industries.
    - c. PHP Systems/Design.
    - d. RectorSeal HVAC; a CSW Industrials Company.
  2. Description: Assembly of bases, vertical and horizontal members, and pipe supports, without membrane penetration.
  3. Bases: Two or more; vulcanized rubber .
  4. Vertical Members: Two or more, galvanized -steel channels.
  5. Horizontal Members: One or more, adjustable height, galvanized -steel pipe support.
  6. Pipe Supports: Clevis hanger .
  7. Hardware: Galvanized steel.
  8. Accessories: Protection pads , 1/2-inch continuous-thread rod.
  9. Height: 24 to 36 inches above ground .

## 2.8 EQUIPMENT and PIPE SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural galvanized -steel shapes.

## 2.9 OUTDOOR EQUIPMENT STANDS

- 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:

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1. Eberl Iron Works, Inc.
2. MIRO Industries.
3. RectorSeal HVAC; a CSW Industrials Company.

## 2.10 MATERIALS

- A. Aluminum: **ASTM B221**.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.
- F. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  1. Properties: Nonstaining, noncorrosive, and nongaseous.
  2. Design Mix: **5000-psi**, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus **200 lb**.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  2. Field fabricate from ASTM A36/A36M, galvanized carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

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- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than **4 inches** thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 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.
- 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.
  - b. **NPS 4: 12 inches** long and **0.06 inch** thick.
  - c. **NPS 5 and NPS 6: 18 inches** long and **0.06 inch** thick.
  - d. **NPS 8 to NPS 14: 24 inches** long and **0.075 inch** thick.
  - e. **NPS 16 to NPS 24: 24 inches** long and **0.105 inch** thick.
5. Pipes **NPS 8** and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands and shapes to suspend piping and equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to **1-1/2 inches** .

### 3.6 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of **2.0 mils**.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

### 3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use galvanized carbon-steel metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless steel pipe hangers and stainless steel attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes **NPS 1/2 to NPS 30**.
  - 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes **NPS 3/4 to NPS 36**, requiring clamp flexibility and up to **4 inches** of insulation.
  - 3. 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.
  - 4. U-Bolts (MSS Type 24): For support of heavy pipes **NPS 1/2 to NPS 30**.
  - 5. 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.
  - 6. 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.

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7. 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.
  8. 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.
  9. Complete Pipe Rolls (MSS Type 44): For support of pipes **NPS 2 to NPS 42** if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers **NPS 3/4 to NPS 24**.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers **NPS 3/4 to NPS 24** if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to **6 inches** for heavy loads.
  2. Steel Clevises (MSS Type 14): For **120 to 450 deg F** piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For **120 to 450 deg F** piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
  2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  4. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  5. C-Clamps (MSS Type 23): For structural shapes.
  6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  8. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  9. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  10. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  11. 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.**
  12. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

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13. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  14. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed **1-1/4 inches**.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  4. 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.
  5. 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.
  6. 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.
- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 05 29

## SECTION 23 05 48.13 - VIBRATION CONTROLS FOR HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric hangers.
3. Spring hangers.
4. Snubbers.
5. Restraints - rigid type.
6. Restraint accessories.
7. Post-installed concrete anchors.
8. Concrete inserts.

- B. Related Requirements:

1. Section 21 05 48.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 22 05 48.13 "Vibration Controls for Plumbing Piping and Equipment" for devices for plumbing equipment and systems.

#### 1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. OSHPD: Office of Statewide Health Planning and Development (for the State of California owned and regulated medical facilities).

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Include load rating for each wind-force-restraint fitting and assembly.
3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and wind-force-restraint component.

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4. Annotate to indicate application of each product submitted and compliance with requirements.
  5. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
1. Detail fabrication and assembly of equipment bases.
  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.
- C. Delegated-Design Submittal:
1. For each wind-load protection device that is required by this Section or is indicated on Drawings, submit the following:
    - a. Vibration Isolator and Wind-Load-Restraint Selection: Select vibration isolators, wind-load restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data.
    - b. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification by professional engineer that riser system was examined for excessive stress and that none exists.
    - c. Concrete Anchors and Inserts: Include calculations showing anticipated wind loads.
    - d. Wind-Load Design Calculations: Submit all static and dynamic loading calculations prepared under "Wind-Load Design Calculations" Paragraph in "Performance Requirements" Article.
    - e. Qualified Professional Engineer: All designated-design submittals for wind-restraint calculations are to be signed and sealed by qualified professional engineer responsible for their preparation.
  2. Wind-Restraint Detail Drawing:
    - a. Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
    - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to 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 wind events. Indicate association with vibration isolation devices.
    - c. Coordinate vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply also with requirements in other Sections for equipment mounted outdoors.
  3. All delegated-design submittals for wind-restraint detail Drawings are to be signed and sealed by qualified professional engineer responsible for their preparation.
  4. Product Listing, Preapproval, and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and basis for approval (tests or calculations).
  5. Design Calculations for Vibration Isolation Devices: Calculate static and dynamic loading due to equipment weight and operating forces required to select proper vibration isolators, and to design vibration isolation bases.
  6. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and

spring deflection changes. Include certification that riser system was examined for excessive stress and that none exists.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

#### 1.6 QUALITY ASSURANCE

- A. Wind-Load-Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: UL product listing .

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design system.
  - 1. Wind-Load Performance: Equipment shall withstand the effects of high wind events determined in accordance with ASCE/SEI 7-05 .
- B. Wind-Load Design Calculations:
  - 1. Perform calculations to obtain force information necessary to properly select wind-load-restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASCE/SEI 7-05 . Where "ASCE/SEI 7" is used throughout this Section, it is to be understood that the edition referred to in this subparagraph is intended as referenced throughout the Section Text unless otherwise noted.
    - a. Factors indicated below that are specific to individual pieces of equipment must be obtained by Contractor and must be included in individual component submittal packages.
    - b. Coordinate design wind-load calculations with vibration isolation requirements. Comply with requirements in other Sections in addition to those in this Section for equipment mounted outdoors.
- C. Consequential Damage: Provide additional restraints for suspended HVAC components or anchorage of floor-, roof-, or wall-mounted HVAC components as indicated in ASCE/SEI 7-05 so that failure of a non-essential or essential HVAC component will not cause the failure of any other essential architectural, mechanical, or electrical building component.

- D. Fire/Smoke Resistance: All components that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84 or UL 723, and be so labeled.
- E. Component Supports:
  - 1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.

## 2.2 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads: .
  - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Mason Industries, Inc.
    - b. Vibro-Acoustics.
    - c. Vibration Mountings & Controls, Inc.
  - 2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  - 3. Size: Factory or field cut to match requirements of supported equipment.
  - 4. Minimum deflection as indicated on Drawings.
  - 5. Pad Material: Oil- and water-resistant rubber.
  - 6. Sandwich-Core Material: Resilient and elastomeric .

## 2.3 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. Mason Industries, Inc.
    - b. Vibro-Acoustics.
    - c. Vibration Mountings & Controls, 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. Damping Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel-to-steel contact.
  - 4. Minimum deflection as indicated on Drawings.

## 2.4 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. Mason Industries, Inc.
    - b. Vibro-Acoustics.



- c. Vibration Mountings & Controls, Inc.
2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Minimum deflection as indicated on Drawings.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
8. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

## 2.5 SNUBBERS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  1. Mason Industries, Inc.
  2. Vibro-Acoustics.
  3. Vibration Mountings & Controls, Inc.
- B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
  1. Post-Installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors. Anchors to be prequalified in accordance with ACI 355.2 testing and designated in accordance with ACI 318-14 Ch. 17 for 2015 or 2018 IBC.
  2. Preset Concrete Inserts: Prequalified in accordance with ICC-ES AC446 testing.
  3. Anchors in Masonry: Design in accordance with TMS 402.
  4. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
  5. Resilient Cushion: Maximum **1/4-inch** air gap, and minimum **1/4 inch** thick.

## 2.6 RESTRAINTS - RIGID TYPE

- 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. California Dynamics Corporation.
  2. Hilti, Inc.
  3. Vibration Mountings & Controls, Inc.
- B. Description: Shop- or field-fabricated bracing assembly made of AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe as per NFPA 13, or other rigid steel brace member. Includes 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.

## 2.7 RESTRAINT ACCESSORIES

- 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. Cooper B-line; brand of Eaton, Electrical Sector.
  2. Hilti, Inc.
  3. Mason Industries, Inc.
- B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

## 2.8 POST-INSTALLED CONCRETE ANCHORS

- A. Mechanical Anchor Bolts:
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. Hilti, Inc.
    - b. Mason Industries, Inc.
    - c. Simpson Strong-Tie Co., Inc.
  2. 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 for anchor and as tested according to ASTM E488/E488M.
- B. Adhesive Anchor Bolts:
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. Hilti, Inc.
    - b. Mason Industries, Inc.
    - c. Simpson Strong-Tie Co., Inc.
  2. 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/E488M.

- C. Provide post-installed concrete anchors that have been prequalified for use in wind-load applications. Post-installed concrete anchors must comply with all requirements of ASCE/SEI 7-05, Ch. 13 .
  - 1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
  - 2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.
- D. Expansion-type anchor bolts are not permitted for equipment in excess of 10 hp that is not vibration isolated.
  - 1. Undercut expansion anchors are permitted.

## 2.9 CONCRETE INSERTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Hilti, Inc.
  - 2. Mason Industries, Inc.
  - 3. Simpson Strong-Tie Co., Inc.
- B. Provide preset concrete inserts that are prequalified in accordance with ICC-ES AC466 testing.
- C. Comply with ANSI/MSS SP-58.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and wind-load 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 wind-load forces.

- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength is adequate to carry static and wind force loads within specified loading limits.

### 3.3 INSTALLATION OF VIBRATION AND WIND-LOAD CONTROL DEVICES

- A. Provide vibration and wind-load control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Device Schedules on Drawings, where Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.
- B. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 30 00 "Cast-in-Place Concrete."
- C. Installation of vibration isolators and wind-load restraints must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- D. Comply with requirements in Section 07 72 00 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- E. Equipment Restraints:
  - 1. Install snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
  - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds **0.125 inch**.
  - 3. Install wind-load-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- F. Piping Restraints:
  - 1. Comply with requirements in MSS SP-127.
  - 2. Space lateral supports as recommended by pipe manufacturer. **40 feet 80 feet**
- G. Install wind-load-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. Post-Installed Concrete 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 structural engineer if reinforcing steel or other embedded items are encountered

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- 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-Type Anchor Bolts: 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-Type Anchor Bolts: 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 MOTION

- A. Provide flexible connections in piping systems where they cross structural joints and other point where differential movement may occur. Provide adequate flexibility to accommodate differential movement as determined in accordance with ASCE/SEI 7. Comply with requirements in Section 23 21 13 "Hydronic Piping" and Section 23 21 16 "Hydronic Piping Specialties" for piping flexible connections.

### 3.5 ADJUSTING

- A. Adjust isolators after system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

### 3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. 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.

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8. Verify snubber minimum clearances.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

END OF SECTION 23 05 48.13

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## SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Equipment labels.
  2. Warning signs and labels.
  3. Pipe labels.
  4. Duct labels.
  5. Valve tags.
  6. Warning tags.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve-numbering scheme.
- D. Valve Schedules: Provide for each piping system. Include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
1. **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. Brady Corporation.
    - b. Brimar Industries, Inc.
    - c. Craftmark Pipe Markers.
  2. **Material and Thickness:** Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch anodized aluminum, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
  3. **Letter and Background Color:** As indicated for specific application under Part 3.
  4. **Minimum Label Size:** Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  5. **Minimum Letter Size:** 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for

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- greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- 6. Fasteners: Stainless steel rivets or self-tapping screws.
- 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

## 2.2 WARNING SIGNS AND LABELS

- A. **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. Brady Corporation.
  - 2. Brimar Industries, Inc.
  - 3. Craftmark Pipe Markers.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, **1/8 inch** thick, with predrilled holes for attachment hardware.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Maximum Temperature: Able to withstand temperatures of up to **160 deg F**.
- E. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch**.
- F. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less than **24 inches**, **1/2 inch** for viewing distances of up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless steel rivets or self-taping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA70E and other applicable codes and standards.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

## 2.3 PIPE LABELS

- 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. Brady Corporation.
  - 2. Brimar Industries, Inc.
  - 3. Craftmark Pipe Markers.



- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
  - 1. Pipe size.
  - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
  - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping .

## 2.4 DUCT LABELS

- 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. Brady Corporation.
  - 2. Brimar Industries, Inc.
  - 3. Craftmark Pipe Markers.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Maximum Temperature: Able to withstand temperatures up to **160 deg F**.
- D. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch**.
- E. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less than **24 inches**, **1/2 inch** for viewing distances of up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- F. Fasteners: Stainless steel rivets or self-tapping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings. Also include the following:
  - 1. Duct size.
  - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution ducts. Arrows may be either integral with label or may be applied separately.
  - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping .

## 2.5 VALVE TAGS

- 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. Brady Corporation.
  2. Brimar Industries, Inc.
  3. Craftmark Pipe Markers.
- B. Description: Stamped or engraved with **1/4-inch** letters for piping system abbreviation and **1/2-inch** numbers.
1. Tag Material: Brass, **0.04-inch** stainless steel, **0.024-inch** aluminum, **0.031-inch [or]** anodized aluminum, **0.031-inch** minimum thickness, with predrilled or stamped holes for attachment hardware.
  2. Fasteners: Brass wire or beaded chain or S-hook.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Valve Schedules: For each piping system, on **8-1/2-by-11-inch** bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Include valve-tag schedule in operation and maintenance data.

## 2.6 WARNING TAGS

- A. **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. Brady Corporation.
  2. Brimar Industries, Inc.
  3. Craftmark Pipe Markers.
- B. Description: 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. Letter and Background Color: As indicated for specific application under Part 3.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

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### 3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

### 3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of mechanical equipment.
- B. Sign and Label Colors:
  - 1. White letters on an ANSI Z535.1 safety-blue background .
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E , and other applicable codes and standards.

### 3.4 INSTALLATION OF PIPE LABELS

- A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Within **3 ft.** of each valve and control device.
  - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 3. Within **3 ft.** of equipment items and other points of origination and termination.
  - 4. Spaced at maximum intervals of **25 ft.** along each run. Reduce intervals to **10 ft.** in areas of congested piping, ductwork, and equipment.
- C. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of **125 deg F** or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- D. Flow-Direction Arrows: Use arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe-Label Color Schedule:
  - 1. Chilled-Water Piping: White letters on an ANSI Z535.1 safety-green background .
  - 2. Refrigerant Piping: White letters on an ANSI Z535.1 safety-blue background .

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### 3.5 INSTALLATION OF DUCT LABELS

- A. Install self-adhesive duct labels showing service and flow direction with permanent adhesive on air ducts.
  - 1. Provide labels in the following color codes:
    - a. For air supply ducts: White letters on blue background .
    - b. For air return ducts: White letters on red background .
    - c. For exhaust-, outside-, relief-, return-, and mixed-air ducts: White letters on green background .
    - d. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate label near each point where ducts enter into and exit from concealed spaces and at maximum intervals of **20 ft.** where exposed or are concealed by removable ceiling system.
- C. Stenciled Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
  - 1. Black letters on White background .

### 3.6 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.
  - 1. Valve-Tag Size and Shape:
    - a. Chilled Water: **1-1/2 inches** , round .
  - 2. Valve-Tag Colors:
    - a. For each piping system, use the same lettering and background coloring system on valve tags as used for the Pipe Label Schedule text and background.

### 3.7 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background .
- B. Attach warning tags, with proper message, to equipment and other items where required .

END OF SECTION 23 05 53

## 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. Testing, Adjusting, and Balancing of Air Systems:
    - a. Constant-volume air systems.
    - b. Variable-air-volume systems.
    - c. Multizone systems.
  - 2. Testing, Adjusting, and Balancing of Hydronic Piping Systems:
    - a. Secondary Pumps on an existing Primary-Secondary hydronic system.
  - 3. Testing, adjusting, and balancing of equipment.
  - 4. Procedures for exhaust hoods.
  - 5. Duct leakage tests verification.
  - 6. Pipe leakage tests verification.
  - 7. HVAC-control system verification.

#### 1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

#### 1.4 PREINSTALLATION MEETINGS

- A. TAB Conference: Conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan, to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

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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: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 45 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.
- C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 60 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
  1. Instrument type and make.
  2. Serial number.
  3. Application.
  4. Dates of use.
  5. Dates of calibration.

## 1.7 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by AABC:
  1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
  2. TAB Technician: Employee of the TAB specialist and certified by AABC.
- B. TAB Specialists Qualifications, Certified by NEBB :

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB .
  2. TAB Technician: Employee of the TAB specialist and certified by NEBB .
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."
- E. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

## 1.8 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, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.
- F. Examine equipment performance data, including fan and pump curves.

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1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainer baskets are installed and clean.
- L. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.
- Q. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
1. Equipment and systems to be tested.
  2. Strategies and step-by-step procedures for balancing the systems.
  3. Instrumentation to be used.

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4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
1. Airside:
    - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
    - b. Duct systems are complete with terminals installed.
    - c. Volume, smoke, and fire dampers are open and functional.
    - d. Clean filters are installed.
    - e. Fans are operating, free of vibration, and rotating in correct direction.
    - f. Variable-frequency controllers' startup is complete and safeties are verified.
    - g. Automatic temperature-control systems are operational.
    - h. Ceilings are installed.
    - i. Windows and doors are installed.
    - j. Suitable access to balancing devices and equipment is provided.
  2. Hydronics:
    - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
    - b. Piping is complete with terminals installed.
    - c. Water treatment is complete.
    - d. Systems are flushed, filled, and air purged.
    - e. Strainers are pulled and cleaned.
    - f. Control valves are functioning in accordance with the sequence of operation.
    - g. Shutoff and balance valves have been verified to be 100 percent open.
    - h. Pumps are started and proper rotation is verified.
    - i. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
    - j. Variable-frequency controllers' startup is complete and safeties are verified.
    - k. Suitable access to balancing devices and equipment is provided.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
1. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 23 33 00 "Air Duct Accessories."
  2. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
  3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 23 07

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13 "Duct Insulation," Section 23 07 16 "HVAC Equipment Insulation," and Section 23 07 19 "HVAC Piping Insulation."

- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

- A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:
  - 1. Motors.
  - 2. Pumps.
  - 3. Fans and ventilators.
  - 4. Air curtains.
  - 5. Terminal units.
  - 6. Commercial kitchen hoods.
  - 7. Unit heaters.
  - 8. Air-handling units.
  - 9. Packaged air conditioners.
  - 10. Split-system air conditioners.
  - 11. Coils.

### 3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' Record drawings duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.

- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.

### 3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    - c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
  - 2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report artificial loading of filters at the time static pressures are measured.
  - 3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  - 4. Obtain approval from Engineer 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.

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1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

### 3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
  - a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
  - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
  - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
  - d. Adjust controls so that terminal is calling for minimum airflow.
  - e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
  - f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

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- a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
  - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow, so that connected total matches fan selection and simulates actual load in the building.
  - c. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
  - d. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
6. Measure fan static pressures as follows:
- a. Measure static pressure directly at the fan outlet or through the flexible connection.
  - b. Measure static pressure directly at the fan inlet or through the flexible connection.
  - c. Measure static pressure across each component that makes up the air-handling system.
  - d. Report any artificial loading of filters at the time static pressures are measured.
7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
- a. Balance the return-air ducts and inlets.
  - b. Verify that terminal units are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical terminal unit, and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls Contractor.
9. Verify final system conditions as follows:
- a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
  - b. Re-measure and confirm that total airflow is within design.
  - c. Re-measure final fan operating data, speed, volts, amps, and static profile.
  - d. Mark final settings.
  - e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
  - f. Verify tracking between supply and return fans.

### 3.8 PROCEDURES FOR MULTIZONE SYSTEMS

- A. Position the unit's automatic zone dampers for maximum flow through the cooling coil.
- B. The procedures for multizone systems will utilize the zone balancing dampers to achieve the indicated airflow within the zone.
- C. After balancing, place the unit's automatic zone dampers for maximum heating flow. Retest zone airflows and record any variances.

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- D. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
1. Measure total airflow.
    - a. Set outside-air, return-air and relief-air dampers for proper position that simulates minimum outdoor air conditions.
    - b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    - c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
  2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report artificial loading of filters at the time static pressures are measured.
  3. Review Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  4. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- E. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
1. Measure airflow of submain and branch ducts.
  2. Adjust submain and branch duct volume dampers for specified airflow.
  3. Re-measure each submain and branch duct after all have been adjusted.
- F. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
  2. Measure inlet and outlet airflow.
  3. Adjust each inlet and outlet for specified airflow.
  4. Re-measure each inlet and outlet after they have been adjusted.
- G. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.

2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

### 3.9 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports for pumps, coils, and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and equipment flow rates with pump design flow rate.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
  1. Check expansion tank for proper setting.
  2. Check highest vent for adequate pressure.
  3. Check flow-control valves for proper position.
  4. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
  5. Verify that motor controllers are equipped with properly sized thermal protection.
  6. Check that air has been purged from the system.
- D. Measure and record upstream and downstream pressure of each piece of equipment.
- E. Measure and record upstream and downstream pressure of pressure-reducing valves.
- F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
  1. Check settings and operation of each safety valve. Record settings.

### 3.10 PROCEDURES FOR SECONDARY PUMPS ON EXISTING PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the secondary circuits.
- B. Adjust pumps to deliver total design flow.
  1. Measure total water flow.
    - a. Position valves for full flow through coils.
    - b. Measure flow by main flow meter, if installed.
    - c. If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.

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2. Measure pump TDH as follows:
    - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
    - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
    - c. Convert pressure to head and correct for differences in gauge heights.
    - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
    - e. With valves open, read pump TDH. Adjust pump discharge valve or speed until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.
  3. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
- C. Adjust flow-measuring devices installed in mains and branches to design water flows.
1. Measure flow in main and branch pipes.
  2. Adjust main and branch balance valves for design flow.
  3. Re-measure each main and branch after all have been adjusted.
- D. Adjust flow-measuring devices installed at terminals for each space to design water flows.
1. Measure flow at terminals.
  2. Adjust each terminal to design flow.
  3. Re-measure each terminal after it is adjusted.
  4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
  5. Perform temperature tests after flows have been balanced.
- E. For systems with pressure-independent valves at terminals:
1. Measure differential pressure and verify that it is within manufacturer's specified range.
  2. Perform temperature tests after flows have been verified.
- F. For systems without pressure-independent valves or flow-measuring devices at terminals:
1. Measure and balance coils by either coil pressure drop or temperature method.
  2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
- G. Verify final system conditions as follows:
1. Re-measure and confirm that total water flow is within design.
  2. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.



3. Mark final settings.

H. Verify that memory stops have been set.

### 3.11 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.

### 3.12 PROCEDURES FOR AIR-COOLED CONDENSING UNITS

A. Verify proper rotation of fan(s).

B. Measure and record entering- and leaving-air temperatures.

C. Measure and record entering and leaving refrigerant pressures.

D. Measure and record operating data of compressor(s), fan(s), and motors.

### 3.13 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each hydronic coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.

3. Entering- and leaving-air temperature at full load.
4. Air pressure drop.
5. Voltage and amperage input of each phase at full load.
6. Calculated kilowatt at full load.
7. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Entering and leaving refrigerant pressure and temperatures.

### 3.14 PROCEDURES FOR EXHAUST HOODS

A. Room Pressure: Measure and record room pressure with respect to atmosphere and adjacent space with hoods in room initially not operating and then with hoods operating.

B. Makeup Air: Systems supplying source of makeup air to hoods shall be in operation during testing and balancing of exhaust hoods.

1. Measure and record temperature of makeup air entering hood. If hood makeup air is from multiple sources having different temperatures, measure and record the airflow and temperatures of each source and calculate the weighted average temperature.
2. Use simulated smoke to observe supply air-distribution air patterns in vicinity of hoods. Consult with hood manufacturer and report conditions that have a detrimental effect on intended capture, containment, and other attributes effecting proper operation.

C. Rooms with Multiple Hoods: Test each hood separately, one at a time, and repeat tests with all hoods intended to operate simultaneously by design.

D. Canopy Hoods: Measure and record the following:

1. Pressure drop across hood.
2. Airflow by duct traverse where duct distribution will allow accurate measurement, and calculate hood average face velocity.
3. Measure velocity across hood face and calculate hood airflow.
  - a. Clearly indicate the direction of flow at each point of measurement.
  - b. Measure velocity across opening on not less than **12-inch** centers. Record velocity at each measurement, and calculate average velocity.
4. Capture and Containment: Check each hood for proper capture and containment using a smoke-emitting device. Observe and report performance. Make adjustments to achieve optimum results.

E. Kitchen Hoods:

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1. Type 1: Measure and record pressure drop and face velocity of hood filters and slots in accordance with hood manufacturer's instructions. Consult hood manufacturer to determine hood airflow using recorded information.
2. Type 2: Measure and record airflow by duct traverse.
3. Capture and Containment: Check each hood for proper capture and containment using a smoke-emitting device. Observe and report performance. Make adjustments to achieve optimum results.

F. AHJ Tests: Conduct additional tests required by authorities having jurisdiction.

### 3.15 DUCT LEAKAGE TESTS

- A. Witness the duct leakage testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

### 3.16 PIPE LEAKAGE TESTS

- A. Witness the pipe pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

### 3.17 HVAC CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:
  1. Verify HVAC control system is operating within the design limitations.
  2. Confirm that the sequences of operation are in compliance with Contract Documents.
  3. Verify that controllers are calibrated and function as intended.
  4. Verify that controller set points are as indicated.
  5. Verify the operation of lockout or interlock systems.
  6. Verify the operation of valve and damper actuators.
  7. Verify that controlled devices are properly installed and connected to correct controller.
  8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
  9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

### 3.18 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent . If design value is less than **100 cfm**, within **10 cfm**.
  - 2. Air Outlets and Inlets: Plus or minus 10 percent . If design value is less than **100 cfm**, within **10 cfm**.
  - 3. Chilled-Water Flow Rate: Plus or minus 10 percent . If design value is less than **10 gpm**, within 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

### 3.19 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.
- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### 3.20 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  - 2. Include a list of instruments used for procedures, along with proof of calibration.
  - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  - 1. Pump curves.
  - 2. Fan curves.
  - 3. Manufacturers' test data.
  - 4. Field test reports prepared by system and equipment installers.

5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
  2. Name and address of the TAB specialist.
  3. Project name.
  4. Project location.
  5. Architect's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents, including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  14. Notes to explain why certain final data in the body of reports vary from indicated values.
  15. Test conditions for fans performance forms, including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Heating coil, dry-bulb conditions.
    - e. Face and bypass damper settings at coils.
    - f. Fan drive settings, including settings and percentage of maximum pitch diameter.
    - g. Variable-frequency controller settings for variable-air-volume systems.
    - h. Settings for pressure controller(s).
    - i. Other system operating conditions that affect performance.
  16. Test conditions for pump performance forms, including the following:
    - a. Variable-frequency controller settings for variable-flow hydronic systems.
    - b. Settings for pressure controller(s).
    - c. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Water and steam flow rates.
  3. Duct, outlet, and inlet sizes.
  4. Pipe and valve sizes and locations.
  5. Terminal units.
  6. Balancing stations.

7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units, include the following:

1. Unit Data:

- a. Unit identification.
- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Unit arrangement and class.
- g. Discharge arrangement.
- h. Sheave make, size in **inches**, and bore.
- i. Center-to-center dimensions of sheave and amount of adjustments in **inches**.
- j. Number, make, and size of belts.
- k. Number, type, and size of filters.

2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and speed.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in **inches**, and bore.
- f. Center-to-center dimensions of sheave and amount of adjustments in **inches**.

3. Test Data (Indicated and Actual Values):

- a. Total airflow rate in **cfm**.
- b. Total system static pressure in **inches wg**.
- c. Fan speed.
- d. Inlet and discharge static pressure in **inches wg**.
- e. For each filter bank, filter static-pressure differential in **inches wg**.
- f. Preheat-coil static-pressure differential in **inches wg**.
- g. Cooling-coil static-pressure differential in **inches wg**.
- h. Heating-coil static-pressure differential in **inches wg**.
- i. List for each internal component with pressure-drop, static-pressure differential in **inches wg**.
- j. Outdoor airflow in **cfm**.
- k. Return airflow in **cfm**.
- l. Outdoor-air damper position.
- m. Return-air damper position.

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.

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- 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**.
- G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
  1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Coil identification.
    - d. Capacity in **Btu/h**.
    - e. Number of stages.
    - f. Connected volts, phase, and hertz.
    - g. Rated amperage.
    - h. Airflow rate in **cfm**.
    - i. Face area in **sq. ft.**.
    - j. Minimum face velocity in **fpm**.
  2. Test Data (Indicated and Actual Values):
    - a. Heat output in **Btu/h**.
    - b. Airflow rate in **cfm**.
    - c. Air velocity in **fpm**.
    - d. Entering-air temperature in **deg F**.
    - e. Leaving-air temperature in **deg F**.
    - f. Voltage at each connection.
    - g. Amperage for each phase.
- H. 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.

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- e. Manufacturer's serial number.
  - f. Arrangement and class.
  - g. Sheave make, size in **inches**, and bore.
  - h. Center-to-center dimensions of sheave and amount of adjustments in **inches**.
2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and speed.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in **inches**, and bore.
    - f. Center-to-center dimensions of sheave and amount of adjustments in **inches**.
    - g. Number, make, and size of belts.
  3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in **cfm**.
    - b. Total system static pressure in **inches wg**.
    - c. Fan speed.
    - d. Discharge static pressure in **inches wg**.
    - e. Suction static pressure in **inches wg**.
- I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
    - a. System fan and air-handling-unit number.
    - b. Location and zone.
    - c. Traverse air temperature in **deg F**.
    - d. Duct static pressure in **inches wg**.
    - e. Duct size in **inches**.
    - f. Duct area in **sq. ft.**.
    - g. Indicated airflow rate in **cfm**.
    - h. Indicated velocity in **fpm**.
    - i. Actual airflow rate in **cfm**.
    - j. Actual average velocity in **fpm**.
    - k. Barometric pressure in **psig**.
- J. 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):

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- 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**.
- K. 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**.
- L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves, and include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Service.
    - d. Make and size.
    - e. Model number and serial number.
    - f. Water flow rate in **gpm**.
    - g. Water pressure differential in **feet of head or psig**.
    - h. Required net positive suction head in **feet of head or psig**.
    - i. Pump speed.
    - j. Impeller diameter in **inches**.
    - k. Motor make and frame size.
    - l. Motor horsepower and rpm.
    - m. Voltage at each connection.
    - n. Amperage for each phase.
    - o. Full-load amperage and service factor.
    - p. Seal type.
  2. Test Data (Indicated and Actual Values):
    - a. Static head in **feet of head or psig**.
    - b. Pump shutoff pressure in **feet of head or psig**.
    - c. Actual impeller size in **inches**.
    - d. Full-open flow rate in **gpm**.

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- e. Full-open pressure in **feet of head or psig**.
- f. Final discharge pressure in **feet of head or psig**.
- g. Final suction pressure in **feet of head or psig**.
- h. Final total pressure in **feet of head or psig**.
- i. Final water flow rate in **gpm**.
- j. Voltage at each connection.
- k. Amperage for each phase.

M. Instrument Calibration Reports:

- 1. Report Data:
  - a. Instrument type and make.
  - b. Serial number.
  - c. Application.
  - d. Dates of use.
  - e. Dates of calibration.

3.21 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager .
- B. Engineer shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day .
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.
- E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
  - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
  - 2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.
- F. Prepare test and inspection reports.

3.22 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93

## SECTION 23 07 13 - DUCT INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return and exhaust duct located in unconditioned space.
  - 4. Indoor, exposed return and exhaust duct located in unconditioned space.
  
- B. Related Sections:
  - 1. Section 23 07 19 "HVAC Piping Insulation."
  - 2. Section 23 31 13 "Metal Ducts" for duct liners.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
  
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
  
- B. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program , certified by the Department of Labor, Bureau of Apprenticeship and Training.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers are to be marked with the manufacturer's name, appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
  - 1. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials are to be applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.

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- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to **450 deg F** in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, Type III with factory-applied FSK jacket . Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation; Saint-Gobain North America.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Manson Insulation Inc.
    - e. Owens Corning.

## 2.3 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products. CP-127.
    - b. Foster Brand; H. B. Fuller Construction Products. 85-60 or 85-70.
    - c. Mon-Eco Industries, Inc. 22-25.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products. CP-82.
    - b. Foster Brand; H. B. Fuller Construction Products. 85-60.
    - c. Mon-Eco Industries, Inc. 22-25.

## 2.4 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic: Water based; suitable for indoor use on below ambient services.
  - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products. CP-38.
    - b. Foster Brand; H. B. Fuller Construction Products. 30-80 or 30-90.
    - c. Knauf Insulation.
  - 2. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
  - 3. Service Temperature Range: **Minus 20 to plus 180 deg F.**

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4. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
5. Color: White .

## 2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and are compatible with insulation materials, jackets, and substrates.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products. CP-50 AHV2.
    - b. Foster Brand; H. B. Fuller Construction Products. 30-36.
    - c. Vimasco Corporation. 713 and 714.
  2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
  3. Service Temperature Range: **0 to plus 180 deg F.**
  4. Color: White.

## 2.6 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.
  2. Materials are compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: **Minus 40 to plus 250 deg F.**
  5. Color: Aluminum.

## 2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

## 2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

## 2.9 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Mesh: Approximately **6 oz./sq. yd.** with a thread count of **5 strands by 5 strands/sq. in.** for covering ducts.
  - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products. Chil-Glas No. 5.
    - b. Foster Brand; H. B. Fuller Construction Products.
- B. Woven Polyester Mesh: Approximately **1 oz./sq. yd.** with a thread count of **10 strands by 10 strands/sq. in.**, in a Leno weave, for ducts.
  - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products. Mast-A-Fab.
    - c. Vimasco Corporation. Elastafab 894.

## 2.10 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of **8 oz./sq. yd.**
  - 1. **Manufacturers:** Subject to compliance with requirements, provide products by the following:
    - a. Alpha Associates, Inc. Alpha-Maritex 84215 and 84217 / 9485RW, Luben 59.

## 2.11 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
  - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. 3M Industrial Adhesives and Tapes Division. Venture Tape 1525 CW NT, 1528 CW, and 1528 CW/SQ.
    - b. Avery Dennison Corporation, Specialty Tapes Division. Fasson 0827.
    - c. Ideal Tape Co., Inc., an American Biltrite Company. 491 AWF FSK.
    - d. Compac Corporation. 110 and 111.
  - 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.

## 2.12 SECUREMENTS

- A. Bands:

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1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Johns Manville; a Berkshire Hathaway company.
  - b. RPR Products, Inc.
2. Stainless Steel: ASTM A167 or ASTM A240/A240M, Type 304 or Type 316; **0.015 inch** thick, **3/4 inch** wide with closed seal.
3. Aluminum: **ASTM B209**, Alloy 3003, 3005, 3105, or 5005; Temper H-14, **0.020 inch** thick, **3/4 inch** wide with closed seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, **0.106-inch-** diameter shank, length to suit depth of insulation indicated.
  - a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - 1) AGM Industries, Inc. CWP-1.
    - 2) Gemco. CD.
    - 3) Midwest Fasteners, Inc. CD.
    - 4) Nelson Stud Welding. TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, **0.106-inch-** diameter shank, length to suit depth of insulation indicated with integral **1-1/2-inch** galvanized carbon-steel washer.
  - a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - 1) AGM Industries, Inc. CHP-1
    - 2) Gemco. Cupped Head Weld Pin.
    - 3) Midwest Fasteners, Inc. Cupped Head.
    - 4) Nelson Stud Welding. CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - 1) AGM Industries, Inc. TactooPerforated Base Insul-Hangers.
    - 2) Gemco. PerforatedBase.
    - 3) Midwest Fasteners, Inc. Spindle.
  - b. Baseplate: Perforated, galvanized carbon-steel sheet, **0.030 inch** thick by **2 inches** square.
  - c. Spindle: Aluminum , fully annealed, **0.106-inch-** diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
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. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - 1) AGM Industries, Inc. Tactoo Self-Adhering Insul-Hangers.
    - 2) Gemco. Peel & Press.
    - 3) Midwest Fasteners, Inc. SelfStick.
  - b. Baseplate: Galvanized carbon-steel sheet, **0.030 inch** thick by **2 inches** square.

- c. Spindle: Copper- or zinc-coated, low-carbon steel , fully annealed, **0.106-inch-**diameter shank, length to suit depth of insulation indicated.
- d. Adhesive-backed base with a peel-off protective cover.
- 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.
  - a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - 1) AGM Industries, Inc. RC-150.
    - 2) Gemco. R-150.
    - 3) Midwest Fasteners, Inc. WA-150.
    - 4) Nelson Stud Welding. Speed Clips.
  - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal **3/4-inch-** wide, stainless steel or Monel.
- D. Wire: **0.062-inch** soft-annealed, stainless steel .

## 2.13 CORNER ANGLES

- A. Aluminum Corner Angles: **0.040 inch** thick, minimum **1 by 1 inch**, aluminum in accordance with **ASTM B209**, Alloy 3003, 3005, 3105, or 5005; Temper H-14.
- B. Stainless-Steel Corner Angles: **0.024 inch** thick, minimum **1 by 1 inch**, stainless steel in accordance with ASTM A167 or ASTM A240/A240M, Type 304 or Type 316.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

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- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket .
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
  - 2. Cover circumferential joints with **3-inch-** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced **4 inches** o.c.
  - 3. Overlap jacket longitudinal seams at least **1-1/2 inches**. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at **2 inches** o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

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- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches** beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least **2 inches** below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least **2 inches**.
  - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least **2 inches**.
  - 1. Comply with requirements in Section 07 84 13 "Penetration Firestopping."
- E. Insulation Installation at Floor Penetrations:
  - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least **2 inches**.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

### 3.5 INSTALLATION OF GLASS-FIBER AND MINERAL-WOOL INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
- B. Comply with manufacturer's written installation instructions.

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1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions **18 inches** and smaller, place pins along longitudinal centerline of duct. Space **3 inches** maximum from insulation end joints, and **16 inches** o.c.
    - b. On duct sides with dimensions larger than **18 inches**, place pins **16 inches** o.c. each way, and **3 inches** maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing **2 inches** from one edge and one end of insulation segment. Secure laps to adjacent insulation section with **1/2-inch** outward-clinching staples, **1 inch** o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below **50 deg F** at **18-foot** intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than **3 inches**.
  5. Overlap unfaced blankets a minimum of **2 inches** on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of **18 inches** o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with **6-inch-** wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced **6 inches** o.c.
- C. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 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.

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- b. On duct sides with dimensions larger than **18 inches**, space pins **16 inches** o.c. each way, and **3 inches** maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing **2 inches** from one edge and one end of insulation segment. Secure laps to adjacent insulation section with **1/2-inch** outward-clinching staples, **1 inch** o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below **50 deg F** at **18-foot** intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than **3 inches**.
  5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with **6-inch-** wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced **6 inches** o.c.

### 3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  1. Draw jacket smooth and tight to surface with **2-inch** overlap at seams and joints.
  2. Embed glass cloth between two **0.062-inch-** thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with **1-1/2-inch** laps at longitudinal seams and **3-inch-** wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return and exhaust duct located in unconditioned space.
4. Indoor, exposed return and exhaust duct located in unconditioned space.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round and flat-oval, supply-air, return-air, outdoor-air, and exhaust-air duct insulation is the following:

1. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.

- B. Concealed, rectangular, supply-air, return-air, outdoor-air, and exhaust-air duct insulation is the following:

1. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.

- C. Exposed, round, flat oval, supply-air, return-air, outdoor-air, and exhaust-air duct is the following:

1. Pre-insulated double wall duct. Refer to Section 23 31 13 Metal Ducts for specifications.

- D. Exposed, rectangular, supply-air, return-air, outdoor-air, and exhaust-air duct insulation is the following:

1. Pre-insulated double wall duct. Refer to Section 23 31 13 Metal Ducts for specifications.

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Sigma HN Engineers, PLLC  
PBK Project No. 20217  
Issue for Construction

CTE Barrientes  
Edinburg CISD  
June 4, 2024

END OF SECTION 23 07 13

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## SECTION 23 07 19 - HVAC PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes insulation for HVAC piping systems.
- B. Related Requirements:
  - 1. Section 23 07 13 "Duct Insulation" for duct insulation.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail insulation application at pipe expansion joints for each type of insulation.
  - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program.

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1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of manufacturer, fabricator, type, description, and size.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with 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.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
  - 1. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

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- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
1. **Manufacturers:** Subject to compliance with requirements, provide products by the following:
    - a. Owens Corning.
  2. Preformed Pipe Insulation without Jacket: Type II, Class 1, unfaced.
  3. Preformed Pipe Insulation with Jacket: Type II, Class 2, with factory-applied PSK jacket.
  4. Block Insulation: Type I.
  5. Special-Shaped Insulation: Type III.
  6. Board Insulation: Type IV.
  7. Fabricated shapes in accordance with ASTM C450, ASTM C585, and ASTM C1639.
  8. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Flexible Elastomeric: Closed-cell, or expanded-rubber materials; suitable for maximum use temperature between **minus 70 deg F** and **220 deg F**. Comply with ASTM C534/C534M, Type I, for tubular materials, Type II for sheet materials.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA.
    - b. Armacell LLC.
    - c. K-Flex USA.

### 2.3 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of **minus 100 to plus 200 deg F**.
1. **Manufacturers:** Subject to compliance with requirements, provide products by the following:
    - a. Foster Brand; H. B. Fuller Construction Products. (81-84).
- C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA. (Aeroseal).
    - b. Armacell LLC. (ArmaFlex 520).
    - c. K-Flex USA. (720-LVOC).
  2. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
  3. Wet Flash Point: Below **0 deg F**.
  4. Service Temperature Range: **40 to 200 deg F**.
  5. Color: Black .
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

- a. Johns Manville; a Berkshire Hathaway company.
- b. P.I.C. Plastics, Inc.
- c. Proto Corporation.
- d. Speedline Corporation.

## 2.4 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
  1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products (CP-38 Chil-Low).
    - b. Foster Brand; H. B. Fuller Construction Products (Vapor Safe 30-80 or Vapor Safe 30-90).
  2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  3. Service Temperature Range: **Minus 20 to plus 180 deg F.**
  4. Comply with MIL-PRF-19565C, Type II, for permeance requirements , with supplier listing on DOD QPD - Qualified Products Database.
  5. Color: White .
- C. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor 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 Construction Products.
  2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  3. Service Temperature Range: **Minus 50 to plus 220 deg F.**
  4. Color: White .

## 2.5 LAGGING ADHESIVES

- A. Adhesives comply with MIL-A-3316C, Class I, Grade A, and are compatible with insulation materials, jackets, and substrates.
  1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products. (CP-50 AHV2).
    - b. Foster Brand; H. B. Fuller Construction Products. (30-36).
    - c. Vimasco Corporation. (713 or 714).
  2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
  3. Service Temperature Range: **0 to plus 180 deg F.**
  4. Color: White.

## 2.6 SEALANTS

- A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants for cellular glass and phenolic products:
- Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - Childers Brand; H. B. Fuller Construction Products. (CP-76).
    - Foster Brand; H. B. Fuller Construction Products. (95-50).
    - Owens Corning. (Pittseal 444).
  - Permanently flexible, elastomeric sealant.
    - Service Temperature Range: **Minus 100 to plus 300 deg F.**
    - Color: White or gray.
- C. FSK and Metal Jacket Flashing Sealants:
- Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - Childers Brand; H. B. Fuller Construction Products. (CP-76).
    - Foster Brand; H. B. Fuller Construction Products. (95-44).
  - Fire- and water-resistant, flexible, elastomeric sealant.
  - Service Temperature Range: **Minus 40 to plus 250 deg F.**
  - Color: Aluminum.
- D. ASJ Flashing Sealants and PVDC and PVC Jacket Flashing Sealants:
- Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - Childers Brand; H. B. Fuller Construction Products.
    - Foster Brand; H. B. Fuller Construction Products.
  - Fire- and water-resistant, flexible, elastomeric sealant.
  - Service Temperature Range: **Minus 40 to plus 250 deg F.**
  - Color: White.

## 2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
- PSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.

## 2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C1136, 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. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Johns Manville; a Berkshire Hathaway company.
  - b. P.I.C. Plastics, Inc.
  - c. Proto Corporation.
  - d. Speedline Corporation.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White .
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
  - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket:

1. **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. Johns Manville; a Berkshire Hathaway company.
  - b. RPR Products, Inc.
2. Aluminum Jacket: Comply with **ASTM B209**, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  - a. Sheet and roll stock ready for shop or field sizing .
  - b. Finish and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Indoor Applications: **3-mil-** thick, heat-bonded polyethylene and kraft paper .
  - d. Moisture Barrier for Outdoor Applications: **3-mil-** thick polysurlyn.
  - e. Factory-Fabricated Fitting Covers:
    - 1) Same material, finish, and thickness as jacket.
    - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 3) Tee covers.
    - 4) Flange and union covers.
    - 5) End caps.
    - 6) Beveled collars.
    - 7) Valve covers.
    - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.9 FIELD-APPLIED FABRIC REINFORCING MESH

- A. Woven Glass-Fiber Mesh: Approximately **2 oz./sq. yd.** with a thread count of **10 strands by 10 strands/sq. in.** for covering pipe and pipe fittings.
  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.
- B. Woven Polyester Mesh: Approximately **1 oz./sq. yd.** with a thread count of **10 strands by 10 strands/sq. in.**, in a Leno weave, for pipe.

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 Construction Products.
  - c. Vimasco Corporation.

#### 2.10 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of **8 oz./sq. yd.**.

#### 2.11 TAPES

- A. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
  1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. 3M Industrial Adhesives and Tapes Division.
    - b. Ideal Tape Co., Inc., an American Biltrite Company.
  2. Width: **2 inches** .
  3. Thickness: **6 mils** .
  4. Adhesion: **64 ounces force/inch** in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: **18 lbf/inch** in width.

#### 2.12 SECUREMENTS

- A. Bands:
  1. Stainless Steel: ASTM A240/A240M, Type 304 ; **0.015 inch** thick, **3/4 inch** wide with closed seal.
  2. Aluminum: **ASTM B209**, Alloy 3003, 3005, 3105, or 5005; Temper H-14, **0.020 inch** thick, **3/4 inch** wide with closed seal.
  3. Springs: Twin spring set constructed of stainless steel, with ends flat and slotted to accept metal bands. Spring size is determined by manufacturer for application.
- B. Staples: Outward-clinching insulation staples, nominal **3/4 inch** wide, stainless steel or Monel.
- C. Wire: **0.062-inch** soft-annealed, stainless steel .

### 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.

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1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the Contract Documents.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  1. Install insulation continuously through hangers and around anchor attachments.
  2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.



3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
  2. Cover circumferential joints with **3-inch-** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced **4 inches** o.c.
  3. Overlap jacket longitudinal seams at least **1-1/2 inches**. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at **2 inches** o.c.
  4. For below-ambient services, apply vapor-barrier mastic over staples.
  5. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
  6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches** beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.

### 3.4 PENETRATIONS

- A. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations 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.

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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: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- 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 07 84 13 "Penetration Firestopping."

### 3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  2. Insulate pipe elbows using prefabricated fitting insulation or mitered or routed fittings made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  3. Insulate tee fittings with prefabricated fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate valves using prefabricated fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using prefabricated fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation conforms to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least **2 inches** over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with 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 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.

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B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch**, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered or routed sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

### 3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

## HVAC PIPING INSULATION

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1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.8 INSTALLATION OF FIELD-APPLIED JACKETS

- A. Where FSK or PSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with **1-1/2-inch** laps at longitudinal seams and **3-inch-** wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated and for horizontal applications, install with **1-inch** overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with **2-inch** overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands **12 inches** o.c. and at end joints.

### 3.9 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Do not field paint aluminum or stainless steel jackets.

### 3.10 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to three locations of straight pipe, three locations of fittings, two locations of strainers, three locations of valves, for each pipe service defined in the "Piping Insulation Schedule, General" Article.

- C. All insulation applications will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Insulation conductivity and thickness per pipe size comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.
- B. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
  - 1. All Pipe Sizes: Insulation is the following:
    - a. Flexible Elastomeric: 3/4 inch thick.
- B. Chilled Water, Above 40 Deg F:
  - 1. Insulation is the following:
    - a. Cellular Glass, NPS 4 and smaller: 1-1/2 inches thick.
    - b. Cellular Glass, NPS 6 and larger: 2 inches thick.
- C. Refrigerant Suction and Hot-Gas Piping:
  - 1. All Pipe Sizes: Insulation is the following:
    - a. Flexible Elastomeric: 1 inch thick.
- D. Refrigerant Suction and Hot-Gas Flexible Tubing:
  - 1. All Pipe Sizes: Insulation is the following:
    - a. Flexible Elastomeric: 1 inch thick.

### 3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Chilled Water :
  - 1. All Pipe Sizes: Insulation is the following:
    - a. Cellular Glass: 3 inches thick.
- B. Refrigerant Suction and Hot-Gas Piping:
  - 1. All Pipe Sizes: Insulation is the following:

- a. Flexible Elastomeric: **2 inches** thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation is the following:
  - a. Flexible Elastomeric: **2 inches** thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Exposed:
  1. PVC : **20 mils** thick.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
  1. Aluminum, Smooth : **0.020 inch** thick.
- D. Piping, Exposed:
  1. Aluminum, Smooth : **0.020 inch** thick.

END OF SECTION 23 07 19

## SECTION 23 08 00 - COMMISSIONING OF HVAC

### 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.
- B. OPR, BoD, and BoD-HVAC documentation prepared by Owner and Architect contains requirements that apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes requirements for commissioning the HVAC system and its subsystems and equipment. This Section supplements the general requirements specified in Division 01 Section "General Commissioning Requirements."
- B. Related Sections include the following:
  - 1. Division 01 Section "General Commissioning Requirements" for general requirements for commissioning processes that apply to this Section.

#### 1.3 DEFINITIONS

- A. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor, plus consultant/design professionals responsible for design of HVAC, electrical, communications, controls for HVAC systems, and other related systems.
- B. BoD: Basis of Design.
- C. BoD-HVAC: HVAC systems basis of design.
- D. CxA: Commissioning Authority.
- E. OPR: Owner's Project Requirements.
- F. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.
- G. TAB: Testing, Adjusting, and Balancing.

#### 1.4 CONTRACTOR'S RESPONSIBILITIES

- A. The following responsibilities are in addition to those specified in Division 01 Section "General Commissioning Requirements."



- B. Contractor:
  - 1. Attend procedures meeting for TAB Work.
  - 2. Certify that TAB Work is complete.
  
- C. Mechanical Contractor :
  - 1. Attend TAB verification testing.
  - 2. Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period.
  
- D. HVAC Instrumentation and Control Subcontractor: With the CxA, review control designs for compliance with the OPR and BoD, controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions.
  
- E. TAB Subcontractor:
  - 1. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.
    - a. Verify the following:
      - 1) Accessibility of equipment and components required for TAB Work.
      - 2) Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.
      - 3) Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
      - 4) Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.
      - 5) Air and water flow rates have been specified and compared to central equipment output capacities.
    - b. Identify discontinuities and omissions in the Contract Documents.
    - c. This review of the Contract Documents by the TAB Subcontractor satisfies requirements for a design review report as specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."
  - 2. Additional Responsibilities: Participate in tests specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls" and
  
- F. Electrical Subcontractor:
  - 1. With the Mechanical Contractor , coordinate installations and connections between and among electrical and HVAC systems, subsystems, and equipment.
  - 2. Attend TAB verification testing.

#### 1.5 COMMISSIONING DOCUMENTATION

- A. The following are in addition to documentation specified in Division 01 Section "General Commissioning Requirements."

- B. BoD HVAC: Owner will provide BoD-HVAC documents, prepared by Architect and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.
- C. Test Checklists: CxA shall develop test checklists for HVAC systems, subsystems, and equipment, including interfaces and interlocks with other systems. CxA shall prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. In addition to the requirements specified in Division 01 Section "General Commissioning Requirements," checklists shall include, but not be limited to, the following:
  - 1. Calibration of sensors and sensor function.
  - 2. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.
  - 3. Control sequences for HVAC systems.
  - 4. Strength of control signal for each set point at specified conditions.
  - 5. Responses to control signals at specified conditions.
  - 6. Sequence of response(s) to control signals at specified conditions.
  - 7. Electrical demand or power input at specified conditions.
  - 8. Power quality and related measurements.
  - 9. Expected performance of systems, subsystems, and equipment at each step of test.
  - 10. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.
  - 11. Interaction of auxiliary equipment.
  - 12. Issues log.

## 1.6 SUBMITTALS

- A. The following submittals are in addition to those specified in Division 01 Section "General Commissioning Requirements."
- B. Testing Procedures: CxA shall submit detailed testing plan, procedures, and checklists for each series of tests. Submittals shall include samples of data reporting sheets that will be part of the reports.
- C. Certificate of Readiness: CxA shall compile certificates of readiness from each Contractor certifying that systems, subsystems, equipment, and associated controls are ready for testing.
- D. Certificate of Completion of Installation, Prestart, and Startup: CxA shall certify that installation, prestart, and startup activities have been completed. Certification shall include completed checklists provided by TAB Subcontractor as specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."
- E. Certified Pipe Cleaning and Flushing Report: CxA shall certify that pipe cleaning, flushing, hydrostatic testing, and chemical treating have been completed.
- F. Test and Inspection Reports: CxA shall compile and submit test and inspection reports and certificates, and shall include them in systems manual and commissioning report.
- G. Corrective Action Documents: CxA shall submit corrective action documents.

- H. Certified TAB Reports: CxA shall submit verified, certified TAB reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Prerequisites for Testing:

1. Certify that HVAC systems, subsystems, and equipment have been completed, calibrated, and started; are operating according to the OPR, BoD, and Contract Documents; and that Certificates of Readiness are signed and submitted.
2. Certify that HVAC instrumentation and control systems have been completed and calibrated; are operating according to the OPR, BoD, and Contract Documents; and that pretest set points have been recorded.
3. Certify that TAB procedures have been completed, and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.
4. Test systems and intersystem performance after approval of test checklists for systems, subsystems, and equipment.
5. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
6. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.
7. Inspect and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.
8. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
9. Annotate checklist or data sheet when a deficiency is observed.
10. Verify equipment interface with monitoring and control system and TAB criteria; include the following:
  - a. Supply and return flow rates for VAV and constant volume systems in each operational mode.
  - b. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.
  - c. Building pressurization.
  - d. Total exhaust airflow and total outdoor-air intake.
  - e. Operation of indoor-air-quality monitoring systems.
11. Verify proper responses of monitoring and control system controllers and sensors to include the following:
  - a. For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.
  - b. Report deficiencies and prepare an issues log entry.
12. Verify that HVAC equipment field quality-control testing has been completed and approved. CxA shall direct, witness, and document field quality-control tests, inspections, and startup specified in individual Division 23 Sections.

- B. Testing Instrumentation: Install measuring instruments and logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for calculation of total capacity of system for each mode of operation. For individual room cooling tests, provide temporary heaters to impose a cooling load indicated in BoD. Operational modes include the following:
  - 1. Occupied and unoccupied.
  - 2. Warm up and cool down.

### 3.2 TAB VERIFICATION

- A. TAB Subcontractor shall coordinate with CxA for work required in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" TAB Subcontractor shall copy CxA with required reports, sample forms, checklists, and certificates.
- B. Contractor, HVAC Subcontractor, and CxA shall witness TAB Work.
- C. TAB Preparation:
  - 1. TAB Subcontractor shall provide CxA with data required for "Pre-Field TAB Engineering Reports" specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."
    - a. CxA shall use this data to certify that prestart and startup activities have been completed for systems, subsystems, and equipment installation.
- D. Verification of Final TAB Report:
  - 1. CxA shall select, at random, 10 percent of report for field verification.
  - 2. CxA shall notify TAB Subcontractor 10 days in advance of the date of field verification; however, notice shall not include data points to be verified. The TAB shall use the same instruments (by model and serial number) that were used when original data were collected.
  - 3. Failure of an item is defined as follows:
    - a. For all readings other than sound, a deviation of more than 10 percent.
      - 1) For sound pressure readings, a deviation of 3 dB. (Note: Variations in background noise must be considered.)
  - 4. Failure of more than 10 percent of selected items shall result in rejection of final TAB report.
- E. If deficiencies are identified during verification testing, CxA shall notify the HVAC Subcontractor and Architect, and shall take action to remedy the deficiency. Architect shall review final tabulated checklists and data sheets to determine if verification is complete and that system is operating according to the Contract Documents.
- F. CxA shall certify that TAB Work has been successfully completed.

### 3.3 TESTING

- A. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.
- B. Perform tests using design conditions whenever possible.

1. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
  2. Alter set points when simulating conditions is not practical and when written approval is received from CxA.
  3. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.
- C. Scope of HVAC Contractor Testing:
1. Testing scope shall include entire HVAC installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. It shall include measuring capacities and effectiveness of operational and control functions.
  2. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. Detailed Testing Procedures: CxA, with HVAC Contractor, TAB Subcontractor, and HVAC Instrumentation and Control Subcontractor, shall prepare detailed testing plans, procedures, and checklists for HVAC systems, subsystems, and equipment.
- E. HVAC Instrumentation and Control System Testing:
1. Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operation for HVAC Controls" The CxA, HVAC Subcontractor, and the HVAC Instrumentation and Control Subcontractor shall collaborate to prepare testing plans.
  2. CxA shall convene a meeting of appropriate entities to review test report of HVAC instrumentation and control systems.
- F. Refrigeration System Testing: HVAC Contractor shall prepare a testing plan to verify performance of refrigerant compressors and condensers, heat pumps, and other refrigeration systems. Plan shall include the following:
1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.
  2. Tracking checklist for managing and ensuring that all pipe sections have been tested.
- G. Testing Reports:
1. Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.
  2. Include data sheets for each controller to verify proper operation of the control system, the system it serves, the service it provides, and its location. For each controller, provide space for recording its readout, the reading at the controller's sensor(s), plus comments. Provide space for testing personnel to sign off on each data sheet.
  3. Prepare a preliminary test report. Deficiencies will be evaluated by Architect to determine corrective action. Deficiencies shall be corrected and test repeated.

4. If it is determined that the system is constructed according to the Contract Documents, Owner will decide whether modifications required to bring the performance of the system to the OPR and BoD documents shall be implemented or if tests will be accepted as submitted. If corrective Work is performed, Owner will decide if tests shall be repeated and a revised report submitted.

END OF SECTION 23 08 00

## SECTION 23 09 23 – DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

### PART 1 GENERAL

#### 1.0 SECTION INCLUDES

- 1.1 ENTERPRISE SYSTEM - GENERAL DESCRIPTION
- 1.2 BUILDING AUTOMATION SYSTEM - GENERAL DESCRIPTION
- 1.3 APPROVED CONTROL SYSTEM MANUFACTURES
- 1.4 QUALITY ASSURANCE
- 1.5 CODES AND STANDARDS
- 1.6 SYSTEM PERFORMANCE
- 1.7 SUBMITTAL REQUIREMENTS
- 1.8 WARRANTY REQUIREMENTS
- 1.9 SYSTEM MAINTENANCE AND REMOTE ANALYSIS
- 1.10 OWNERSHIP OF PROPRIETARY MATERIAL
- 1.11 DEFINITIONS

#### 1.1 ENTERPRISE SYSTEM - GENERAL DESCRIPTION

A. Provide an Enterprise Operator Interface System with the required building controllers to integrate and control all mechanical equipment associated with this project as listed in the project plans and specifications.

B. The Enterprise operator interface is a web-based, systems integration solution that provides facility managers an online, enterprise-wide view and control over of all their buildings and systems, from any device with a web browser on the network. (PC, laptop, tablet, smart phone).

C. The system shall collect and display data from other systems via BACnet™ IP, providing users the critical information needed to make enterprise-wide decisions for optimized performance.

D. The Enterprise operator web interface shall be accessible via a web browser without requiring any “plug-ins” (i.e. JAVA Runtime Environment (JRE), Adobe Flash).

E. The Enterprise operator interface software will be installed on a local server provided by the building owner. The server hardware and any System level controllers are to reside on the building owner’s network. (Note: The central server hardware, associated server operating system software, network cabling and switches is to be provided by others).

#### 1.2 BUILDING AUTOMATION SYSTEM - GENERAL DESCRIPTION

A. Provide a new Building Automation System (BAS) to integrate and control all mechanical equipment associated with this project.

1. The Building Automation System shall be as indicated on the drawings and described in these specifications. System must be fully integrated and coordinated with mechanical equipment DDC controllers furnished and installed in the equipment manufacturer's factory as specified in those sections. The intent of the BAS is to integrate all mechanical equipment into one system for global monitoring, control, and alarming associated with the building. It is the BAS manufacturer's responsibility to provide all the design, engineering, and field coordination required to ensure all equipment sequence of operations are met as specified and the designated BAS operators have the capability of managing the building mechanical system to ensure occupant comfort while maintaining energy efficiency.

2. The BAS shall meet open standard protocol communication standards (As defined in System Communications Section) to ensure the system maintains "interoperability" to avoid proprietary arrangements that will make it difficult for the Owner to consider other BAS manufacturers in future projects.

3. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of mechanical systems and terminal devices on this project.

4. Approved vendors, products and web services shall comply with SOC2 Type I as defined by the AICPA. SOC2 Type 1 compliance is a certification that confirms that a service provider has established and implemented effective controls to secure their clients' data in accordance with the Trust Services Criteria (TSC).

a. SOC2 Type 1 compliance provides assurance to customers that the service provider has established and implemented effective security controls and is committed to protecting their data.

b. To achieve SOC2 Type 1 compliance, the manufacturer shall have completed an independent audit to assess design and implementation of their controls, policies, and procedures.

5. The BAS shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by the security permissions of the operator role. Multiple users shall have access to all valid system data. An operator shall be able to log onto any workstation on the control system and have access to all appropriate data.

### 1.3 APPROVED CONTROL SYSTEM MANUFACTURES

#### A. Approved BAS Manufacturers

1. Trane Tracer®

### 1.4 QUALITY ASSURANCE

#### A. BAS Manufacturer Qualifications

1. The BAS manufacturer shall have an established business office within 50.00 miles of the project site and must provide 24 hours/day, 7 days/week response in the event of a customer warranty or service call.



2. The BAS Manufacturer shall have factory trained and certified personnel providing all engineering, service, startup, and commissioning field labor for the project from their local office location. BAS manufacturer shall be able to provide training certifications for all local office personnel upon request.

3. The BAS shall be provided by a single manufacturer and this manufacturer's equipment must consist of operator workstation software, Web-based hardware/software, Open Standard Protocol hardware/software, Custom application Programming Language, Graphical Programming Language, Building Controllers, Custom Application Controllers, and Application Specific Controllers. All other products specified herein (i.e., sensors, valves, dampers, actuators, etc.) need not be manufactured by the BAS manufacturer listed in this specification.

4. Independent representatives of BAS manufacturers are not acceptable. BAS vendor must be corporate owned entity of BAS manufacturer.

### 1.5 CODES AND STANDARDS

A. Codes and Standards: Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section.

1. Underwriters Laboratories: Products shall be UL-916-PAZX listed.

2. National Electrical Code -- NFPA 70.

3. Federal Communications Commission -- Part J.

4. ASHRAE/ANSI 135-2012 (BACnet) - (System Level Devices) - Building Controllers shall conform to the listed version of the BACnet specification in order to improve interoperability with various building system manufacturers' control systems and devices.

5. ASHRAE/ANSI 135-2012 (BACnet) - (Unit Level Devices) - Unit Controllers shall conform to the listed version of the BACnet specification in order to improve interoperability with various building system manufacturers' control systems and devices.

### 1.6 SYSTEM PERFORMANCE

A. Performance Standards. The BAS system shall conform to the following:

1. Graphic Display. The system shall display a graphic with a minimum of 20 dynamic points. All current data shall be displayed within 10 seconds of the operator's request.

2. Graphic Refresh. The system shall update all dynamic points with current data within 10 seconds.

3. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be 5 seconds. Analog objects shall start to adjust within 5 seconds.

4. 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 10 seconds.

5. Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 10 seconds.
6. 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.
7. 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.
8. Multiple Alarm Annunciations. All workstations on the network shall receive alarms within 5 seconds of each other.

### 1.7 SUBMITTAL REQUIREMENTS

A. BAS manufacturer shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software being provided for this project. 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.

1. Provide a digital PDF of the submittal package for review and approval. The PDF file shall have bookmarks for every data sheet on all hardware and software being provided to allow reviewers to quickly jump to a particular page or section within the PDF, search through pages, and get a sense of the document's contents.

B. Quantities of items submitted shall be reviewed by the Engineer and Owner. Such review shall not relieve the BAS manufacturer of furnishing quantities required based upon contract documents.

C. Provide the Engineer and Owner, any additional information or data which is deemed necessary to determine compliance with the specifications or which is deemed valuable in documenting and understanding the system to be installed.

D. All shop drawings shall be provided to the Owner electronically as .dwg or .dxf file formats once they have been approved and as-built drawings have been completed.

E. Submit the following within 90 days of contract award:

1. A complete bill of materials of equipment to be used indicating quantities, manufacturers and model numbers.
2. A schedule of all control valves including the valve size, pressure drop, model number (including pattern and connections), flow, CV, body pressure rating, and location.
3. A schedule of all control dampers including damper size, pressure drop, manufacturer, and model number.
4. Provide all manufacturers' technical cut sheets for major system components. When technical 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. Include:

- a. Building Controllers

- b. Custom Application Controllers
  - c. Application Specific Controllers
  - d. Operator Workstations
  - e. Portable Operator Terminals
  - f. Auxiliary Control Devices
5. Provide proposed Building Automation System architectural diagram depicting various controller types, workstations, device locations, addresses, and communication cable requirements
6. Provide detailed termination drawings showing all required field and factory terminations, as well as terminal tie-ins to DDC controls provided by mechanical equipment manufacturers. Terminal numbers shall be clearly labeled.
7. Provide a sequence of operation for each controlled mechanical system and terminal end devices.
8. Provide a BACnet Protocol Implementation Conformance Statement (PICS) for each BACnet system level device (i.e. Building Controller & Operator Workstations) type. This defines the points list for proper coordination of interoperability with other building systems if applicable for this project.
- F. Project Record Documents: Upon completion of installation, submit three (3) copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:
- 1. Project Record Drawings - These shall be as-built versions of the submittal shop drawings. One set of electronic media including CAD .dwg and .pdf drawing files shall be provided.
  - 2. Testing and Commissioning Reports and Checklists signed off by trained factory (equipment manufacturers) and field (BAS) commissioning personnel.
  - 3. Operating and Maintenance (O & M) Manuals - These shall be as-built versions of the submittal product data. In addition to the information required for the submittals, Operating & Maintenance manual shall include:
    - a. Procedures for operating the BAS including logging on/off, alarm management, generation of reports, trends, overrides of computer control, modification of setpoints, and other interactive system requirements.
    - b. Explanation of how to design and install new points, new DDC controllers, and other BAS hardware.
    - c. Documentation, installation, and maintenance information for all third party hardware/software products provided including personal computers, printers, hubs, sensors, valves, etc.
    - d. Original issue media for all software provided, including operating systems, programming language, operator workstation software, and graphics software.
    - e. Licenses, Guarantee, and Warranty documents for all equipment and systems.

G. Training Manuals: The BAS manufacturer shall provide a course outline and copies of training manuals at least two weeks prior to the start of any corporate training class to be attended by the Owner.

## 1.8 WARRANTY REQUIREMENTS

A. Warrant all work as follows:

1. BAS system labor and materials shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. BAS failures during the warranty period shall be adjusted, repaired, or replaced at no charge to the Owner. The BAS manufacturer shall respond to the Owner's request for warranty service within 24 hours of the initiated call and will occur during normal business hours (8AM-5PM).
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 BAS is operational and has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of the warranty period.
3. To ensure that the owner will have the most current operating system provided by the manufacturer, the BAS manufacturer shall include licensing and labor costs to facilitate software/firmware updates throughout the warranty period at no charge to the owner. These updates shall include upgrades for functional enhancements associated with the following: operator workstation software, project specific software, graphics, database, firmware updates, and all security related service packs. Written authorization by the Owner must be granted prior to the installation of these updates.
4. The BAS manufacturer shall provide a web-accessible Users Network for the proposed System and give the Owner free access to question/answer forum, user tips, upgrades, and training schedules for a one year period of time correlating with the warranty period.

## 1.9 SYSTEM MAINTENANCE AND REMOTE ANALYSIS

A. The BAS Manufacture shall provide Building Automation System remote support and system analysis for a period of 1 year (beginning the date of substantial completion).

B. The BAS manufacturer shall setup a secure remote connection for data collection, analytics and remote technical support for the HVAC systems included in this contract.

1. Provide technician support during the warranty period to diagnose issues remotely through the secure remote connection.
2. The building owner is responsible for providing adequate internet access.

C. Connectivity / Remote Access / Network Security

1. Provide and maintain secure remote access to the facilities Building Automation System (BAS) or other building systems. Users accessing service through this connection shall not have access to the building owners network. Secure remote access to the BAS shall not require ANY inbound ports on a firewall to be "exposed" or "forwarded".

2. Secure remote access to the BAS shall be available anywhere, anytime, using a compatible client device (PC/tablet/phone)

3. The Owner will provide up to Three (3) IP drops and IP addresses on the owners network to gain access to the internet. The BAS manufacture shall coordinate with the Owners IT team, verify the proposed system shall meet all network security requirements and any other network configuration information necessary to each control contractor for the purpose of configuring each Area Controller on the network. It shall be the responsibility of the BAS manufacture to coordinate with the owner for network connectivity.

D. The BAS Manufacture shall provide a professional analysis for the facility HVAC systems.

1. The analysis shall consist of an evaluation of HVAC systems including charts and graphs which indicate both current building performance and opportunities for building and HVAC system performance improvement.

E. The following shall be provided after substantial completion of the project:

1. Orientation meeting with the building owner's representative to identify the HVAC systems that will be evaluated.

2. System setup for data collection and analytics. BAS Manufacture to setup a secure remote data collection and analytics for identified systems.

3. Assessment analysis shall be performed by trained personnel with relevant professional credentials in HVAC systems, energy management and building optimization methodologies.

4. Consultation meeting with owner to review performance reports and improvement opportunities.

F. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of owner.

#### 1.10 OWNERSHIP OF PROPRIETARY MATERIAL

A. Project specific software and documentation shall become the owner's property upon project completion. This includes the following:

1. Operator Graphic files
2. As-built hardware design drawings
3. Operating & Maintenance Manuals
4. BAS System software database

#### 1.11 DEFINITIONS

- A. DDC: Direct digital control
- B. I/O: Input/output.
- C. MS/TP: Manager Subordinate / Token Passing.
- D. POT: Portable Operator's Terminal.

E. PID: Proportional plus integral plus derivative.

F. RTD: Resistance temperature detector.

G. BAS/ATC: Building Automation System/Automatic Temperature Controls.

## PART 2 PRODUCTS

### 2.0 SECTION INCLUDES

#### 2.1 MATERIALS:

#### 2.2 SYSTEM COMMUNICATION

#### 2.3 ENTERPRISE SYSTEM - OPERATOR WEB INTERFACE

#### 2.4 BUILDING CONTROLLER - OPERATOR INTERFACE

#### 2.5 BUILDING CONTROLLER SOFTWARE

#### 2.6 BUILDING / SYSTEM CONTROLLERS

#### 2.7 ADVANCED APPLICATION CONTROLLERS

#### 2.8 APPLICATION SPECIFIC CONTROLLERS:

#### 2.9 VARIABLE AIR VOLUME TERMINAL UNIT CONTROLLERS

#### 2.10 INPUT/OUTPUT INTERFACE:

#### 2.11 POWER SUPPLIES:

#### 2.12 AUXILLARY CONTROL DEVICES:

#### 2.13 WIRING AND RACEWAYS:

#### 2.1 MATERIALS:

A. Use new products that the manufacturer is currently manufacturing and that have been installed in a minimum of 25 installations. Do not use this installation as a product test site unless explicitly approved in writing by the owner or the owner's representative. Spare parts shall be available for at least five years after completion of this contract.

#### 2.2 SYSTEM COMMUNICATION

##### A. System Communications

1. Each workstation, building controller, and equipment controller communication interface shall utilize the BACnet™ protocol with an Ethernet (IEEE 802.3), Wi-Fi (IEEE 802.11), RS485 (EIA-485), or Zigbee® (802.15.4) physical interface and an appropriate data link technology as defined in ANSI®/ASHRAE® Standard 135-2012. (e.g. BACnet over IP, BACnet over IPv6, BACnet SC, BACnet over MS/TP, BACnet Zigbee).

2. All system controllers shall be BTL listed as a BACnet Building Controller (B-BC) as defined in ANSI®/ASHRAE® Standard 135-2012.

3. All documented status and control points, schedule, alarm, and data-log services or objects shall be available as standard object types as defined in ANSI®/ASHRAE® Standard 135-2012.
4. Each System Controller shall communicate with a network of Custom Application and Application Specific Controllers utilizing one or more of the interfaces documented within Field Bus Communications below.
5. All Operator Workstations (B-OWS, B-AWS) and Building Controllers (B-BC) shall support BACnet Secure Connect (BACnet SC), a secure and encrypted datalink layer specifically designed for those networks.

#### B. Field Bus Communications

##### 1. BACnet™

- a. All equipment and plant controllers shall be BTL listed as a BACnet Application Specific Controller (B-ASC) or a BACnet Advanced Application Controller (B-AAC) as defined in ANSI®/ASHRAE® Standard 135-2012.
- b. All communication shall conform to ANSI®/ASHRAE® Standard 135-2012.
- c. System Controller shall function as a BACnet router to each unit controller providing a globally unique BACnet Device ID for all BACnet controllers within the system.
- d. BACnet Zigbee®
  - 1) Communication between System Controller and equipment/plant controllers shall utilize BACnet Zigbee as defined in ANSI®/ASHRAE® Standard 135-2012.
  - 2) Each equipment controller wireless communication interface shall self-heal to maintain operation in the event of network communication failure.
  - 3) Each zone sensor wireless communication interface shall be capable of many-to-one sensors per controller to support averaging, monitoring, and multiple zone applications. Sensing options shall include temperature, relative humidity, CO2, and occupancy.
- e. BACnet MS/TP
  - 1) Communication between System Controller and equipment/plant controllers shall utilize BACnet MS/TP as defined in ANSI®/ASHRAE® Standard 135-2012.

#### 2.3 ENTERPRISE SYSTEM - OPERATOR WEB INTERFACE

##### A. Building Health Operator Interface View

1. The Enterprise operator web interface shall provide a standard building health view that provides visual indication of which buildings have issues.
2. The Enterprise operator web interface building health will display the summary information including number of active alarms for today, number of devices off-line, number or hot/cold spaces.

3. The Enterprise operator web interface shall provide a direct link from any building health card to a building summary view that displays: active alarms for today, current chiller plant stats (if applicable), air handler status, and spaces that are too hot/cold.
4. The Enterprise operator web interface shall provide the ability to group, filter, and sort the list of buildings.
5. The Enterprise operator web interface shall allow a user to save filtering and grouping options as their default view.
6. The Enterprise operator web interface shall allow a user to disable the building health display for any building.

#### B. Customizable Navigation Tree

1. The Enterprise operator web interface shall include a fully customizable navigation tree that shall allow an operator to do the following:
  - a. Move and edit any of the nodes of the tree.
  - b. Move entire groups to any area of the tree.
  - c. Change the name of any node in the tree.
  - d. Create custom nodes for any page in the web interface including: graphics, data log views, schedules, and dashboards.
  - e. Support navigation from multi-building to single building view.
  - f. Provide the ability to assign graphics to any node in the tree.
  - g. Ability to create folders and assign and change hierarchy of nodes of the tree.

#### C. Provide Mobile App Interface

1. Enterprise Operator Interface manufacturer shall provide a phone/tablet interface with the ability to view/override status & setpoints, view/change schedules, view/acknowledge/comment on alarms, and view graphics for all spaces and equipment.
2. This phone/tablet interface shall resize itself appropriately for the size of the interface (i.e. no "pinching & zooming" required). This phone/tablet interface shall function remotely from the facility while following IT security best-practices (e.g. no ports exposed to the internet).
3. Provide mobile (smart phone or tablet) interfaces to the building automation system, compatible with iOS and Android™ operating systems.
4. Controls manufacturer shall provide a phone/tablet interface with the ability to view/override status & setpoints, view/change schedules, view/acknowledge/comment on alarms, and view graphics for all spaces and equipment.
5. This phone/tablet interface shall resize itself appropriately for the size of the interface (i.e. no "pinching & zooming" required).



6. This phone/tablet interface shall function remotely from the facility while following IT security best-practices (e.g. no ports exposed to the internet).

7. The operator interface shall support system access on a mobile device via a mobile app to:

- a. Alarm Log
- b. System Status
- c. Equipment Status
- d. Space Status
- e. Standard Equipment Graphics
- f. Override Setpoints
- g. Override Occupancy
- h. Acknowledge Alarms
- i. Comment on Alarms

#### D. Equipment & Application Pages

1. The Enterprise operator web 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) 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.

d. View of all custom graphical programming for supported controllers in real time.

e. View and management of all points for equipment and applications.

f. Support documents that have been assigned for that equipment.

g. Live data view for any selected points.

h. Touch friendly design for all action buttons, navigation, and spacing.

#### E. System Graphics

1. Enterprise operator web 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.
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.

F. 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.

G. Document Support - The Enterprise operator web interface shall support the ability to import support files into a support files library.

1. Imported support files can include the following types of document formats: pdf, docx, xlsx, pptx, jpeg, tif, bmp, png, jpg, gif
2. All imported support files can be associated directly with equipment or family types that can then be accessed directly from standard pages.

#### H. Manual Control and Override

1. Provide a method for a user to view, override, and edit if applicable, the status of any object and property in the system.
2. Timed 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.
5. Global Point Control. Provide a method for a user to view, override, and edit if applicable, the status of multiple object and properties in the system. The point status shall be available by menu, on graphics or through custom programs.
6. Creating Override Search Queries. The system shall allow the operator to search for overrides across building(s), equipment, systems. User shall have the ability to view and release multiple overrides at once or one at a time.

I. Scheduling. A user shall be able to perform the following tasks utilizing the Enterprise operator web 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.
7. Create schedules and exceptions for multiple buildings.
8. Apply emergency schedule to multiple buildings.
9. Drag and drop scheduling editing.
10. Global schedule and exceptions across multiple buildings.

J. Data Logs

1. The Enterprise operator web interface shall allow a user with the appropriate security permissions to define a Data Log for any data in the system.
2. The Enterprise operator web interface shall allow a user to define any Data Log options as described in the Application and Control Software section.
3. The operator shall be able to specify the duration of historical data to view by scrolling, zooming, or selecting from a pull down list.
4. The system shall provide a graphical trace display of the associated time stamp and value for any selected point along the x-axis.
5. Operator will have the ability to show alarms and overrides on any data log view.
6. The Enterprise operator web interface shall allow a user to Print or download Data Log views in multiple formats including raw data (CSV, XLS) or image (PNG, JPG, PDF, SVG).

K. 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. The operator will have the option of selecting an audible alarm notification for all alarm classes they subscribe to.
3. The system operator will have the option of setting specific times and days that they will receive alarm notifications.
4. Alarm/Event Log. The operator shall be able to view all logged system alarms/events from any Enterprise operator web interface.

- a. The operator shall be able to sort and filter alarms from events. Alarms shall be sorted in a minimum of 24 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.
- f. All alarm logs will provide both grouping multiple filter options for sorting and locating specific alarm or groups of alarms.
- g. Alarm logs shall provide the ability to navigate directly to object with one click.

#### 5. Alarm Configuration

- 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.
- c. The operator shall be able to set up conditional alarm limits based on reference points.
- d. The operator shall be able to create queries to see current alarm properties across building(s), equipment, systems for any available point.
- e. The operator shall be able to run saved queries to see current alarm settings and modify and change them in mass.

L. User Change Log. The operator shall be able to view all logged user changes in the system from any Enterprise operator web interface.

1. An operator shall be able to group user changes by: date, affected, date & affected, user, date & user, transaction type, date & transaction type, or sort only.
2. The operator will have the option of additional filtering capability of: date, transaction, type, user, affected, and details that can be used individually or in conjunction with other filters.

#### M. Standard and Custom Reports

1. The Enterprise operator web interface shall provide a reporting package that allows the operator to select reports to run.
2. The Enterprise operator web interface shall provide the ability to schedule reports to run at specified intervals of time.
3. The Enterprise operator web interface shall provide the ability to email schedule reports at specified intervals of time.

4. The Enterprise operator web interface shall allow a user to create reports in either a pdf. or Excel format.
5. Reports and logs shall be readily printed to the system printer.
6. The Enterprise operator web interface shall provide the ability to create and modify both standard and custom reports.
7. The following standard reports shall be available without requiring a user to manually design 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. Site Commissioning Report: Provide a one-time report that lists all equipment with the unit configuration and present operation.
  - d. Air Handler Status Report: Current status and short historical operation of selected air handlers.
  - e. Air System Status Report: Current status and short historical operation of selected VAS.
  - f. Area Status Report: Current status and short historical operation of selected Area.
  - g. Chiller Plant Status Report: Current status and short historical operation of selected chiller plant.
  - h. Chiller Status (ASHRAE) Report: Standard points defined by ASHRAE 147-2013 for tracking and operation of air conditioning equipment.
  - i. Schedules Report: List of all weekly events for all schedules in selected buildings.
  - j. Space Comfort Analysis Report: List of spaces that meet selected criteria for potential comfort issues (temp variance, high, low, unoccupied).
  - k. Space List Report: Current status of multiple spaces in selected buildings.
  - l. Space Status Report: Current status and short historical operation of selected spaces.
8. The following custom report functionality shall be available without requiring a third party reporting tool:
  - a. Bar Chart: Create a bar chart for any data log or custom report equation in the system.
  - b. Line Chart: Create a line chart for any data log or custom report equation in the system.
  - c. Scatter Plot: Create a scatter plot for any data log or custom report equation in the system.
  - d. Histogram: Create a Histogram for any data log, point, or custom report equation in the system.
  - e. Pie Chart: Create a Pie chart for any data log, point, or custom report equation in the system.
  - f. Single Values: Display single values from any point, data log, or equation on a custom report.

- g. Values Table: Display a formatted table for point values from any family type (spaces, air handlers, chillers, areas, air systems, chiller plants, or programmable controllers).
- h. Data Log Table: Create a formatted table from selected data logs.
- i. User Change Log Table: Create a formatted table of user changes with date/time, user, what was changed, new/old value for any family type (spaces, air handlers, chillers, areas, air systems, chiller plants, or programmable controllers).
- j. Text Box: Create a text boxes that can be placed and sized on any custom report.
- k. Image: Download and place images that can be placed and sized on any custom report.
- l. Size and position of ability of all items on a custom report.
- m. Both standard and custom page size capabilities.
- n. Save, edit, delete, and save as capability.
- o. Equation capability on data logs or points that can be used in custom reports (+, -, \*, /).

#### N. Remote Access / Network Security

1. The project's Controls Contractor shall provide secure remote access to the Building Automation System (BAS).
2. Secure remote access to the BAS shall not require additional software to be installed on the client device (i.e. VPN client).
3. Secure remote access to the BAS shall not require ANY inbound ports on a firewall to be "exposed" or "forwarded".

#### O. System Security

1. User Profiles shall restrict the user to only the objects, applications, and system functions as assigned by the system administrator.
2. The system shall include pre-defined "roles" that allow a system administrator to quickly assign permissions to a user.
3. User logon/logoff attempts shall be recorded.
4. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.
5. The system shall support Active Directory for user set-up and management.
6. The system shall track and record all user log-in activity and all changes done at the enterprise level including who made the change, when, what was changed, pervious value and new value.

#### P. Single Sign-on Authentication with SAML

1. To ensure seamless and secure access into the Enterprise Management system while maintaining the ability for using a single sign-on, the system shall support the use of SAML (Security Assertion Markup Language) 2.0 Single Sign-On Authentication.

2. The BAS shall be the service provider and allow the passing of username and password credentials, between it and the trusted IDP (identity provider – ex. Okta, Ping Identity, One Login, etc.)

3. The BAS system will allow users to utilize their organization email address and domain password to log in.

#### Q. 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.

### 2.4 BUILDING CONTROLLER - OPERATOR INTERFACE

#### A. Provide Building Controller Web Interface

1. Manufacturer shall provide a user interface with time-of-day schedules, data collection, dashboards, reports and building summary, system applications, and self-expiring timed overrides. Manufacturer shall provide a published user and applications guide(s) that detail the system application operation, configuration, setup and troubleshooting.

2. The building controller web interface shall be accessible via a web browser without requiring any “plug-ins” (i.e. JAVA Runtime Environment (JRE), Adobe Flash).

#### 3. User Roles

a. The system shall include pre-defined “roles” that allow a system administrator to quickly assign permissions to a user.

b. User logon/logoff attempts shall be recorded.

c. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.

#### 4. On-Line Help and Training

a. Provide a context sensitive, on line help system to assist the operator in operation and configuration of the system.

b. On-line help shall be available for all system functions and shall provide the relevant data for each particular screen.

#### 5. Equipment & Application Pages

a. The building controller web 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:

1) Alarms relevant to the equipment or application without requiring a user to navigate to an alarm page and perform a filter.

2) Historical Data (As defined in Trend Logs section of CONTROLLER SOFTWARE) for the equipment or application without requiring a user to navigate to a Data Log page and perform a filter.

6. Building Controller System Graphics.

a. The building operator web 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.

b. 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.

c. Animation. Graphics shall be able to animate by displaying different Image lies for changed object status.

d. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.

7. 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.

8. Manual Control and Override

a. 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.

b. 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.

c. Override Owners. The system shall convey to the user the owner of each override for all priorities that an override exists.

d. Provide a specific icon to show timed override or operator override, when a point, unit controller or application has been overridden manually.

9. Scheduling. - The scheduling application shall provide graphical representation of the day, week, month and exception events.

10. Alarm/Event Notification

a. Alarm/Event Log. The operator shall be able to view all logged system alarms/events from any building operator web interface.

1) 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.



2) The operator shall be able to acknowledge and add comments to alarms.

3) Alarm/event messages shall use full language, easily recognized descriptors.

b. Alarm Suppression. Alarms shall be able to be suppressed based on load/source relationships to present the likely root cause to the building operator as described in ASHRAE Guideline 36. Load/Source relationships shall be configurable by the user through a web interface.

#### 11. Reports and Logs

a. The building operator web interface shall provide a reporting package that allows the operator to select reports.

b. The building operator web interface shall provide the ability to schedule reports to run at specified intervals of time.

c. The following standard reports shall be available without requiring a user to manually configure the report:

1) All Points in Alarm Report: Provide an on demand report showing all current alarms.

2) All Points in Override Report: Provide an on demand report showing all overrides in effect.

3) Commissioning Report: Provide a one-time report that lists all equipment with the unit configuration and present operation.

4) Points report: Provide a report that lists the current value of all points.

d. The controls vendor shall provide a hardening report that summarizes the port configuration details to ensure sites have not been exposed to the Internet in alignment with Cyber Security best practices.

#### B. Provide Mobile App Interface

1. Provide mobile (smart phone or tablet) interfaces to the building automation system, compatible with iOS and Android™ operating systems.

2. Controls manufacturer shall provide a phone/tablet interface with the ability to view/override status & setpoints, view/change schedules, view/acknowledge/comment on alarms, and view graphics for all spaces and equipment.

3. This phone/tablet interface shall resize itself appropriately for the size of the interface (i.e. no "pinching & zooming" required).

4. This phone/tablet interface shall function remotely from the facility while following IT security best-practices (e.g. no ports exposed to the internet).

5. The operator interface shall support system access on a mobile device via a mobile app to:

a. Alarm Log

b. System Status

- c. Equipment Status
- d. Space Status
- e. Standard Equipment Graphics
- f. Override Setpoints
- g. Override Occupancy
- h. Acknowledge Alarms
- i. Comment On Alarms

C. Provide Local Operator Touch Sensitive Display

1. Provide a color touch sensitive display that allows the building occupants to accomplish the following tasks:
  - a. Control the set points for multiple pieces of equipment with a single touch. Set point adjustment by the occupant shall be bound by editable limits.
  - b. Occupant override of the system/equipment operating mode shall be possible with a single touch on the local operator display. With the ability to set up point overrides to expire at designated times.
  - c. The local operator display shall provide occupant access to system time of day scheduling. Occupants shall have the ability to schedule events more than one year in advance. Exception schedules and holidays shall be shown clearly on the calendar, visible to the occupant on the touchscreen display.
  - d. The local operator display shall offer PIN control, which shall limit system control access to only those with proper login credentials.
  - e. The local operator display shall display the alerts that require service of the connected equipment.
2. To ensure interoperability with the Building Automation System (BAS), the local operator display shall be provided by the BAS solution provider associated with this project.
3. Touchscreen display shall be a minimum of 10 inches in size and be provided with mounting hardware to allow it to be installed on an office wall or control panel door.

2.5 BUILDING CONTROLLER SOFTWARE

- A. Manufacturer shall provide standard applications to deliver HVAC system control. Standard applications include Time of Day Scheduling with Optimal Start/Stop, VAV Air Systems Control, Chiller Plant Control, Historical Trend Logs and Trim and Respond. Manufacturer shall provide system optimization strategies for functions such as fan pressure optimization and ventilation optimization.
- B. 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 building operator interface.

## 1. Trend Logs

a. The system shall harvest trend logs for defined key measurements for each controlled HVAC device and HVAC application. Trend logs shall be captured for a minimum of 5 key operating points for each piece of HVAC equipment and HVAC application and stored for no less than 1 year at 15-minute intervals. Data Logs shall be capable of being configured on an interval or change of value basis.

### 1) Fan Coil / Cabinet Unit Heater / Unit Ventilator / WSHP Unit

- a) Discharge Air Temperature
- b) Space Temperature Active
- c) Space Temperature Setpoint Active
- d) Air Flow Setpoint Active
- e) Discharge Air Flow

### 2) Air Handling Unit/Rooftop (VAV)

- a) Discharge Air Temperature
- b) Discharge Air Temperature Setpoint Active
- c) Space Temperature Active
- d) Cooling Capacity Status
- e) Discharge Air Flow

### 3) Air Handling Unit/Rooftop (CV)

- a) Discharge Air Temperature
- b) Space Temperature Active
- c) Space Temperature Setpoint Active
- d) Cooling Capacity Status
- e) Heating Capacity Primary Status
- f) Outdoor Air Damper Position

### 4) VAV Terminal Unit

- a) Discharge Air Temperature
- b) Space Temperature Active
- c) Space Temperature Setpoint Active
- d) Air Flow Setpoint Active
- e) Discharge Air Flow

5) Variable Air System (VAS)

- a) VAS Operating Mode
- b) Duct Static Optimization Duct Static Setpoint
- c) Duct Pressure Optimization Maximum
- d) Space Temperature Average
- e) Ventilation Optimization Air Setpoint

2.6 BUILDING / SYSTEM CONTROLLERS

A. There shall be one or more independent, standalone microprocessor based System Controllers to manage the global strategies described in CONTROLLER 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.

B. Controls manufacturer shall provide secure remote access to the Building Automation System (BAS). Secure remote access shall not require IP ports to be "exposed" (i.e. port-forwarded or external public IP addresses) to the Internet. Controls manufacturer shall update secure remote access software as necessary to follow cyber security best practices and respond to cyber security events.

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. The Advanced Application Controller shall be capable of operating as a stand-alone controller or as a member of a Building Automation System (BAS).

C. When the Advanced Application Controller is operating as a member of a Building Automation System (BAS), the application controller shall operate as follows:

1. Application Controller will receive operation mode commands from the BAS network controller. The BAS commands shall include but not be limited to the follow: Occupied Heat/Cool, Unoccupied Heat/Cool, Morning Warm-up, / Pre-cool, Occupied Bypass).
2. Application Controller will provide equipment status parameters to the BAS through BACnet communication.

3. Application Controller will operate as a stand-alone controller in the event of communication failure with the BAS.

4. In case of communications failure, stand-alone operation shall use default values or last known values for remote sensors read over the network such as outdoor air temperature.

D. 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.

E. For ease of troubleshooting, the Controller shall support data trend logging.

1. Trends shall be capable of being collected at a minimum sample rate of once every second
2. Shall be capable of trending all BACnet points used by controller
3. Trends shall be capable of being scheduled or triggered.
4. With a minimum of 20,000 trending points total on a controller

F. 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.

G. 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: Between 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].

H. 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. 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.
9. The Controller shall provide a dedicated static pressure input.

I. 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. To keep BACnet MS/TP network traffic to a minimum, expansion I/O must communicate via an internal controller communication bus (point expansion via the BACnet MS/TP network is not allowed).

J. 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 the following methods: direct cable connection to the Controller, connection through another controller on BACnet link.
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. 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.

10. Controller data shall be maintained through a power failure.

K. 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.

L. 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 as BACnet Advanced Application Controller (B-AAC)

## 2.8 APPLICATION SPECIFIC CONTROLLERS:

A. General Description

1. 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.

2. 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.

B. The Application Specific Controller shall be capable of operating as a stand-alone controller or as a member of a Building Automation System (BAS).

C. When the Application Specific Controller is operating as a member of a Building Automation System (BAS), the application controller shall operate as follows:

1. Application Controller will receive operation mode commands from the BAS network controller. The BAS commands shall include but not be limited to the follow: Occupied Heat/Cool, Unoccupied Heat/Cool, Morning Warm-up, / Pre-cool, Occupied Bypass).

2. Application Controller will provide equipment status parameters to the BAS through BACnet communication.

3. Application Controller will operate as a stand-alone controller in the event of communication failure with the BAS.

4. In case of communications failure stand-alone operation shall use default values or last known values for remote sensors read over the network such as outdoor air temperature.

D. 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 that a BAS is not present.

#### E. 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. 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.

F. 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].

#### G. 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.

H. 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

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.

a. Configuration change shall not be made in a programming environment, but rather by a configuration page utilizing dropdown list, check boxes, and numeric boxes.

8. 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

I. 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.

J. Application controller shall 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 as BACnet Application Specific Controller (B-ASC)

## 2.9 VARIABLE AIR VOLUME TERMINAL UNIT CONTROLLERS

### A. General Description

1. Variable Air Volume (VAV) controllers shall be microprocessor-based DDC controllers which, through hardware or firmware design, control specified equipment. They are typically not user programmable, but are configurable for operation of VAV terminal units.

2. Variable Air Volume (VAV) controllers are controllers that operate equipment that control the space temperature of single zone.

B. The VAV controller shall be capable of operating as a stand-alone controller or as a member of a Building Automation System (BAS).

C. When the VAV controller is operating as a member of a Building Automation System (BAS), the application controller shall operate as follows:

1. The VAV controller will receive operation mode commands from the BAS network controller. The BAS commands shall include but not be limited to the following: Occupied Heat/Cool, Unoccupied Heat/Cool, Morning Warm-up, / Pre-cool, Occupied Bypass).

2. The VAV controller will provide equipment status parameters to the BAS through BACnet communication.

3. The VAV controller will operate as a stand-alone controller in the event of communication failure with the BAS.

4. In case of communications failure stand-alone operation shall use default values or last known values for remote sensors read over the network such as outdoor air temperature.

D. Stand-Alone Operation: Each VAV Terminal Unit shall be controlled by a single controller and provide stand-alone control in the event that a BAS is not present.

E. The VAV controller shall communicate to the building automation system via one of the following protocols: BACnet™ MS/TP or BACnet™ Zigbee defined in ANSI®/ASHRAE® Standard 135-2020

#### 1. BACnet™ MS/TP

a. To allow maximum communications speed and co-existence with other controllers, the controller shall support at a minimum the following BACnet MS/TP manager baud rates: 9600, 19200, 38400, 76800.

#### 2. BACnet™ Zigbee

a. VAV controller wireless communication interface shall self-form and self-heal to maintain operation in the event of network communication failure.

b. IEEE 802.15.4 radios to minimize risk of interference, reliability, and range.

- c. 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.
  - d. To protect against harmful interference, certifications shall include Energy Management Equipment FCC CFR47, Section 15.247 & subpart E, Digital Modulation Transmission with no SAR (FCC ID: TPF-251701)
- F. Each VAV terminal unit shall use a space zone sensor(s) to measure the space condition it is serving.
1. The VAV controller shall use a wired or wireless communication interface to connect to its space zone sensor.
  2. Each zone sensor communication interface shall be capable of many-to-one sensors per controller to support averaging, monitoring, and multiple zone applications. Sensing options shall include temperature, relative humidity, CO<sub>2</sub>, and occupancy.
  3. Wireless zone sensors
    - a. To check for proper operation, wireless zone temperature sensors shall include a signal strength and battery condition indicators on the zone sensor.
    - b. The wireless zone sensor battery life shall provide at least 15 years life under normal operating conditions and must be readily available Lithium size AA, 1.5V.
    - c. The wireless zone sensor and receiver addresses shall be held in non-volatile memory to ensure operation through system voltage disturbances and to minimize the risk of incorrect association.
    - d. To ensure proper system performance, the wireless zone sensor 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.
    - e. Zone temperature sensing accuracy shall be +/- 0.5F (+/- 0.28C).

G. 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. 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.

H. 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  $-40^{\circ}$  to  $158^{\circ}$  F [ $-40^{\circ}$  to  $70^{\circ}$  C].

I. 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, 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 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).

J. 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 be 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.

a. Configuration change shall not be made in a programming environment, but rather by a configuration page utilizing dropdown list, check boxes, and numeric boxes.

8. For ease of troubleshooting, the Controller shall support BACnet data trend logging.

a. Trends shall be capable of being collected at a minimum sample rate of once every second.

b. Shall be capable of trending all BACnet points used by controller

c. Trends shall be capable of being scheduled or triggered

K. 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.

L. Controller shall 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. AS/NZS CISPR 32:2016
5. VCCI-CSPR 32:2016
6. CAN ICES-003(B)/NMB-003(B)
7. To ensure integration to the building automation system the controller must be BTL (BACnet Testing Lab) listed. The following BACnet profiles are in order of most functionality (B-BC) to least functionality (B-ASC).
  - a. BACnet Building Controller (B-BC)
  - b. BACnet Advance Applications Controller (B-AAC)
  - c. BACnet Application Specific Controller (B-ASC)

## 2.10 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.

#### 2.11 POWER SUPPLIES:

A. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish overcurrent protection in both primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.

1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in overvoltage and overcurrent protection and shall be able to withstand a 150% current overload for at least three seconds without trip-out or failure.

a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MIL-STD 810C for shock and vibration.

b. Line voltage units shall be UL recognized and CSA approved.

#### 2.12 AUXILLARY CONTROL DEVICES:

A. 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.

B. Control dampers shall be parallel or opposed blade types as scheduled on drawings.

C. 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.

D. Control Valves

1. Control valves shall be two-way or three-way type for two-position or modulating service as scheduled or shown.
2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
  - a. Water Valves:
    - 1) Two-way: 150% of total system (pump) head.
    - 2) Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.

E. Water Valves

1. Body and trim style and materials shall be in accordance with manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
2. Sizing Criteria:
  - a. Two-position service: Line size.

- b. Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 34.5 kPa (5 psi), whichever is greater.
  - c. Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 34.5 kPa (5 psi) maximum.
  - d. Valves DN 15 (1/2 in.) through DN 50 (2 in.) shall be bronze body or cast brass ANSI Class 250, spring-loaded, PTFE packing, quick opening for two-position service. Two-way valves to have replaceable composition disc or stainless steel ball.
  - e. Valves DN 65 (2 1/2 in.) and larger shall be cast iron ANSI Class 125 with guided plug and PTFE packing.
3. Water valves shall fail normally open or closed, as scheduled on plans, or as follows:
- a. Water zone valves—normally open preferred
  - b. Heating coils in air handlers - normally open
  - c. Chilled-water control valves - normally closed
  - d. Other applications—as scheduled or as required by sequences of operation
4. Zone valves shall be sized to meet the control application and they shall maintain their last position in the event of a power failure.

#### F. 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.

#### G. 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.

#### H. Wired Humidity Sensors

1. Duct and room sensors shall have a sensing range of 20% to 80%.

2. Duct sensors shall be provided with a sampling chamber.

#### 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.

### 2.13 WIRING AND RACEWAYS:

A. General: Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of this specification.

B. All insulated wire to be copper conductors, UL labeled for 90°C (194°F) minimum service.

C. Fiber Optic Cable. Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. The sheath shall be UL Listed OFNP in accordance with NEC Article 770. The optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125 µm.

## PART 3 EXECUTION

### 3.0 SECTION INCLUDES

3.1 EXAMINATION:

3.2 PROTECTION:

3.3 COORDINATION:

3.4 GENERAL WORKMANSHIP:

3.5 FIELD QUALITY CONTROL:

3.6 COMMUNICATION WIRING:

3.7 FIBER OPTIC CABLE:

3.8 INSTALLATION OF SENSORS:

3.9 FLOW SWITCH INSTALLATION:

3.10 WARNING LABELS:

3.11 IDENTIFICATION OF HARDWARE AND WIRING:

3.12 CONTROLLERS:

3.13 PROGRAMMING:

3.14 CONTROL SYSTEM CHECKOUT AND TESTING:

3.15 CLEANING:

3.16 TRAINING:

3.1 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.

3.2 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.

3.3 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 20 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. Life Safety

1. Duct smoke detectors required for air handler shutdown shall be supplied under Section 26100 of this specification. The contractor shall interlock smoke detectors to air handlers for shutdown as described in the Sequences of Operation for this project.

2. Smoke dampers and actuators required for duct smoke isolation are provided under Section 26100. The contractor shall interlock these dampers to the air handlers as described in the Sequences of Operation for this project as applicable.

3. Fire/smoke dampers and actuators required for fire rated walls are provided under another Section 26100. Control of these dampers shall be by 26100

E. 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.

3.4 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.

### 3.5 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.

### 3.6 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.

### 3.7 FIBER OPTIC CABLE:

A. All cabling shall be installed in a neat and workmanlike manner. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.

B. Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post installation residual cable tension shall be within cable manufacturer's specifications.

C. Fiber optic cabinets, hardware, and cable entering the cabinet shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.

### 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 FLOW SWITCH INSTALLATION:

A. Coordinate installation of flow switch with Mechanical Contractor who will be responsible for installing a thread outlet in steel piping applications. Copper pipe applications will require the use CxCxF Tee, and no pipe extensions or substitutions will be allowed.

B. Mount a minimum of 5 pipe diameters upstream and 5 pipe diameters downstream, or two feet, whichever is greater, from pipe fittings and other inline potential obstructions.

C. Install in accordance with manufacturers' instructions, which will require proper flow direction, horizontal alignment with flow switch mounting on the top of pipe.

### 3.10 WARNING LABELS:

A. Permanent warning labels shall be affixed to all equipment that can be automatically started by the BAS system.

B. Permanent warning labels shall be affixed to all motor starters and all control panels that are connected to multiple power sources utilizing separate disconnects.

### 3.11 IDENTIFICATION OF HARDWARE AND WIRING:

A. All field wiring and cabling, including that within factory mounted, and wired control panels and devices for mechanical equipment, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information for troubleshooting, maintenance, and service purposes. BAS manufacturer to coordinate this labeling requirement with mechanical equipment manufacturer as it relates to controls.

B. Permanently label or code each point of field terminal strips to show the instrument or item served and correlate them to the BAS design drawings.

C. Identify control panels with minimum 1-cm letters on laminated plastic nameplates.

D. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

### 3.12 CONTROLLERS:

A. Provide a separate DDC Controller for individual HVAC mechanical equipment. 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.

### 3.13 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. BAS Operator's Interface

1. When Operator Workstation is specified, provide color graphics for each piece of mechanical equipment depicting sufficient I/O to monitor and troubleshoot operation. Operator color graphics shall include Chiller Plant, Cooling Tower System, Boiler Plant, Air Handling Units, Rooftop Units, VAV Terminal Boxes, Fan Coil Units, Unit Ventilators, Heat Exchangers, Exhaust Fans, etc. These standard graphics shall depict all points dynamically as specified in the points list and/or indicated in sequence of operation.

2. The BAS manufacturer shall provide all the labor necessary to install, initialize, start up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface data base, and any third party software installation and integration required for successful operation of the operator interface.

3. As part of this execution phase, the BAS manufacturer shall perform a complete test of the operator interface.

3.14 CONTROL SYSTEM CHECKOUT AND TESTING:

A. Start-up testing. All testing in this section shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the owner's representative is notified of the system demonstration.

1. The contractor shall furnish all labor and test apparatus required to calibrate and prepare for service all of the instruments, controls, and accessory equipment furnished under this specification.

2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.

3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to manufacturer's recommendations.

4. Verify all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starter, etc.) operate properly and normal positions are correct.

5. Verify all analog output devices (I/Ps, actuators, etc) are functional, that start and span are correct, and that direction and normal positions are correct. The contractor shall check all control

valves and autoatic dampers to ensure proper action and closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.

6. Verify the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimal start/stop routines.

7. Alarms and Interlocks

a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.

b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.

c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

3.15 CLEANING:

A. The BAS manufacturer's installing contractor(s) shall clean up all debris resulting from their installation activities on a daily basis. The installation contractors shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Owner, Construction Manager, General Contractor, and/or Mechanical Contractor.

B. At the completion of work in any area, the installation contractor shall clean all of their work, equipment, etc., making it free from dust, dirt and debris.

C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage. Any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.16 TRAINING:

A. Provide minimum of (8) hours of operator training throughout the contract period. The training will be provided for personnel designated by the Owner.

B. These objectives will be divided into logical groupings; participants may attend one or more of these, depending on level of knowledge required:

1. Day-to-day BAS Operators

2. BAS Troubleshooting & Maintenance

END OF SECTION 23 09 00



## SECTION 23 09 23.11 - CONTROL VALVES

### 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 control valves and actuators for DDC systems.
- B. Related Requirements:
  - 1. Section 23 09 23 "Direct Digital Control (DDC) System for HVAC" control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

#### 1.3 DEFINITIONS

- A. Cv: Design valve coefficient.
- B. DDC: Direct-digital control.
- C. NBR: Nitrile butadiene rubber.
- D. PTFE: Polytetrafluoroethylene
- E. 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.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including the following:
  - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
  - 3. Product description with complete technical data, performance curves, and product specification sheets.
  - 4. Installation, operation, and maintenance instructions, including factors affecting performance.

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B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include diagrams for pneumatic signal and main air tubing.

C. Delegated-Design Submittal:

1. Schedule and design calculations for control valves and actuators, including the following:
  - a. Flow at project design and minimum flow conditions.
  - b. Pressure differential drop across valve at project design flow condition.
  - c. Maximum system pressure differential drop (pump close-off pressure) across valve at project minimum flow condition.
  - d. Design and minimum control valve coefficient with corresponding valve position.
  - e. Maximum close-off pressure.
  - f. Leakage flow at maximum system pressure differential.
  - g. Torque required at worst case condition for sizing actuator.
  - h. Actuator selection indicating torque provided.

## 1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings and corresponding product installation 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. Control valve installation location shown in relationship to room, duct, pipe, and equipment.
2. Size and location of wall access panels for control valves installed behind walls.
3. Size and location of ceiling access panels for control valves installed above inaccessible ceilings.

## 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For control valves to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

## CONTROL VALVES

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- C. Delegated Design: Engage a qualified professional, as defined in Section 01 40 00 "Quality Requirements," to size products where indicated as delegated design.
- D. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.
- E. Backup Power Source: Systems and equipment served by a backup power source shall have associated control valve actuators served from a backup power source.
- F. Environmental Conditions:
  - 1. Provide electric control valve actuators, with protective enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Electric control valve actuators not available with integral enclosures, complying with requirements indicated, shall be housed in protective secondary enclosures.
    - a. Hazardous Locations: Explosion-proof rating for condition.
- G. Determine control valve sizes and flow coefficients by ISA 75.01.01.
- H. Control valve characteristics and rangeability shall comply with ISA 75.11.01.
- I. Selection Criteria:
  - 1. Control valve shutoff classifications shall be FCI 70-2, Class IV or better unless otherwise indicated.
  - 2. Valve pattern, three-way or straight through, shall be as indicated on Drawings.
  - 3. Modulating straight-through pattern control valves shall have equal percentage flow-throttling characteristics unless otherwise indicated.
  - 4. Modulating three-way pattern water valves shall have linear flow-throttling characteristics. The total flow through the valve shall remain constant regardless of the valve's position.
  - 5. Modulating butterfly valves shall have linear or equal percentage flow-throttling characteristics.
  - 6. Fail positions unless otherwise indicated:
    - a. Chilled Water: Last position.
  - 7. Rotary-type control valves, such as ball and butterfly valves, shall have Cv falling between 65 and 75 degrees of valve full open position and minimum valve Cv between 15 and 25 percent of open position.
  - 8. Selection shall consider viscosity, flashing, and cavitation corrections.
  - 9. Valves shall have stable operation throughout full range of operation, from design to minimum Cv.
  - 10. Minimum Cv shall be calculated at 10 percent of design flow, with a coincident pressure differential equal to the system design pump head.
  - 11. In water systems, select modulating control valves at terminal equipment for a design Cv based on a pressure drop of **5 psig** at design flow unless otherwise indicated.
  - 12. Two-position control valves shall be line size unless otherwise indicated.
  - 13. In water systems, use ball- or globe-style control valves for two-position control for valves **NPS 2** and smaller and butterfly style for valves larger than **NPS 2**.

## 2.2 BALL-STYLE CONTROL VALVES

- A. Pressure-Independent Ball Valves **NPS 2** and Smaller:
  - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

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- a. Belimo Aircontrols (USA), Inc.
- b. Griswold Controls.
- c. HCI; Hydronics Components Inc.
- d. Siemens Industry, Inc., Building Technologies Division.
- e. Valve Solutions, Inc.
2. Performance:
  - a. Pressure Rating: 600 psig for NPS 1 and 400 psig for NPS 1-1/2 & NPS 2.
  - b. Close-off pressure of 200 psig.
  - c. Process Temperature Range: Between zero to 212 deg F.
  - d. Rangeability: 100 to 1.
3. Integral Pressure Regulator: Located upstream of ball to regulate pressure, to maintain a constant pressure differential while operating within a pressure differential range of 5 to 50 psig.
4. Body: Forged brass, nickel plated, and with threaded ends.
5. Ball: Chrome-plated brass.
6. Stem and Stem Extension: Chrome-plated brass, blowout-proof design.
7. Stem sleeve or other approved means to allow valve to be opened and closed without damaging field-applied insulation and insulation vapor barrier seal.
8. Ball Seats: Reinforced PTFE.
9. Stem Seal: Reinforced PTFE packing ring stem seal with threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if equivalent cycle endurance can be achieved.
10. Flow Characteristic: Equal percentage.

## 2.3 BUTTERFLY-STYLE CONTROL VALVES

### A. Commercial-Grade, Two-Way Butterfly Valves:

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Bray.
  - b. Keystone; Emerson Electric Co., Automation Solutions.
  - c. Siemens Industry, Inc., Building Technologies Division.
  - d. Valve Solutions, Inc.
2. Performance:
  - a. Bi-directional bubble tight shutoff at 250 psig.
  - b. Comply with MSS SP-67 or MSS SP-68.
  - c. Rotation: Zero to 90 degrees.
  - d. Linear or modified equal percentage flow characteristic.
3. Body: Cast iron ASTM A 126, Class B, ductile iron ASTM A 536 or cast steel ASTM A 216/A 216M WCB fully lugged, suitable for mating to ASME B16.5 flanges.
4. Disc: 316 stainless steel.
5. Shaft: 316 or 17-4 PH stainless steel.
6. Seat: Reinforced EPDM or reinforced PTFE with retaining ring.
7. Shaft Bushings: Reinforced PTFE or stainless steel.
8. Replaceable seat, disc, and shaft bushings.
9. Corrosion-resistant nameplate indicating:
  - a. Manufacturer's name, model number, and serial number.
  - b. Body size.
  - c. Body and trim materials.
  - d. Flow arrow.

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## 2.4 ELECTRIC AND ELECTRONIC CONTROL VALVE ACTUATORS

- 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. Belimo Aircontrols (USA), Inc.
  2. Bray.
  3. Honeywell International Inc.
  4. Siemens Industry, Inc., Building Technologies Division.
  5. Valve Solutions, Inc.
- B. Actuators for Hydronic Control Valves: Capable of closing valve against system pump shutoff head.
- C. Position indicator and graduated scale on each actuator.
- D. Type: Motor operated, with or without gears, electric and electronic.
- E. Voltage: 24-V ac.
- F. Deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
- G. Function properly within a range of 85 to 120 percent of nameplate voltage.
- H. Construction:
1. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
  2. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.
  3. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.
- I. Field Adjustment:
1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
  2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.
- J. Two-Position Actuators: Single direction, spring return or reversing type.
- K. Modulating Actuators:
1. Operation: Capable of stopping at all points across full range and starting in either direction from any point in range.
  2. Control Input Signal:
    - a. Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position and other input drives actuator to close position. No signal of either input remains in last position.

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- b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10- or 2- to 10-V dc and 4- to 20-mA signals.
  - c. Pulse Width Modulation (PWM): Actuator drives to a specified position according to pulse duration (length) of signal from a dry contact closure, triac sink, or source controller.
  - d. Programmable Multi-Function:
    - 1) Control Input, Position Feedback, and Running Time: Factory or field programmable.
    - 2) Diagnostic: Feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
    - 3) Service Data: Include, at a minimum, number of hours powered and number of hours in motion.
- L. Position Feedback:
- 1. Equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
  - 2. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.
- M. Fail-Safe:
- 1. Where indicated, provide actuator to fail to an end position.
  - 2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
  - 3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.
- N. Integral Overload Protection:
- 1. Provide against overload throughout the entire operating range in both directions.
  - 2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.
- O. Valve Attachment:
- 1. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to valve shaft without the need for connecting linkages.
  - 2. Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.
  - 3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.
- P. Temperature and Humidity:
- 1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of **-20 to +120 deg F**.
  - 2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.
- Q. Enclosure:
- 1. Suitable for ambient conditions encountered by application.

2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with heater and control where required by application.

R. Stroke Time:

1. Operate valve from fully closed to fully open within 15 seconds.
2. Operate valve from fully open to fully closed within 15 seconds.
3. Move valve to failed position within 5 seconds.
4. Select operating speed to be compatible with equipment and system operation.

S. Sound:

1. Spring Return: 62 dBA.
2. Non-Spring Return: 45 dBA.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for valves installed in piping to verify actual locations of piping connections before installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 CONTROL VALVE APPLICATIONS

A. Control Valves:

1. Chilled water System, Control Valves at Chillers, Two-Way Applications Controlled by Flow: Butterfly-style valves, commercial-grade, two-way valves.
2. Chilled water System, Pressure Independent Characterized Control Valves (PICCV) at AHUs, Two-Way Applications Controlled by Temperature: Pressure-independent ball valves.
3. Chilled water System, Characterized Control Valves (CCV) at Final AHU in chilled water loop, Three Way, Controlled by Temperature: Ball valves with two ports and characterized disk.

#### 3.3 INSTALLATION, GENERAL

- A. Furnish and install products required to satisfy most stringent requirements indicated.
- B. Install products level, plumb, parallel, and perpendicular with building construction.

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- C. Properly support instruments, tubing, piping, wiring, and conduits to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a 10-lb force.
- D. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- E. Firestop penetrations made in fire-rated assemblies and seal penetrations made in acoustically rated assemblies.
- F. Fastening Hardware:
  - 1. Stillson wrenches, pliers, and other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
  - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
  - 3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- G. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.
- H. Corrosive Environments:
  - 1. Use products that are suitable for environment to which they will be subjected.
  - 2. If possible, avoid or limit use of materials in corrosive environments, including, but not limited to, the following:
    - a. Laboratory exhaust airstreams.
    - b. Process exhaust airstreams.
  - 3. Use Type 316 stainless-steel tubing and fittings when in contact with a corrosive environment.
  - 4. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
  - 5. Where control devices are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

### 3.4 ELECTRIC POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

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### 3.5 CONTROL VALVES

- A. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.
- B. Install flanges or unions to allow drop-in and -out valve installation.
- C. Where indicated, install control valve with three-valve bypass manifold to allow for control valve isolation and removal without interrupting system flow by providing manual throttling valve in bypass pipe.
- D. Install drain valves in piping upstream and downstream of each control valve installed in a three-valve manifold and for each control valve larger than **NPS 2** .
- E. Install pressure temperature taps in piping upstream and downstream of each control valve larger than **NPS 1** .
- F. Valve Orientation:
  - 1. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
  - 2. Install valves in a position to allow full stem movement.
  - 3. Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.
- G. Clearance:
  - 1. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
  - 2. Install valves with at least **12 inches** of clear space around valve and between valves and adjacent surfaces.
- H. Threaded Valves:
  - 1. Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
  - 2. Align threads at point of assembly.
  - 3. Apply thread compound to external pipe threads, except where dry seal threading is specified.
  - 4. Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.
- I. Flanged Valves:
  - 1. Align flange surfaces parallel.
  - 2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

### 3.6 CONNECTIONS

- A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

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### 3.7 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Install engraved phenolic nameplate with valve identification on valve.

### 3.8 CLEANING

- A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.
- B. Wash and shine glazing.
- C. Polish glossy surfaces to a clean shine.

### 3.9 CHECKOUT PROCEDURES

- A. Control Valve Checkout:
  - 1. Check installed products before continuity tests, leak tests, and calibration.
  - 2. Check valves for proper location and accessibility.
  - 3. Check valves for proper installation for direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
  - 4. For pneumatic products, verify air supply for each product is properly installed.
  - 5. For pneumatic valves, verify that pressure gauges are provided in each air line to valve actuator and positioner.
  - 6. Verify that control valves are installed correctly for flow direction.
  - 7. Verify that valve body attachment is properly secured and sealed.
  - 8. Verify that valve actuator and linkage attachment are secure.
  - 9. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
  - 10. Verify that valve ball, disc, and plug travel are unobstructed.
  - 11. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

### 3.10 ADJUSTMENT, CALIBRATION, AND TESTING

- A. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.
- B. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressures.
- C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

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- D. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 23 09 23.11

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## SECTION 23 09 23.12 - CONTROL DAMPERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Electric and electronic control damper actuators.

B. Related Requirements:

1. Section 23 09 23 "Direct Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

#### 1.2 DEFINITIONS

A. DDC: Direct digital control.

- B. 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.

#### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of damper and actuator:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation instructions, including factors affecting performance.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include diagrams for air and process signal tubing.
5. Include diagrams for pneumatic signal and main air tubing.

C. Delegated Design Submittal:

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1. Schedule and design calculations for control dampers and actuators, including the following.
  - a. Flow at project design and minimum flow conditions.
  - b. Face velocity at project design and minimum airflow conditions.
  - c. Pressure drop across damper at project design and minimum airflow conditions.
  - d. AMCA 500D damper installation arrangement used to calculate and schedule pressure drop, as applicable to installation.
  - e. Maximum close-off pressure.
  - f. Leakage airflow at maximum system pressure differential (fan close-off pressure).
  - g. Torque required at worst case condition for sizing actuator.
  - h. Actuator selection indicating torque provided.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plan drawings and corresponding product installation 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. Product installation location shown in relationship to room, duct, and equipment.
  2. Size and location of wall access panels for control dampers and actuators installed behind walls.
  3. Size and location of ceiling access panels for control dampers and actuators installed above inaccessible ceilings.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For control dampers to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.
- C. Delegated Design: Engage a qualified professional, as defined in Section 01 40 00 "Quality Requirements," to size products where indicated as delegated design.
- D. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.
- E. Backup Power Source: Systems and equipment served by a backup power source shall have associated control damper actuators served from a backup power source.
- F. Environmental Conditions:

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1. Provide electric control-damper actuators, with protective enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Electric control-damper actuators not available with integral enclosures, complying with requirements indicated, shall be housed in protective secondary enclosures.
  - a. Hazardous Locations: Explosion-proof rating for condition.

G. Selection Criteria:

1. Fail positions unless otherwise indicated:
  - a. Return Air: Open.
  - b. Outdoor Air: Close.
2. Dampers shall have stable operation throughout full range of operation, from design to minimum airflow over varying pressures and temperatures encountered.
3. Select modulating dampers for a pressure drop of 2 percent of fan total static pressure unless otherwise indicated.
4. Two-position dampers shall be full size of duct or equipment connection unless otherwise indicated.

## 2.2 GENERAL CONTROL-DAMPER ACTUATORS REQUIREMENTS

- A. Actuators shall operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.
- B. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.
- C. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.
- D. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.
- E. Avoid the use of excessively oversized actuators which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.
- F. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.
- G. Provide mounting hardware and linkages for connecting actuator to damper.
- H. Select actuators to fail in desired position in the event of a power failure.

## 2.3 ELECTRIC AND ELECTRONIC CONTROL DAMPER ACTUATORS

- 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. Belimo Aircontrols (USA), Inc.
  2. Honeywell Building Solutions; Honeywell International, Inc.
  3. Siemens Industry, Inc., Building Technologies Division.

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- B. Type: Motor operated, with or without gears, electric and electronic.
- C. Voltage:
  - 1. 24 V .
  - 2. Actuator shall deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
  - 3. Actuator shall function properly within a range of 85 to 120 percent of nameplate voltage.
- D. Construction:
  - 1. Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
  - 2. 100 up to 400 W: Gears ground steel, oil immersed, shaft-hardened steel running in bronze, copper alloy, or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel, or cast-aluminum housing.
  - 3. Greater Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.
- E. Field Adjustment:
  - 1. Spring return actuators shall be easily switchable from fail open to fail closed in the field without replacement.
  - 2. Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when the actuator is not powered.
- F. Two-Position Actuators: Single direction, spring return or reversing type.
- G. Modulating Actuators:
  - 1. Capable of stopping at all points across full range, and starting in either direction from any point in range.
  - 2. Control Input Signal:
    - a. Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position, and other input drives actuator to close position. No signal of either input remains in last position.
    - b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10- or 2- to 10-V dc and 4- to 20-mA signals.
    - c. Pulse Width Modulation (PWM): Actuator drives to a specified position according to a pulse duration (length) of signal from a dry-contact closure, triac sink or source controller.
    - d. Programmable Multi-Function:
      - 1) Control input, position feedback, and running time shall be factory or field programmable.
      - 2) Diagnostic feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
      - 3) Service data, including at a minimum, number of hours powered and number of hours in motion.
- H. Position Feedback:
  - 1. Equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.

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2. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.
- I. Fail-Safe:
    1. Where indicated, provide actuator to fail to an end position.
    2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
    3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.
  - J. Integral Overload Protection:
    1. Provide against overload throughout the entire operating range in both directions.
    2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.
  - K. Damper Attachment:
    1. Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.
    2. Attach actuator to damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.
    3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.
  - L. Temperature and Humidity:
    1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of **minus 20 to plus 120 deg F**.
    2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.
  - M. Enclosure:
    1. Suitable for ambient conditions encountered by application.
    2. NEMA 250, Type 2 for indoor and protected applications.
    3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
    4. Provide actuator enclosure with a heater and controller where required by application.
  - N. Stroke Time:
    1. Operate damper from fully closed to fully open within 15 seconds.
    2. Operate damper from fully open to fully closed within 15 seconds.
    3. Move damper to failed position within 5 seconds.
    4. Select operating speed to be compatible with equipment and system operation.
    5. Actuators operating in smoke control systems comply with governing code and NFPA requirements.
  - O. Sound:
    1. Spring Return: 62 dBA.
    2. Non-Spring Return: 45 dBA.

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## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for dampers and instruments installed in duct systems to verify actual locations of connections before installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 CONTROL-DAMPER APPLICATIONS

- A. Control Dampers: Provide electric and electronic actuators for all outside air and return air dampers on AHUs.

### 3.3 INSTALLATION, GENERAL

- A. Furnish and install products required to satisfy most stringent requirements indicated.
- B. Properly support dampers and actuators, tubing, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a 10-lb force.
- C. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- D. Seal penetrations made in fire-rated and acoustically rated assemblies.
- E. Fastening Hardware:
  - 1. Stillson wrenches, pliers, or other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
  - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
  - 3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- F. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.
- G. Corrosive Environments:
  - 1. Use products that are suitable for environment to which they will be subjected.
  - 2. If possible, avoid or limit use of materials in corrosive environments, including, but not limited to, the following:

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- a. Laboratory exhaust airstreams.
- b. Process exhaust airstreams.
3. Use Type 316 stainless steel tubing and fittings when in contact with a corrosive environment.
4. When conduit is in contact with a corrosive environment, use Type 316 stainless steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
5. Where actuators are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

### 3.4 ELECTRIC POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

### 3.5 CONTROL DAMPERS

- A. Install smooth transitions, not exceeding 15 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.
- B. Clearance:
  1. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
  2. Install dampers with at least **24 inches** of clear space on sides of dampers requiring service access.
- C. Service Access:
  1. Dampers and actuators shall be accessible for visual inspection and service.
  2. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Section 23 33 00 "Air Duct Accessories."
- D. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.
- E. Attach actuator(s) to damper drive shaft.
- F. For duct-mounted and equipment-mounted dampers installed outside of equipment, install a visible and accessible indication of damper position from outside.

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### 3.6 CONNECTIONS

- A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

### 3.7 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Install engraved phenolic nameplate with damper identification on damper.

### 3.8 CHECKOUT PROCEDURES

- A. Control-Damper Checkout:
  - 1. Check installed products before continuity tests, leak tests, and calibration.
  - 2. Check dampers for proper location and accessibility.
  - 3. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.
  - 4. For pneumatic products, verify air supply for each product is properly installed.
  - 5. For pneumatic dampers, verify that pressure gages are provided in each air line to damper actuator and positioner.
  - 6. Verify that control dampers are installed correctly for flow direction.
  - 7. Verify that proper blade alignment, either parallel or opposed, has been provided.
  - 8. Verify that damper frame attachment is properly secured and sealed.
  - 9. Verify that damper actuator and linkage attachment are secure.
  - 10. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
  - 11. Verify that damper blade travel is unobstructed.

### 3.9 ADJUSTMENT, CALIBRATION, AND TESTING:

- A. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.
- B. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressure.
- C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.
- D. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 23 09 23.12

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## SECTION 23 09 23.14 - FLOW INSTRUMENTS

### 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. Airflow measurement stations and sensors.
- 2. Airflow switches.
- 3. Airflow transmitters.

- B. Related Requirements:

- 1. Section 23 09 23 "Direct Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

#### 1.3 DEFINITIONS

- A. Ethernet: Local area network based on IEEE 802.3 standards.
- B. FEP: Fluorinated ethylene propylene.
- C. HART: Highway addressable remote transducer protocol is the global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bi-directional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from technician's hand-held device or laptop to a plant's process control, asset management, safety, or other system using any control platform.
- D. PEEK: Polyetheretherketone.
- E. PTFE: Polytetrafluoroethylene.
- F. PPS: Polyphenylene sulfide.
- G. RS-485: A TIA standard for multipoint communications using two twisted pairs.
- H. RTD: Resistance temperature detector.
- I. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

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#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including the following:
1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  2. Operating characteristics; electrical characteristics; and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
  3. Product description with complete technical data, performance curves, and product specification sheets.
  4. Installation instructions, including factors affecting performance.
  5. Product certificates.
- B. Shop Drawings:
1. Include plans, elevations, sections, and mounting details.
  2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  3. Include diagrams for power, signal, and control wiring.
  4. Include diagrams for air and process signal tubing.
  5. Number-coded identification system for unique identification of wiring, cable, and tubing ends.
- C. Delegated Design Submittal:
1. Schedule and design calculations for flow instruments, including the following.
    - a. Flow at Project design and minimum flow conditions.
    - b. Pressure drop at Project design and minimum flow conditions.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For instruments to include in operation and maintenance manuals.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Provide parts, as indicated by manufacturer's recommended parts list, for product operation during one -year period following warranty period.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Select and size products to achieve specified performance requirements.
- B. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.2 GENERAL REQUIREMENTS FOR FLOW INSTRUMENTS

- A. Air sensors and transmitters shall have an extended range of 10 percent above Project design flow and 10 percent below minimum Project flow to signal abnormal flow conditions and to provide flexibility for changes in operation.
- B. Source Limitations: For flow instruments, obtain products from single source from single manufacturer.

### 2.3 AIRFLOW MEASUREMENT STATIONS AND SENSORS

- A. Performance Requirements:
  - 1. Adjustable for changes in system operational parameters.
  - 2. Airflow Sensor and Transmitter Range: Extended range of 10 percent above Project design flow and 10 percent below minimum Project flow to signal abnormal flow conditions.
  - 3. Manufacturer shall certify that each flow instrument indicated complies with specified performance requirements and characteristics.
    - a. Product certificates are required.
- B. Thermal Airflow Measurement Stations:
  - 1. Common Performance Requirements:
    - a. Provide stations that are adjustable for changes in system operational parameters.
    - b. Manufacturer shall certify that each flow instrument indicated complies with specified performance requirements and characteristics.
    - c. Thermal airflow stations with one or more sensor nodes mounted in a probe, and a remotely mounted microprocessor-based transmitter at each measurement location.
    - d. Sensor Nodes: One self-heated and one zero-power bead-in-glass thermistor, using the principle of thermal dispersion.
    - e. Airflow Rate and Temperature of Each Sensor: Equally weighted and averaged by the transmitter prior to output.
    - f. Sensor-Node and Probe Assemblies:
      - 1) Sensor-Node Construction: Two bead-in-glass, hermetically sealed thermistors potted in a marine-grade waterproof epoxy with sensor housings constructed of glass-filled polypropylene. Construct with only the thermistor located within the sensing node and all other electronic components outside the airstream. Epoxy- or glass-encapsulated chip thermistors or devices with exposed leads are not allowed. Devices that use epoxy- or glass-

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- encapsulated chip thermistors, or electronics in the airstream, are unacceptable. Devices with exposed leads are unacceptable.
- 2) Store sensor-node airflow and temperature calibration data in a serial memory chip, in the cable connecting plug. Stored data does not require matching or adjustments to the transmitter in the field.
  - 3) Sensing-Node Temperature Accuracy: Within **0.15 deg F** over an operating range of **minus 20 to plus 160 deg F** and humidity range of 0 to 100 percent RH.
  - 4) Sensor-Probe Mounting Bracket Construction: Type 304 stainless steel.
  - 5) Internal Probe Wiring: Kynar-coated copper between the connecting cable and sensor nodes. PVC-jacketed wiring is unacceptable.
  - 6) Internal Probe Wiring Connections: Solder joints and spot welds, sealed and protected from the elements, so that direct exposure to water will not affect instrument operation. Connectors within the probe, of any type, are unacceptable. Printed circuit boards within the probe are unacceptable.
  - 7) Sensor-Probe Jacket: Integral, FEP jacket, plenum-rated CMP/CL2P, UL/cUL-listed cable, rated for exposures from **minus 67 to plus 392 deg F**, and for continuous and direct UV exposure. Plenum-rated PVC jacket cables are unacceptable.
  - 8) Sensor-Probe Cable Connector Plug: Gold-plated pins for connection to the transmitter.
- g. Transmitter Features and Functions:
- 1) High and/or low airflow alarm with user-defined set point and percent of set-point tolerance.
  - 2) Manual or automatic alarm reset, and low-limit cutoff value may be selected to disable the alarm.
  - 3) Alarm delay function, field defined.
  - 4) Sensor-node malfunction via the system status alarm and ignore the sensor node that is in a fault condition.
  - 5) Field configuration, diagnostics, and field output adjustment wizard that allow for a one- or two-point field adjustment to factory calibration for installations that require adjustment.
  - 6) Automatic reset after power disruption, transients, and brown-outs through a watchdog timer circuit.
  - 7) Operating temperature range of **minus 20 to plus 120 deg F** and humidity range of 5 to 95 percent RH.
  - 8) Electrical Power Requirement: 24 V ac (between 22.8 and 26.4 V ac under load) at 20 VA maximum, using a switching power supply that is overcurrent and overvoltage protected.
  - 9) Printed Circuit Board Interconnects: Gold-plated edge fingers, receptacle plug pins, and printed circuit board test points.
  - 10) Printed Circuit Boards: Electroless nickel immersion gold (ENIG) plated.
  - 11) Integrated Circuitry: Temperature-rated, industrial-grade. Commercial-grade integrated circuitry is not acceptable.
  - 12) Integration Buffers: Separate integration buffers for display of airflow output, airflow signal output (analog and network), and individual sensor output (IR-interface).
2. For Air-Ducted/Plenum:
- 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) Ebtron, Inc.
  - b. Airflow Station Performance:

- 1) Independent processing of up to 16 separately wired sensor-node assemblies.
  - 2) Accuracy: Within 3 percent of reading for ducted applications, and within 5 percent of reading for non-ducted applications, when installed in accordance with manufacturer's recommended placement guidelines. Include the combined uncertainty of the sensor nodes and transmitter. For devices whose overall accuracy is based on individual accuracy specifications of the sensor probes and transmitter, demonstrate compliance with the accuracy requirement over the entire operating range.
- c. Sensor-Node and Probe Assemblies:
- 1) Performance rated and tested with a 100 percent survival rate in a 30-day saltwater and acid vapor test with written independent laboratory results.
  - 2) Sensor-Node Calibration: Individually calibrated at 16 measurement points to airflow standards directly calibrated at NIST to the NIST Laser Doppler Anemometer (LDA) primary velocity standard.
    - a) Accuracy: Within 2 percent of reading over the entire calibrated airflow range of **0 to 5000 fpm**.
    - b) Individually calibrate thermistor at a minimum of three temperatures to NIST-traceable temperature standards.
  - 3) Provide the number of independent sensor nodes as follows:
    - a) For Duct/Plenum Area up to **0.5 sq. ft.**: One.
    - b) For Duct/Plenum Area Greater Than **0.5 through 1.0 sq. ft.**: Two.
    - c) For Duct/Plenum Area Greater Than **2.0 through 4.0 sq. ft.**: Six.
    - d) For Duct/Plenum Area Greater Than **4.0 through 8.0 sq. ft.**: Eight.
    - e) For Duct/Plenum Area Greater Than **8.0 through 12.0 sq. ft.**: 12.
    - f) For Duct/Plenum Area Greater Than **12.0 through 14.0 sq. ft.**: 14.
    - g) For Duct/Plenum Area Greater Than **14.0 sq. ft.**: 16.
  - 4) For an aspect ratio of 1.5 or less, and an area of **25 sq. ft.** or greater, four probes are required.
  - 5) Sensor-Probe Construction: Gold-anodized, 6063 aluminum alloy tube or Type 316 stainless steel tube, with each sensor probe containing one or more independently wired sensing nodes.
- d. Transmitter:
- 1) Transmitter determines the average airflow rate and temperature of connected sensor nodes in an array for a single location.
  - 2) User Interface: 16-character, alpha-numeric, LCD display, with two field-selectable analog output signals and network output capability. Provide one of the following transmitter configurations:
    - a) Model GTM116 Transmitter: Two field-selectable 0- to 10-V dc, or 4- to 20-mA, scalable, isolated, and overcurrent protected analog output signals. The first output (AO1) provides the total airflow rate. The second output (AO2) is field configurable for temperature or low and/or high airflow set-point (user-defined) or system status alarm. The Ethernet (BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) network connection provides the average airflow rate, temperature, high and/or low airflow set-point alarm, system status alarm, individual sensor-node airflow rates, and individual sensor-node temperatures. The transmitter shall be provided with a Bluetooth low-energy interface card capable of transmitting all transmitter setup parameters, diagnostics, average airflow, and temperature of the device and the airflow and temperature of each sensor node. Software capable of capturing and displaying this transmission will be available via download to Android or iOS phone or tablet. Software



- shall allow for setup parameters, airflow, temperature, and diagnostic data to be saved on the phone or be emailed.
- b) Model GTD116 Transmitter with Data-Logger Interface: Capable of logging airflow and temperature rates over specified time intervals.
3. For Air-Ducted/Plenum - Duct Size **2 sq. ft.** or Less:
- 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) Ebtron, Inc.
- b. Airflow Station Performance:
- 1) Independent processing of up to four separately wired sensor-node assemblies.
  - 2) Accuracy: Within 3 percent of reading for ducted applications, and within 5 percent of reading for non-ducted applications, when installed in accordance with manufacturer's recommended placement guidelines. Include the combined uncertainty of the sensor nodes and transmitter. For devices whose overall accuracy is based on individual accuracy specifications of the sensor probes and transmitter, demonstrate compliance with the accuracy requirement over the entire operating range.
- c. Sensor-Node and Probe Assemblies:
- 1) Performance rated and tested with a 100 percent survival rate in a 30-day saltwater and acid vapor test with written independent laboratory test results.
  - 2) Sensor-Node Calibration: Individually calibrated at 16 measurement points to airflow standards directly calibrated at NIST to the NIST Laser Doppler Anemometer (LDA) primary velocity standard.
    - a) Accuracy: Within 2 percent of reading over the entire calibrated airflow range of **0 to 5000 fpm.**
    - b) Individually calibrate thermistor at a minimum of three temperatures to NIST-traceable temperature standards.
  - 3) Provide the number of independent sensor nodes as follows:
    - a) For Duct/Plenum Area up to **0.5 sq. ft.:** One.
    - b) For Duct/Plenum Area Greater Than **0.5 through 1.0 sq. ft.:** Two.
    - c) For Duct/Plenum Area Greater Than **1.0 sq. ft.:** Four.
  - 4) For probes less than **8 inches**, one sensor node/probe is required.
  - 5) Sensor-Probe Construction: Gold-anodized, 6063 aluminum alloy tube or Type 316 stainless steel tube, with each sensor probe containing one or more independently wired sensing nodes.
- d. Transmitter:
- 1) Transmitter determines the average airflow rate and temperature of connected sensor nodes in an array for a single location.
  - 2) User Interface: 16-character, alpha-numeric, LCD display, with two field-selectable analog output signals or one isolated RS-485 (BACnet MS/TP, or Modbus RTU) field-selectable network connection.
  - 3) Model HTA104 Transmitter, Analog Capability: Two field-selectable 0- to 10-V dc, or 4- to 20-mA, scalable, isolated, and overcurrent protected analog output signals. The first output (AO1) provides the total airflow rate. The second output (AO2) is field configurable for temperature or low and/or high airflow set-point (user-defined) or system status alarm.
  - 4) Model HTAN104 Transmitter, Network Communications: The RS-485 (BACnet MS/TP or Modbus RTU) network connection provides the average airflow rate, temperature, high and/or low airflow set-point alarm, system status alarm, individual sensor-node airflow rates, and individual sensor-node temperatures.

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4. Airflow Station Performance:
  - a. Independent processing of up to two separately wired sensor-node assemblies.
  - b. Accuracy: Within 3 percent of reading when installed in accordance with manufacturer's recommended placement guidelines. Include the combined uncertainty of the sensor nodes and transmitter. For devices whose overall accuracy is based on individual accuracy specifications of the sensor probes and transmitter, demonstrate compliance with the accuracy requirement over the entire operating range.
5. Sensor-Node and Probe Assemblies:
  - a. Sensor-Node Calibration:
    - 1) Individually calibrated at a minimum of seven calibration points to NIST-traceable volumetric standards from 0 to 3000 fpm.
    - 2) Individually calibrate thermistor at a minimum of three temperatures to NIST-traceable temperature standards.
  - b. Provide the number of independent sensor nodes as follows:
    - 1) For a Duct Diameter of 4 Inches: One.
    - 2) For Duct Diameters 5 through 16 Inches: Two.
  - c. Sensor-Probe Construction: Mill-finish, 6063 aluminum alloy tube or Type 316 stainless steel tube, with each sensor probe containing one or more independently wired sensing nodes.
6. Transmitter:
  - a. Transmitter determines the average airflow rate and temperature of all connected sensor nodes in an array for a single location.
  - b. User Interface: An alpha-numeric, LCD display, with two field-selectable analog output signals or one isolated RS-485 (BACnet MS/TP or Modbus RTU) field-selectable network connection.
  - c. Model EF-A Transmitter, Analog Capability: Two field-selectable 0- to 10-V dc, or 2- to 10-V dc, scalable analog output signals. The first output (AO1) provides the total airflow rate. The second output (AO2) is field configurable for temperature or low and/or high airflow set-point (user-defined) or system status alarm.
  - d. Model EF-N Transmitter, Network Communications: The RS-485 (BACnet MS/TP or Modbus RTU) network connection provides the average airflow rate, temperature, high and/or low airflow set-point alarm, system status alarm, individual sensor-node airflow rates, and individual sensor-node temperatures.
  - e. Contact Closure Relay: One dry contact relay with onboard jumper to drive a remote LED, rated for no less than 30 V dc or 24 V ac at 3 A maximum. User configurable as normally open or normally closed during set up.
7. For Packaged HVAC Units :
  - 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) Ebtron, Inc.
  - b. Airflow Station Performance:
    - 1) Independent processing of up to two separately wired sensor-node assemblies.
    - 2) Accuracy: Within 10 percent of reading when installed in accordance with manufacturer's recommended placement guidelines. Include the combined uncertainty of the sensor nodes and transmitter. For devices whose overall accuracy is based on individual accuracy specifications of the sensor probes and transmitter, demonstrate compliance with the accuracy requirement over the entire operating range.
  - c. Sensor-Node and Probe Assemblies:

- 1) Sensor-Node Internal Wiring Connections: Sealed and protected from the elements and suitable for direct exposure to water. Devices with exposed leads are unacceptable.
  - 2) Sensor-Node Calibration:
    - a) Individually calibrated at a minimum of seven calibration points to NIST-traceable airflow standards from **0 to 3000 fpm**.
    - b) Individually calibrate thermistor at a minimum of three temperatures to NIST-traceable temperature standards.
  - 3) Provide the number of independent sensor nodes as follows:
    - a) For a Duct Diameter of **4 Inches**: One.
    - b) For Duct Diameters **5 through 16 Inches**: Two.
  - 4) Sensor-Probe Construction: Mill-finish, 6063 aluminum alloy tube, with each sensor probe containing one or more independently wired sensing nodes.
- d. Transmitter:
- 1) Transmitter determines the average airflow rate and temperature of all connected sensor nodes in an array for a single location.
  - 2) User Interface: An alpha-numeric, LCD display, with two field-selectable analog output signals or one isolated RS-485 (BACnet MS/TP or Modbus RTU) field-selectable network connection.
  - 3) Model EF-A Transmitter, Analog Capability: Two field-selectable 0- to 10-V dc, or 2- to 10-V dc, scalable analog output signals. The first output (AO1) provides the total airflow rate. The second output (AO2) is field configurable for temperature or low and/or high airflow set-point (user-defined) or system status alarm.
  - 4) Contact Closure Relay: One dry contact relay with onboard jumper to drive a remote LED, rated for no less than 30 V dc or 24 V ac at 3 A maximum. User configurable as normally open or normally closed during set up.
8. For Combination Control Damper and Airflow Station - Equal Area Method Distribution Pattern:
- 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) Ebtron, Inc.
  - b. Thermal airflow station and integral damper with two or more sensor nodes mounted in a probe, and a remotely mounted microprocessor-based transmitter at each measurement location. Sensor-node distribution pattern to be based on equal area method.
  - c. Airflow Station Performance:
    - 1) Independent processing of up to 16 separately wired sensor-node assemblies.
    - 2) Accuracy: Within 3 percent of reading for ducted applications, and within 5 percent of reading for non-ducted applications, when installed in accordance with manufacturer's recommended placement guidelines. Include the combined uncertainty of the sensor nodes and transmitter. For devices whose overall accuracy is based on individual accuracy specifications of the sensor probes and transmitter, demonstrate compliance with the accuracy requirement over the entire operating range.
  - d. Sensor-Node and Probe Assemblies:
    - 1) Performance rated and tested with a 100 percent survival rate in a 30-day saltwater and acid vapor test with written independent laboratory test results.
    - 2) Sensor-Node Calibration: Individually calibrated at 16 measurement points to airflow standards directly calibrated at NIST to the NIST Laser Doppler Anemometer (LDA) primary velocity standard.

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- a) Accuracy: Within 2 percent of reading over the entire calibrated airflow range of **0 to 5000 fpm**.
- b) Individually calibrate thermistor at a minimum of three temperatures to NIST-traceable temperature standards.
- 3) Provide the number of independent sensor nodes as follows:
  - a) For Damper Area up to **1.0 sq. ft.**: Two.
  - b) For Duct/Plenum Area Greater Than **1.0 through 4.0 sq. ft.**: Four.
  - c) For Duct/Plenum Area Greater Than **4.0 through 8.0 sq. ft.**: Six.
  - d) For Duct/Plenum Area Greater Than **8.0 through 12.0 sq. ft.**: Eight.
  - e) For Duct/Plenum Area Greater Than **12.0 through 16.0 sq. ft.**: 12.
  - f) For Duct/Plenum Area Greater Than **16.0 sq. ft.**: 16.
- 4) Sensor Probe Construction: Gold-anodized, 6063 aluminum alloy tube with each sensor probe containing one or more independently wired sensing nodes.
- e. Transmitter:
  - 1) Transmitter determines the average airflow rate and temperature of connected sensor nodes in an array for a single location.
  - 2) User Interface: 16-character, alpha-numeric, LCD display, with two field-selectable analog output signals and network output capability. Provide one of the following transmitter configurations:
  - 3) Model GTM116 Transmitter: Two field-selectable 0- to 10-V dc, or 4- to 20-mA, scalable, isolated, and overcurrent protected analog output signals and network output capability. The first output (AO1) provides the total airflow rate. The second output (AO2) is field configurable for temperature or low and/or high airflow set-point (user-defined) or system status alarm. The Ethernet (BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) network connection provides the average airflow rate, temperature, high and/or low airflow set-point alarm, system status alarm, individual sensor-node airflow rates, and individual sensor-node temperatures. The transmitter shall be provided with a Bluetooth low-energy interface card capable of transmitting all transmitter setup parameters, diagnostics, average airflow, and temperature of the device and the airflow and temperature of each sensor node. Software capable of capturing and displaying this transmission will be available via download to Android or iOS phone or tablet. Software shall allow for setup parameters, airflow, temperature, and diagnostic data to be saved on the phone or be emailed.
  - 4) Model GTD116 Transmitter with Data-Logger Interface: Capable of logging airflow and temperature rates over specified time intervals.
- f. Integral Control Damper and Sleeve:
  - 1) Frame and Sleeve: Extruded 6063T5 aluminum with an integral damper frame.
    - a) Thickness: Not less than **0.080-inch** thickness for each damper section.
    - b) Sleeve Depth: **15 inches** for ducted applications and **18 inches** for non-ducted applications including damper frame. Non-ducted applications include a **3-inch** radius, aluminum entry flair.
    - c) Installation: Provide an additional **7 inches** for non-ducted, **10 inches** for ducted, applications between the downstream edge of an intake louver and the leading edge of the entry flair for outside air intake applications that are close coupled to intake louvers.
    - d) Leakage: The damper leakage shall not exceed **3 cfm/sq. ft.** of face area against **1-inch wg** differential static pressure.
  - 2) Blades: Extruded 6063T5 aluminum airfoil blades not less than **0.060-inch** thickness.

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- a) Blade Seals: Extruded EPDM.
  - b) Frame Seals: Extruded silicone secured in an integral slot within the aluminum extrusions.
  - c) Orientation: Parallel or opposed blade configuration as required by application.
  - 3) Bearings: Celcon inner bearing fixed to a **7/16-inch** aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
  - 4) Linkage: Aluminum- and corrosion-resistant zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip, installed inside the frame.
  - 5) Control-Damper Actuator: Modulating, electronic, damper actuator of sufficient number and adequate size, factory mounted and tested. Control-damper actuators are specified in Section 23 09 23.12 "Control Dampers."
9. For Combination Control Damper and Airflow Station - Modified Log Distribution Pattern:
- 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) Ebtron, Inc.
  - b. Thermal airflow station and integral damper with one or more sensor nodes mounted in a probe, and a remotely mounted microprocessor-based transmitter at each measurement location. Sensor node distribution pattern to be based on modified log Tchebycheff method.
  - c. Airflow Station Performance:
    - 1) Independent processing of up to 16 separately wired sensor-node assemblies.
    - 2) Accuracy: Within 3 percent of reading for ducted applications, and within 5 percent of reading for non-ducted applications, when installed in accordance with manufacturer's recommended placement guidelines. Include the combined uncertainty of the sensor nodes and transmitter. For devices whose overall accuracy is based on individual accuracy specifications of the sensor probes and transmitter, demonstrate compliance with the accuracy requirement over the entire operating range.
  - d. Sensor-Node and Probe Assemblies:
    - 1) Performance rated and tested with a 100 percent survival rate in a 30-day saltwater and acid vapor test with written independent laboratory test results.
    - 2) Sensor-Node Calibration: Individually calibrated at 16 measurement points to airflow standards directly calibrated at NIST to the NIST Laser Doppler Anemometer (LDA) primary velocity standard.
      - a) Accuracy: Within 2 percent of reading over the entire calibrated airflow range of **0 to 5000 fpm**.
      - b) Individually calibrate thermistor at a minimum of three temperatures to NIST-traceable temperature standards.
    - 3) Provide the number of independent sensor nodes as follows:
      - a) For Damper Area up to **1.0 sq. ft.**: Two.
      - b) For Duct/Plenum Area Greater Than **1.0 through 2.0 sq. ft.**: Four.
      - c) For Duct/Plenum Area Greater Than **2.0 through 4.0 sq. ft.**: Six.
      - d) For Duct/Plenum Area Greater Than **4.0 through 8.0 sq. ft.**: Eight.
      - e) For Duct/Plenum Area Greater Than **8.0 through 12.0 sq. ft.**: 12.
      - f) For Duct/Plenum Area Greater Than **12.0 through 14.0 sq. ft.**: 14.
      - g) For Duct/Plenum Area Greater Than **14.0 sq. ft.**: 16.
    - 4) Sensor Probe Construction: Gold-anodized, 6063 aluminum alloy tube with each sensor probe containing one or more independently wired sensing nodes.

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- e. Transmitter:
- 1) Transmitter determines the average airflow rate and temperature of connected sensor nodes in an array for a single location.
  - 2) User Interface: 16-character, alpha-numeric, LCD display, with two field-selectable analog output signals and network output capability. Provide one of the following transmitter configurations:
    - a) Model GTM116 Transmitter: Two field-selectable 0- to 10-V dc, or 4- to 20-mA, scalable, isolated, and overcurrent protected analog output signals and network output capability. The first output (AO1) provides the total airflow rate. The second output (AO2) is field configurable for temperature or low and/or high airflow set-point (user-defined) or system status alarm. The Ethernet (BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) network connection provides the average airflow rate, temperature, high and/or low airflow set-point alarm, system status alarm, individual sensor-node airflow rates, and individual sensor-node temperatures. The transmitter shall be provided with a Bluetooth low-energy interface card capable of transmitting all transmitter setup parameters, diagnostics, average airflow, and temperature of the device and the airflow and temperature of each sensor node. Software capable of capturing and displaying this transmission will be available via download to Android or iOS phone or tablet. Software shall allow for setup parameters, airflow, temperature, and diagnostic data to be saved on the phone or be emailed.
    - b) Model GTD116 Transmitter with Data-Logger Interface: Capable of logging airflow and temperature rates over specified time intervals.
- f. Integral Control Damper and Sleeve:
- 1) Frame and Sleeve: Extruded 6063T5 aluminum with an integral damper frame.
    - a) Thickness: Not less than **0.080-inch** thickness for each damper section.
    - b) Sleeve Depth: **13 inches** for all applications including damper frame. Sleeve includes a **1-inch**-radius, aluminum entry flair.
    - c) Installation: Provide an additional **7 inches** between the downstream edge of an intake louver and the leading edge of the entry flair for outside air intake applications that are close coupled to intake louvers.
    - d) Leakage: The damper leakage shall not exceed **3 cfm/sq. ft.** of face area against **1-inch wg** differential static pressure.
  - 2) Blades: Extruded 6063T5 aluminum airfoil blades not less than **0.060-inch** thickness.
    - a) Blade Seals: Extruded EPDM.
    - b) Frame Seals: Extruded silicone secured in an integral slot within the aluminum extrusions.
    - c) Orientation: Parallel or opposed blade configuration as required by application.
  - 3) Bearings: Celcon inner bearing fixed to a **7/16-inch** aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
  - 4) Linkage: Aluminum- and corrosion-resistant zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip, installed inside the frame.
  - 5) Control-Damper Actuator: Modulating, electronic, damper actuator of sufficient number and adequate size, factory mounted and tested. Control-damper actuators are specified in Section 23 09 23.12 "Control Dampers."

C. Pitot-Tube Airflow Sensor Station:

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. Air Monitor Corporation.
  - b. Ruskin Company.
2. Description: Multiple total- and static-pressure sensors positioned at the center of equal area of the station cross section and interconnected by respective averaging manifolds.
  - a. Stations **4 sq. ft.** and Smaller: One total-pressure sensor and one static-pressure sensor for every **16 sq. in.** of station area.
  - b. Stations Larger than **4 sq. ft.:** One total-pressure sensor and one static-pressure sensor for every **36 sq. in.** of station area.
3. Casing: Galvanized sheet steel at least **0.079 inch** thick with coating complying with ASTM A653/A653M, **G90**. Casings shall be stainless steel, **0.0781 inch** thick, when connected to stainless duct and aluminum, **0.063 inch** thick, when connected to aluminum duct.
  - a. Joints and Seams: Continuously weld. Clean galvanized areas damaged by welding and coat with aluminum paint.
  - b. Casing Depth: At least **8 inches**.
  - c. Casing Flanges: Outward flange, minimum flange face **1.5 inches**.
  - d. Casing Configuration and Size: Match shape (rectangular, round, flat oval) and same size as adjacent duct unless otherwise indicated.
4. Include an open parallel cell air straightener or air equalizer honeycomb mechanically fastened to casing.
  - a. Construct straightener or equalizer from Type 3003 aluminum or Type 316 stainless steel, depending on casing material. Use stainless steel for units with stainless steel casings.
5. Construct pressure sensor array from drawn copper or stainless steel tubing. Use stainless steel for units with stainless steel casings. Copper tubing shall comply with ASTM B75 and ASTM B280. Minimum tube wall thickness shall be **0.030 inch**. Include internal piping and external pressure transmitter ports.
6. Station Labeling: Identification label on each station casing indicating model number, size, area, and application-specific airflow range.
7. Performance:
  - a. Pressure Loss: **0.015-inch wg** at **1000 fpm**, or **0.085-inch wg** at **2000 fpm**.
  - b. Accuracy: Within 2 percent of actual airflow.
  - c. Self-Generated Sound: NC 40 and sound level within the duct shall not be amplified.
  - d. Performance rated and tested according to AMCA 610. Each station shall bear the AMCA seal.

2.4 AIRFLOW SWITCHES

A. Polymer Film Sail Switch:

1. Performance:
  - a. Suitable for applications operating at velocities up to **400 fpm**.
  - b. Suitable for mounting with air direction in horizontal, vertical up or down.
  - c. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - d. Voltage: 24-, 120-, 240-V ac.
  - e. Normally Open Full Load Current: 2 A at 120-V ac.

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- f. Normally Closed Full Load Current: 1 A at 120-V ac.
  - g. Normally open switch actuates at 250 fpm and opens at 75 fpm.
  - h. Normally closed switch actuates at 75 fpm and closes at 250 fpm.
  - i. Maximum Process Temperature: 170 deg F.
  - j. Maximum Ambient Temperature: 125 deg F.
2. Construction:
- a. Polyester film sail encasing a wire frame.
  - b. Sail actuates a SPDT snap switch.
  - c. Enclosure Material: Zinc-plated steel.
  - d. Enclosure with removable cover.
  - e. NEMA 250, Type 1 enclosure.
  - f. Removable spring counterbalances sail to allow mounting in either vertical (up or down) or horizontal airflow.
  - g. Electrical Connections: Screw terminals.
  - h. Conduit Connections: 1/2-inch trade size conduit knock outs on top and bottom.

B. Stainless Steel Single Vane Switch:

1. Description:
  - a. Velocities up to 2000 fpm.
  - b. Suitable for mounting with air direction in horizontal.
2. Performance:
  - a. Voltage: 125-, 240-, and 480-V ac.
  - b. Full Load Current: 9.8 A at 125-V ac.
  - c. Field-Adjustable Velocity Set Point: 400 to 1600 fpm.
  - d. Maximum Process Temperature: 180 deg F.
  - e. Maximum Ambient Temperature: 125 deg F.
3. Construction:
  - a. Stainless steel vane.
  - b. Vane actuates a SPDT snap switch.
  - c. Enclosure Material: Die-cast metal.
  - d. Enclosure with removable cover.
  - e. NEMA 250, Type 1 enclosure.
  - f. Screw set-point adjustment.
  - g. Electrical Connections: Screw terminals.
  - h. Conduit Connections: 1-inch trade size conduit knock outs on top and bottom.

## 2.5 AIRFLOW TRANSMITTERS

A. Airflow Transmitter with 0.10 Percent Accuracy and Auto-Zero Feature:

1. Transmitter shall receive total- and static-pressure signals from a primary element, amplify signals, extract the square root, and scale the signals to produce 4- to 20-mA dc output signals linear to airflow.
2. NEMA 250, Type 1 enclosure.
3. Construct assembly so that shock, vibration, and pressures surges of up to 1 psig will neither harm transmitter, nor affect its accuracy.
4. Transmitter with automatic zeroing circuit capable of automatically readjusting transmitter zero at predetermined time intervals. The automatic zeroing circuit shall re-zero transmitter to within 0.1 percent of true zero.
5. Performance:
  - a. Range: As required by application and at least 10 percent below minimum airflow and 10 percent greater than design airflow.

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- b. Calibrated Span: Field adjustable, minus 40 percent of the range.
- c. Accuracy: Within 0.10 percent of natural span.
- d. Repeatability: Within 0.15 percent of calibrated span.
- e. Linearity: Within 0.2 percent of calibrated span.
- f. Hysteresis and Deadband (Combined): Less than 0.2 percent of calibrated span.
6. Integral digital LED or digital display for continuous indication of airflow.

B. Pressure Differential Transmitters for Airflow Measurement:

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. Setra System.
2. Performance:
  - a. Range: As required by application and at least 10 percent below minimum airflow and 10 percent greater than design airflow.
  - b. Accuracy: Within 0.25 percent of the full-scale range.
  - c. Hysteresis: Within 0.10 percent of full scale.
  - d. Repeatability: Within 0.05 percent of full scale.
  - e. Stability: Within one percent of span per year.
  - f. Overpressure: **10 psig**.
  - g. Temperature Limits: **Zero to 150 deg F**.
  - h. Compensate Temperature Limits: **40 to 150 deg F**.
  - i. Thermal Effects: 0.033 percent of full scale per degree F.
  - j. Shock and vibration shall not harm the transmitter.
3. Display: Four-digit digital with minimum **0.4-inch**- high numeric characters.
4. Operator Interface:
  - a. Zero and span adjustments located behind cover.
5. Construction:
  - a. Plastic casing with removable plastic cover.
  - b. Fittings: Swivel fittings for connection to copper tubing or barbed fittings for connection to polyethylene tubing. Fittings on bottom of instrument case.
  - c. Screw terminal block for wire connections.
  - d. Vertical plane mounting.
  - e. NEMA 250, Type 4.
  - f. Mounting Bracket: Appropriate for installation.

C. Pressure Differential Indicating Transmitter, Switch, and Controller for Airflow Measurement:

1. Description:
  - a. Three-in-one instrument, including digital display, control relay switches, and a transmitter with a current output.
  - b. Field configurable for pressure, velocity, and volumetric flow applications through user interface.
  - c. Select instrument range based on application.
2. Performance:
  - a. Accuracy including hysteresis and repeatability:
    - 1) Ranges Less than **5-Inch wg**: Within 1 percent.
    - 2) Other Ranges: Within 0.5 percent at **77 deg F**.
  - b. Stability: Within 1 percent per year.
  - c. Response Time: 250 ms.
  - d. Overpressure:
    - 1) Ranges Less than **50-Inch wg**: **5 psi**.
    - 2) Range of **100-Inch wg**: **9 psi**.

- e. Temperature Limits: 32 to 140 deg F.
- f. Thermal Effects: 0.020 percent per deg F.
- g. Warm-up Period: One hour.
3. Controller: Programming through menu keys to access five menus.
  - a. Security level.
  - b. Pressure, velocity, or flow application.
  - c. Engineering units.
  - d. K-factor for use with flow application.
  - e. Set-point control only; set-point and alarm operation; alarm operation as high, low, or high/low with manual; or automatic reset and delay.
  - f. View high and low readings.
  - g. Digital dampening for smoothing erratic applications.
  - h. Scaling of analog output to fit range and field calibration.
4. Display:
  - a. Four-digit digital, with minimum 0.4-inch- high alphanumeric characters.
  - b. Four LED indicators; two LEDs for set point and two LEDs for alarm status.
5. Operator Interface:
  - a. Set-point adjustment through keypad on face of instrument.
  - b. Zero and span adjustments accessible through menu.
  - c. Programming through keypad.
6. Output Analog Signal: Two-wire, 4- to 20-mA dc current source; capable of operating into a 900-ohm load.
7. Output Digital Signal: Two, SPDT relays; each rated for 1 A at 30-V ac or 30-V dc.
8. Construction:
  - a. Die-cast aluminum casing and bezel.
  - b. Connections on side and back.
  - c. Vertical plane mounting.
  - d. NEMA 250, Type 1 rating.
  - e. Nominal 4-inch- diameter face.
  - f. Mounting Bracket: Appropriate for installation.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
- C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- D. Provide the services of an independent inspection agency to confirm that proposed mounting locations comply with requirements indicated and approved submittals.
  1. Indicate dimensioned locations with mounting height for all surface-mounted products to walls and ceilings on shop drawings.
  2. Do not begin installation without submittal approval of mounting location.

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- E. Complete installation rough-in only after confirmation by independent inspection is complete and approval of location is documented for review by Owner and Architect on request.
- F. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- G. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTRUMENT APPLICATIONS

- A. Select from instrument types to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.
- B. Thermal Airflow Measurement Stations:
  - 1. For Air-Ducted/Plenum:
    - a. Measured Velocities Greater Than 200 fpm: Thermal airflow measurement station.
    - b. Provide a remotely mounted microprocessor-based transmitter at each measurement location.
  - 2. For Air-Ducted/Plenum - Duct Size 2 sq. ft. or Less:
    - a. Measured Velocities Less Than 200 fpm: Thermal airflow measurement station.
    - b. Provide a remotely mounted microprocessor-based transmitter at each measurement location.
  - 3. For Packaged HVAC Units, :
    - a. Measured Velocities Greater Than 200 fpm: Thermal airflow measurement station.
    - b. Provide a remotely mounted microprocessor-based transmitter at each measurement location.
  - 4. For Damper-Mounted Airflow Stations:
    - a. Measured Velocities Greater Than 200 fpm: Thermal airflow measurement station.
    - b. Provide a remotely mounted microprocessor-based transmitter at each measurement location.
- C. Duct-Mounted Airflow Sensors:
  - 1. Measured Velocities 500 fpm and Less: Thermal airflow station.
  - 2. Measured Velocities Greater than 500 fpm : Pitot-tube airflow sensor station Thermal airflow station.
- D. Damper-Mounted Airflow Sensors:
  - 1. Measured Velocities 400 fpm and Less: Thermal airflow station.
  - 2. Measured Velocities Greater than 500 fpm : Pitot-tube airflow sensor station Thermal airflow station Damper with integral flow measurement Damper with integral flow control.
- E. Fan-Mounted Airflow Sensors:
  - 1. Measured Velocities 500 fpm and Less: Thermal airflow station.
  - 2. Measured Velocities Greater than 500 fpm : Pitot-tube fan inlet airflow sensor station Piezometer ring fan inlet airflow sensor Thermal airflow station.
- F. Airflow Switches:
  - 1. Measured Velocities 400 fpm and Less: Polymer film sail switch.
  - 2. Measured Velocities Greater than 400 fpm: Stainless steel single-vane switch.

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G. Airflow Transmitters for Use with Pitot-Tube-Type Sensors:

1. Outdoor Air Airflow: Airflow transmitter with 0.10 percent accuracy and auto-zero feature .
2. Return Air Airflow: Airflow transmitter with 0.10 percent accuracy and auto-zero feature .
3. Supply Air Airflow: Airflow transmitter with 0.10 percent accuracy and auto-zero feature .

3.3 INSTALLATION, GENERAL

- A. Furnish and install products required to satisfy more stringent of all requirements indicated.
- B. Install products level, plumb, parallel, and perpendicular with building construction.
- C. Properly support instruments, tubing, piping wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment .
- D. Install ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- E. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.4 ELECTRIC POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceway and Boxes for Electrical Systems."

3.5 INSTRUMENTS, GENERAL INSTALLATION REQUIREMENTS

- A. Mounting Location:
  1. Rough-in: Outline instrument-mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.
  2. Install switches and transmitters for air flow associated with individual air-handling units and connected ductwork and piping near air-handlings units co-located in air-handling unit system control panel, to provide service personnel a single and convenient location for inspection and service.
  3. Install airflow switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
  4. Mount switches and transmitters not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support

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- frames. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.
5. Install instruments in dry gas and non-condensable-vapor piped services above their process connection point. Slope process connection lines up to instrument with a minimum slope of 2 percent.
- B. Mounting Height:
1. Mount instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
  2. Mount switches and transmitters, located in mechanical equipment rooms and other similar space not subject to code, state, and federal accessibility requirements, within a range of **42 to 72 inches** above the adjacent floor, grade, or service catwalk or platform.
    - a. Make every effort to mount at **60 inches**.
- C. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

### 3.6 INSTALLATION OF FLOW INSTRUMENTS

- A. Airflow Sensors:
1. Install sensors in straight sections of duct with manufacturer-recommended straight duct upstream and downstream of sensor.
  2. Installed sensors shall be accessible for visual inspection and service. Install access door(s) in duct or equipment located upstream of sensor, to allow service personnel to hand clean sensors.
- B. Transmitters:
1. Install airflow transmitters serving an air system in a single location adjacent to or within system control panel.

### 3.7 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Install engraved phenolic nameplate with instrument identification and on face of ceiling directly below instruments concealed above ceilings.

### 3.8 CLEANING

- A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.
- B. Wash and shine glazing.

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- C. Polish glossy surfaces to a clean shine.

### 3.9 CHECKOUT PROCEDURES

#### A. Description:

1. Check out installed products before continuity tests, leak tests, and calibration.
2. Check instruments for proper location and accessibility.
3. Check instruments for proper installation with respect to direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
4. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.

#### B. Flow Instrument Checkout:

1. Verify that sensors are installed correctly with respect to flow direction.
2. Verify that sensor attachment is properly secured and sealed.
3. Verify that processing tubing attachment is secure and isolation valves have been provided.
4. Inspect instrument tag against approved submittal.
5. Verify that recommended upstream and downstream distances have been maintained.

### 3.10 ADJUSTMENT, CALIBRATION, AND TESTING

#### A. Description:

1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
4. Equipment and procedures used for calibration shall meet instrument manufacturer's recommendations.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If after-calibration-indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

#### B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.

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2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

3.11 MAINTENANCE SERVICE

3.12 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.
- B. Coordinate video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.
- C. Record videos on DVD disks.
- D. Owner shall have right to make additional copies of video for internal use without paying royalties.

END OF SECTION 23 09 23.14

## SECTION 23 09 23.16 - GAS INSTRUMENTS

### 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 Gas Instruments:
  - 1. Carbon-dioxide sensors and transmitters.
- B. Related Requirements:
  - 1. Section 23 09 23 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

#### 1.3 DEFINITIONS

- A. NDIR: Nondispersive infrared.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including the following:
  - 1. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
  - 2. Installation instructions, including factor affecting performance.
  - 3. Product description with complete technical data, performance curves, product specification sheets.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include diagrams for power, signal, and control wiring.
  - 3. Number-coded identification system for unique identification of wiring, cable, and tubing ends.

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## 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gas instruments to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 CARBON-DIOXIDE SENSORS AND TRANSMITTERS

- A. Description:
  - 1. NDIR technology or equivalent technology providing long-term stability and reliability.
  - 2. Two-wire, 4-20 mA output signal, linearized to carbon-dioxide concentration in ppm.
- B. Construction:
  - 1. House electronics in an ABS plastic enclosure. Provide equivalent of NEMA 250, Type 1 enclosure for wall-mounted space applications and NEMA 250, Type 4 for duct-mounted applications.
  - 2. Equip with digital display for continuous indication of carbon-dioxide concentration.
- C. Performance:
  - 1. Measurement Range: Zero to 2000 ppm.
  - 2. Accuracy: Within 2 percent of reading, plus or minus 30 ppm.
  - 3. Repeatability: Within 1 percent of full scale.
  - 4. Temperature Dependence: Within 0.05 percent of full scale over an operating range of 25 to 110 deg F.
  - 5. Long-Term Stability: Within 5 percent of full scale after more than five years.
  - 6. Response Time: Within 60 seconds.
  - 7. Warm-up Time: Within five minutes.
- D. Provide calibration kit. Turn over to Owner at start of warranty period.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
- C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

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### 3.2 INSTALLATION, GENERAL

- A. Furnish and install products required to satisfy more stringent of all requirements indicated.
- B. Install products level, plumb, parallel, and perpendicular with building construction.
- C. Properly support instruments, tubing, piping, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to seismic loads.
- D. Fastening Hardware:
  - 1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
  - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by using excessive force or oversized wrenches.
  - 3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- E. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.
- F. Corrosive Environments:
  - 1. Use products that are suitable for environment to which they are subjected.
  - 2. If possible, avoid or limit use of materials in corrosive environments, including but not limited to, the following:
    - a. Laboratory exhaust airstreams.
    - b. Process exhaust airstreams.
  - 3. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
  - 4. Where instruments are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

### 3.3 ELECTRICAL POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

### 3.4 INSTRUMENTS, GENERAL INSTALLATION REQUIREMENTS

- A. Mounting Location:

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1. Install transmitters for gas associated with individual air-handling units and associated connected ductwork and piping near air-handlings units co-located in air-handling unit system control panel, to provide service personnel a single and convenient location for inspection and service.
2. Install gas switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
3. Mount switches and transmitters not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer's mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.
4. Install instruments in dry gas and non-condensable vapor piped services above their process connection point. Slope process connection lines up to instrument with a minimum slope of 2 percent.

B. Mounting Height:

1. Mount instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
2. Mount switches and transmitters located in mechanical equipment rooms and other similar space not subject to code, state, and federal accessibility requirements within a range of 42 to 72 inches above the adjacent floor, grade, or service catwalk or platform.
  - a. Make every effort to mount at 60 inches.

- C. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated, using neoprene gaskets or grommets.

### 3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Install engraved phenolic nameplate with instrument identification on face.

### 3.6 CHECKOUT PROCEDURES

- A. Check out installed products before continuity tests, leak tests, and calibration.
- B. Check instruments for proper location and accessibility.
- C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that impact performance.
- D. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.

### 3.7 ADJUSTMENT, CALIBRATION, AND TESTING

- A. Description:

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1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
  2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
  3. For each analog instrument, perform a three-point calibration test for both linearity and accuracy.
  4. Equipment and procedures used for calibration shall comply with instrument manufacturer's written recommendations.
  5. Provide diagnostic and test equipment for calibration and adjustment.
  6. Field instruments and equipment used to test and calibrate installed instruments shall have an accuracy of at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
  7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
  8. If, after calibration, indicated performance cannot be achieved, replace out-of-tolerance instruments.
  9. Comply with field-testing requirements and procedures in ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.
- B. Analog Signals:
1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
  2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
  3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.
- C. Digital Signals:
1. Check digital signals using a jumper wire.
  2. Check digital signals using an ohmmeter to test for contact.
- D. Meters: Check sensors at zero, 50, and 100 percent of Project design values.
- E. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.
- F. Switches: Calibrate switches to make or break contact at set points indicated.
- G. Transmitters:
1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
  2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

## GAS INSTRUMENTS

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3.8 MAINTENANCE SERVICE

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.
- B. Coordinate gas instrument demonstration video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.
- C. Record videos on DVD disks.
- D. Owner shall have right to make additional copies of video for internal use without paying royalties.

END OF SECTION 23 09 23.16

**GAS INSTRUMENTS**

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## SECTION 23 09 23.19 - MOISTURE INSTRUMENTS

### 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 moisture switches, sensors, and transmitters.
- B. Related Requirements:
  - 1. Section 23 09 23 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, including the following:
  - 1. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
  - 2. Product description with complete technical data, performance curves, and product specification sheets.
- B. Shop Drawings:
  - 1. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Include diagrams for power, signal, and control wiring.
  - 3. Include number-coded identification system for unique identification of wiring, cable, and tubing ends.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: To include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 MOISTURE SWITCHES

#### A. Humidistat for Duct Applications:

1. Description:
  - a. Two-position control.
  - b. Field-adjustable set point.
  - c. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Performance:
  - a. Relative Humidity Range: 15 to 95 percent.
  - b. Relative Humidity Differential: 5 percent.
  - c. Ambient Temperature: 40 to 135 deg F.
  - d. Voltage: 120-V ac.
  - e. Current: 7.2 FLA.
  - f. Switch Type: SPDT snap switch.
3. Construction:
  - a. Enclosure: Metal, NEMA 250, Type 1.
  - b. Electrical Connections: Screw terminals.

#### B. Humidistat for Space Applications:

1. Description:
  - a. Two-position control.
  - b. Field-adjustable set point.
  - c. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Performance:
  - a. Relative Humidity Range: 10 to 90 percent.
  - b. Relative Humidity Differential: 5 percent.
  - c. Ambient Temperature: 40 to 135 deg F.
  - d. Voltage: 24-V ac.
  - e. Pilot Duty: 60 VA.
  - f. Switch Type: SPDT snap switch.
3. Construction:
  - a. Enclosure: Plastic, NEMA 250, Type 1.
  - b. Electrical Connections: Cable, 6 inches long.

### 2.2 MOISTURE SENSORS AND TRANSMITTERS

#### A. Combination Humidity and Temperature Sensor and Transmitter with Display:

1. Description:
  - a. Factory package consisting of humidity and temperature sensor, digital display, keypad user interface, installation hardware, interconnecting sensor cabling, installation instructions, and operating manual.

- b. Each transmitter shall be individually calibrated and provided with NIST traceable calibration certifications.
    - c. Provide a service cable for connecting to a notebook computer and Microsoft Windows compatible software.
  2. Display:
    - a. Alphanumeric display of the following on the face of the enclosure:
      - 1) Percent relative humidity.
      - 2) Absolute humidity.
      - 3) Mixing ratio.
      - 4) Dry-bulb temperature.
      - 5) Wet-bulb temperature.
      - 6) Dew point temperature.
      - 7) Enthalpy.
    - b. Visual display of measurement trends, and minimum and maximum values over a one-year period.
  3. Electronics Enclosure:
    - a. Integral to sensors for wall- (room-)mounted applications and remote from temperature and humidity sensors for duct and equipment applications.
    - b. NEMA 250, Type 4 or 4X.
    - c. Labeled terminal strip for field wiring connections.
    - d. **?-inch** trade size threaded conduit connection.
  4. Programming:
    - a. Transmitter parameters shall be field programmable through keypad on the face of the enclosure.
    - b. Programmed parameters shall be stored in nonvolatile EEPROM.
  5. Output Signals:
    - a. Three Analog Outputs: 4 to 20 mA or zero to 10-V dc for each output. Option to use a serial communication interface.
  6. Temperature Sensor:
    - a. Temperature range matched to application, but not less than **minus 40 to 140 deg F**.
    - b. Within **0.5 deg F** accuracy over the temperature range of **50 to 100 deg F** and within **1 deg F** over the remainder of the range.
    - c. Provide duct installation kit for duct applications.
  7. Humidity Sensor:
    - a. Relative Humidity Measurement Range: Zero to 100 percent.
    - b. Response time in still air within 40 seconds.
    - c. Accuracy including non-linearity, hysteresis, and repeatability:
      - 1) For Temperature Between **59 and 77 Deg F** and Relative Humidity between Zero and 90 Percent: Within 1 percent.
      - 2) For Temperature between **59 and 77 Deg F** and Relative Humidity between 90 and 100 Percent: Within 1.7 percent.
      - 3) For Temperature between **Minus 4 and 104 Deg F**: Within 1 percent plus 0.008 times relative humidity reading.
      - 4) For Temperature between **Minus 40 and 356 Deg F**: Within 1.5 percent plus 0.015 times the relative humidity reading.
    - d. Sintered, stainless-steel filter, protecting sensor.
    - e. Provide duct installation kit for duct applications.
  8. Power Supply:



- a. Field Power: 120-V ac, 60 Hz unless otherwise required by the application.
- b. Internal Power: As required by transmitter.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 MOISTURE INSTRUMENT APPLICATIONS

- A. Relative Humidity Control : Combination humidity and temperature sensor and transmitter with display.

### 3.3 INSTALLATION, GENERAL

- A. Install products level, plumb, parallel, and perpendicular with building construction.
- B. Properly support instruments, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a 10-lb force .
- C. Fastening Hardware:
  1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
  2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
  3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- D. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

E. Corrosive Environments:

1. Use products that are suitable for environment to which they are subjected.
2. If possible, avoid or limit use of materials in corrosive environments.
3. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
4. Where instruments are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.4 ELECTRIC POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

3.5 MOISTURE INSTRUMENTS INSTALLATION

- A. Mounting Location: Rough-in instrument-mounting locations before setting instruments and routing, cable, wiring, tubing, and conduit to final location.
- B. Mounting Height:
  1. Mount instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
  2. Mount switches and transmitters located in mechanical equipment rooms and other similar space not subject to code, state, and Federal accessibility requirements within a range of **42 to 72 inches** above the adjacent floor, grade, or service catwalk or platform.
    - a. Make every effort to mount at **60 inches**.

3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

- B. Install engraved phenolic nameplate with instrument identification on face of ceiling directly below instruments concealed above ceilings.

### 3.7 CHECKOUT PROCEDURES

- A. Check installed products before continuity tests and calibration.
- B. Check instruments for proper location and accessibility.
- C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that impact performance.

### 3.8 ADJUSTMENT, CALIBRATION, AND TESTING

#### A. Description:

1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
4. Equipment and procedures used for calibration shall meet instrument manufacturer's written instructions.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

#### B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistance source.

#### C. Digital Signals:

### MOISTURE INSTRUMENTS 23 09 23.19 - 6

1. Check digital signals using a jumper wire.
  2. Check digital signals using an ohmmeter to test for contact.
- D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.
- E. Switches: Calibrate switches to make or break contact at set points indicated.
- F. Transmitters:
1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
  2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

### 3.9 MAINTENANCE SERVICE

#### 3.10 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.
- B. Coordinate video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.
- C. Record videos on DVD disks.
- D. Owner shall have right to make additional copies of video for internal use without paying royalties.

END OF SECTION 23 09 23.19

## SECTION 23 09 23.21 - MOTION INSTRUMENTS

### 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. Dual-technology motion sensors.

- B. Related Requirements:

- 1. Section 23 09 23 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include operating characteristics; electrical characteristics; and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
- 2. Include product description with complete technical data, performance curves, and product specification sheets.

- B. Shop Drawings:

- 1. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- 2. Include diagrams for power, signal, and control wiring.
- 3. Include number-coded identification system for unique identification of wiring, cable, and tubing ends.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plan drawings and corresponding product installation 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. Product installation location shown in relationship to visual range and obstructions.
  2. Wall- and ceiling-mounted instruments located in finished space showing relationship to other installed devices.
- B. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For motion instruments to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 INDOOR MOTION SENSORS

- 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. Hubbell Control Solutions; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  2. Leviton Manufacturing Co., Inc.
  3. Lutron Electronics Co., Inc.
  4. Square D; Schneider Electric USA.
- B. Description: Wall- or ceiling-mounted, solid-state units with a separate relay unit.
1. Operation: Unless otherwise indicated, turn on when covered area is occupied and off when unoccupied; with a time delay for turning off, adjustable over a minimum range of 1 to 15 minutes.
  2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  3. Relay Unit: Dry contacts rated for 20-A load at 120- and 277-V ac. Power supply to sensor shall be 24-V dc, 150 mA, Class 2 power source as defined by NFPA 70.
  4. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a **1/2-inch** knock out in a standard electrical enclosure.

### MOTION INSTRUMENTS

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- c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  5. Indicator: Digital display, to show when motion is being detected during testing and normal operation of the sensor.
  6. Bypass Switch: Override the on function in case of sensor failure.
- C. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in coverage area. A particular technology or combination of technologies that controls on-off functions shall be field selectable by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
  2. Detector Sensitivity: Detect occurrences of **6-inch-** minimum movement of any portion of a human body that presents a target of not less than **36 sq. in.**, and detect a person of average size and weight moving not less than **12 inches** in either a horizontal or a vertical manner at an approximate speed of **12 inches/s.**
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of **1000 sq. ft.** when mounted on a **96-inch-** high ceiling. Apply occupancy detectors where indicated.

## 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. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Coordinate layout and installation of wall-mounted devices with other wall-mounted devices. Align centerline with adjacent devices. Align centerline with devices above.
- C. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

### 3.3 ELECTRICAL POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Motion instruments will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
  - 1. Verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

### 3.7 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for direct-digital control systems specified in Section 23 09 23 "Direct-Digital Control System for HVAC."



- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 23 09 23.21

**MOTION INSTRUMENTS**  
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## SECTION 23 09 23.22 - POSITION INSTRUMENTS

### 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 position limit switches for use in direct-digital control systems for HVAC.
- B. Related Requirements:
  - 1. Section 23 09 23 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include operating characteristics, electrical characteristics, and furnished accessories indicating default control signal with loss of power and electrical power requirements.
  - 2. Include product description with complete technical data and product specification sheets.
- B. Shop Drawings:
  - 1. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Include diagrams for power, signal, and control wiring.
  - 3. Include number-coded identification system for unique identification of wiring.

### PART 2 - PRODUCTS

#### 2.1 POSITION LIMIT SWITCHES

- 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. OMRON Corporation.
- B. Description: Select type of actuating head (plunger, roller lever, or rod) to suit application.

## POSITION INSTRUMENTS 23 09 23.22 - 1

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Performance:

1. Life expectancy: Not less than 30 million mechanical operations and 750,000 electrical operations.
2. Operating Frequency: 300 mechanical operations per minute and 30 electrical operations per minute.
3. Voltage: 125-, 250-, 480-, and 600-V ac or 8-, 12-, 14-, 24-, 30-, 48-, 125-, and 250-V dc, as required by application.
4. Current Rating: As required by application.
5. Temperature Rise: 50 deg C.
6. Ambient Temperature: 14 to 175 deg F.
7. Ambient Relative Humidity: 35 to 95 percent.

D. Construction:

1. NEMA 250, Type 4X enclosure.
2. Switch Type: SPDT or DPDT, as required by application.
3. Electrical Connection: Screw or plug-in terminals.
4. Conduit Connection: NPS 1/2.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Install products level, plumb, parallel, and perpendicular with building construction.
- B. Properly support instruments, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement, sway, or a break in attachment when subjected to a 10-lb force.
- C. Fastening Hardware:
  1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
  2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by using excessive force or oversized wrenches.

## POSITION INSTRUMENTS

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3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- D. Install products in locations that are accessible and that permit maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.
- E. Corrosive Environments:
  1. Use products that are suitable for environment to which they are subjected.
  2. If possible, avoid or limit use of materials in corrosive environments, including, but not limited to:
    - a. Laboratory exhaust airstreams.
    - b. Process exhaust airstreams.
  3. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
  4. Where instruments are located in a corrosive environment and are not corrosive resistant from the manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

### 3.3 ELECTRICAL POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

### 3.4 POSITION INSTRUMENTS INSTALLATION

- A. Mounting Location:
  1. Rough-in instrument-mounting locations before setting instruments and routing, cable, wiring, and conduit to final location.
  2. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.
- B. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated, using neoprene gaskets or grommets.

### 3.5 ADJUSTMENT, CALIBRATION, AND TESTING

- A. Digital Signals:
  1. Check digital signals using a jumper wire.
  2. Check digital signals using an ohmmeter to test for contact.

## POSITION INSTRUMENTS

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- B. Switches: Calibrate switches to make or break contact at set points indicated.

END OF SECTION 23 09 23.22

POSITION INSTRUMENTS  
23 09 23.22 - 4

## SECTION 23 09 23.23 - PRESSURE INSTRUMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Air-pressure sensors.
2. Air-pressure transmitters.

B. Related Requirements:

1. Section 23 09 23 "Direct Digital Control (DDC) System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

#### 1.2 DEFINITIONS

- A. HART: Highway addressable remote transducer protocol is the global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bi-directional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from technician's hand-held device or laptop to a control, asset management, safety, or other system using any control platform.

#### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics; electrical characteristics; and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation instructions, including factors affecting performance.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Number-coded identification system for unique identification of wiring, cable, and tubing ends.

## PRESSURE INSTRUMENTS

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#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plan drawings and corresponding product installation 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. Product installation location shown in relationship to room, duct, pipe, and equipment.
  - 2. Wall-mounted instruments located in finished space, showing relationship to light switches, fire alarm devices, and other installed devices.
  - 3. Size and location of wall access panels for instruments installed behind walls.
  - 4. Size and location of ceiling access panels for instruments installed in accessible ceilings.
- B. Product Certificates: For each product requiring a certificate.
- C. Product Test Reports: For each product requiring test performed by a qualified testing agency.
- D. Source quality-control reports.
- E. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For instruments to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 AIR-PRESSURE SENSORS

- A. Duct Insertion Static Pressure Sensor:
  - 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. Dwyer Instruments, Inc.
  - 2. Insertion length to be at middle of duct .
  - 3. Sensor with four radial holes of **0.04-inch** diameter.
  - 4. Brass or stainless steel construction.
  - 5. Sensor with threaded end support, sealing washers and nuts.
  - 6. Connection: **NPS 1/4** compression fitting.
  - 7. Suitable for flat oval, rectangular, and round duct configurations.
- B. Duct Insertion Static Pressure Sensor - Dual Orifice Design:
  - 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. MAMAC Systems, Inc.
  - 2. Sensor probe with two opposing orifices designed to reduce error-associated air velocity.
  - 3. Sensor insertion length to be middle of duct .
  - 4. Construct sensor of 6061-T6 aluminum alloy or Type 304 stainless steel.

### PRESSURE INSTRUMENTS

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5. Connection: Threaded, **NPS 1/8** swivel fitting for connection to copper tubing or **NPS 1/4** barbed fitting for connection to polyethylene tubing.
6. Sensor probe attached to a mounting flange with neoprene gasket and two holes for fasteners.
7. Mounting flange to be suitable for flat oval, rectangular, and round duct configurations.
8. Pressure Rating: **10 psig**.

C. Duct Traverse Static Pressure Sensor:

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. Air Monitor Corporation.
2. Sensor to traverse the duct cross section and have at least one pickup point every **6 inches** along length of sensor.
3. Construct sensor of 18-gage Type T6063-T5 extruded and anodized aluminum.
4. Sensor supported with threaded rod, sealing washer, and nut at one end and a mounting plate with gasket at other end.
5. Mounting plate with threaded, **NPS 3/8** compression fitting for connection to tubing.
6. Accuracy within 1 percent of actual operating static pressure.
7. Dual offset static sensor design to provide accurate sensing of duct static pressure in the presence of turbulent and rotational airflows with a maximum 30-degree yaw and pitch.
8. Suitable for velocities of **100 to 10000 fpm** and temperatures of up to **200 deg F**.
9. Sensor air resistance to be less than 0.1 times the velocity pressure at probe-operating velocity.
10. Suitable for flat oval, rectangular, and round duct configurations.

## 2.2 AIR-PRESSURE TRANSMITTERS

A. Air-Pressure Differential Transmitter with Display:

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. Setra System.
2. Performance:
  - a. Range: Approximately 2 times set point.
  - b. Accuracy: Within 0.25 percent of the full-scale range.
  - c. Hysteresis: Within 0.10 percent of full scale.
  - d. Repeatability: Within 0.05 percent of full scale.
  - e. Stability: Within 1 percent of span per year.
  - f. Overpressure: **10 psig**.
  - g. Temperature Limits: **Zero to 150 deg F**.
  - h. Compensate Temperature Limits: **40 to 150 deg F**.
  - i. Thermal Effects: 0.033 percent of full scale per degree F.
  - j. Shock and vibration to not harm the transmitter.
3. Output Signals:
  - a. Analog Current Signal:
    - 1) Two-wire, 4- to 20-mA dc current source.
    - 2) Signal capable of operating into 800-ohm load.
  - b. Analog Voltage Signal:
    - 1) Three wire, zero to 10 V.
    - 2) Minimum Load Resistance: 1000 ohms.

## PRESSURE INSTRUMENTS

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4. Display: Four-digit digital display with minimum **0.4-inch**- high numeric characters.
5. Operator Interface: Zero and span adjustments located behind cover.
6. Construction:
  - a. Plastic casing with removable plastic cover.
  - b. Threaded, **NPS 1/4** swivel fittings for connection to copper tubing or **NPS 3/16** barbed fittings for connection to polyethylene tubing. Fittings on bottom of instrument case.
  - c. Screw terminal block for wire connections.
  - d. Vertical plane mounting.
  - e. NEMA 250, Type 4.
  - f. Provide mounting bracket suitable for installation.

B. Air-Pressure Differential Transmitter:

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. Ashcroft Inc.
2. Performance:
  - a. Range: Approximately 2 times set point.
  - b. Accuracy: Within 0.25 percent of the span at reference temperature of **70 deg F**.
  - c. Hysteresis: Within 0.02 percent of the span.
  - d. Repeatability: Within 0.05 percent of the calibrated span.
  - e. Stability: Within 0.25 percent of span per year.
  - f. Overpressure: **15 psig**.
  - g. Temperature Limits: **Minus 20 to 160 deg F**.
  - h. Compensate Temperature Limits: **35 to 135 deg F**.
  - i. Thermal Effects: 0.015 percent of full scale per degree F.
  - j. Warm-up Time: Within 5 seconds.
  - k. Response Time: 5 ms .
  - l. Shock and vibration to not harm the transmitter.
3. Output Signals:
  - a. Analog Current Signal:
    - 1) Two-wire, 4- to 20-mA dc current source.
    - 2) Signal capable of operating into 1000-ohm load.
  - b. Analog Voltage Signal:
    - 1) Three wire, zero to 6 V.
    - 2) Minimum Load Resistance: 1000 ohms.
4. Operator Interface:
  - a. Zero and span adjustments within 10 percent of full span.
  - b. Potentiometer adjustments located on face of transmitter.
5. Construction:
  - a. Type 300 stainless steel enclosure.
  - b. Swivel fittings for connection to copper tubing or barbed fittings for connection to polyethylene tubing. Fittings on front of instrument enclosure.
  - c. Screw terminal block for wire connections.
  - d. Vertical plane mounting.
  - e. NEMA 250, Type 2.
  - f. Mounting Bracket: Appropriate for installation.
  - g. Reverse wiring protected.
  - h. Calibrate to NIST-traceable standards and provide each transmitter with a certificate of calibration.

## PRESSURE INSTRUMENTS

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### 2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled pressure instruments, as indicated by instrument requirements. Affix standards organization's certification and label.
- B. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
- C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Install products level, plumb, parallel, and perpendicular with building construction.
- B. Properly support instruments, tubing, piping wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement, sway, or a break in attachment when subjected to a 10-lb force.
- C. Provide ceiling, floor, roof, wall openings, and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- D. Fastening Hardware:
  - 1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
  - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by using excessive force or oversized wrenches.
  - 3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- E. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.
- F. Corrosive Environments:

## PRESSURE INSTRUMENTS

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1. Use products that are suitable for environment to which they are subjected.
2. If possible, avoid or limit use of materials in corrosive environments.
3. When conduit is in contact with a corrosive environment, use Type 316 stainless steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
4. Where instruments are located in a corrosive environment and are not corrosive resistant from the manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

### 3.3 ELECTRICAL POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

### 3.4 PRESSURE INSTRUMENT INSTALLATION

- A. Mounting Location:
  1. Rough-in: Outline instrument-mounting locations before setting instruments and routing, cable, wiring, tubing, and conduit to final location.
  2. Install switches and transmitters for air and liquid pressure associated with individual air-handling units and associated connected ductwork and piping near air-handlings units co-located in air-handling unit system control panel, to provide service personnel a single and convenient location for inspection and service.
  3. Install liquid and steam pressure switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
  4. Install air-pressure switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
  5. Mount switches and transmitters not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.
  6. Install instruments (except pressure gages) in steam, liquid, and liquid-sealed piped services below their process connection point. Slope tubing down to instrument with a slope of 2 percent.
  7. Install instruments in dry gas and noncondensable vapor piped services above their process connection point. Slope process connection lines up to instrument with a minimum slope of 2 percent.
- B. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

## PRESSURE INSTRUMENTS

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C. Duct Pressure Sensors:

1. Install sensors using manufacturer's recommended upstream and downstream distances.
2. Unless indicated on Drawings, locate sensors approximately 67 percent of distance of longest hydraulic run. Location of sensors to be submitted and approved before installation.
3. Install mounting hardware and gaskets to make sensor installation airtight.
4. Route tubing from the sensor to transmitter.
5. Use compression fittings at terminations.
6. Install sensor in accordance with manufacturer's instructions.
7. Support sensor to withstand maximum air velocity, turbulence, and vibration encountered to prevent instrument failure.

D. Air-Pressure Differential Switches:

1. Install air-pressure sensor in system for each switch connection. Install sensor in an accessible location for inspection and replacement.
2. A single sensor may be used to share a common signal to multiple pressure instruments.
3. Install access door in duct and equipment to access sensors that cannot be inspected and replaced from outside.
4. Route **NPS 3/8** tubing from sensor to switch connection.
5. Do not mount switches on rotating equipment.
6. Install switches in a location free from vibration, heat, moisture, or adverse effects, which could damage the switch and hinder accurate operation.
7. Install switches in an easily accessible location serviceable from floor.
8. Install switches adjacent to system control panel if within **50 feet** ; otherwise, locate switch in vicinity of system connection.

### 3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing to have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Install engraved phenolic nameplate with instrument identification and on face of ceiling directly below instruments concealed above ceilings.

### 3.6 CHECKOUT PROCEDURES

- A. Check out installed products before continuity tests, leak tests, and calibration.
- B. Check instruments for proper location and accessibility.
- C. Check instruments for proper installation with respect to direction of flow, elevation, orientation, insertion depth, or other applicable considerations that impact performance.

### 3.7 ADJUSTMENT, CALIBRATION, AND TESTING

- A. Description:

## PRESSURE INSTRUMENTS

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1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, perform a three-point calibration test for both linearity and accuracy.
4. Equipment and procedures used for calibration to comply with instrument manufacturer's recommendations.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments to have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent to be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If, after calibration, indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of project design values.

### 3.8 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.

## PRESSURE INSTRUMENTS

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- B. Coordinate pressure instrument demonstration video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.
- C. Record videos on DVD disks.
- D. Owner has right to make additional copies of video for internal use without paying royalties.

END OF SECTION 23 09 23.23

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## SECTION 23 09 23.27 - TEMPERATURE INSTRUMENTS

### 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. Air temperature sensors.
2. Combination air temperature sensors and switches.
3. Air temperature switches.
4. Air temperature RTD transmitters.
5. High-end, commercial-grade, liquid temperature sensors.
6. High-end, commercial-grade, liquid temperature transmitters.

- B. Related Requirements:

1. Section 23 09 23 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

#### 1.3 DEFINITIONS

- A. HART (Highway Addressable Remote Transducer) Protocol: The global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bidirectional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from a technician's hand-held device or laptop to a plant's process control, asset management, safety, or other system using any control platform.

- B. RTD: Resistance temperature detector.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.

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3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation operation and maintenance instructions, including factors affecting performance.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include number-coded identification system for unique identification of wiring, cable, and tubing ends.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by manufacturer and witnessed by a qualified testing agency .
- B. Field quality-control reports.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Provide two matching product(s) in Project inventory for each unique size and type.
  1. .

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Environmental Conditions:

1. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.
  - a. If instrument alone cannot meet requirement, install instrument in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated and cooled, filtered, and ventilated as required by instrument and application.
2. Instruments and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Instrument's installed location shall dictate following NEMA 250 enclosure requirements:
  - a. Outdoors, Protected: Type 3 .



- b. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4 .

## 2.2 AIR TEMPERATURE SENSORS

### A. Platinum RTDs: Common Requirements:

1. 1000 ohms at zero deg C and a temperature coefficient of 0.00385 ohm/ohm/deg C.
2. Two-wire, PTFE-insulated, 22-gage stranded copper leads.
3. Performance Characteristics:
  - a. Range: **Minus 50 to 275 deg F.**
  - b. Interchangeable Accuracy: At **32 deg F** within **0.5 deg F.**
  - c. Repeatability: Within **0.5 deg F.**
  - d. Self-Heating: Negligible.
4. Transmitter Requirements:
  - a. Transmitter optional for 1000-ohm RTD, contingent on compliance with end-to-end control accuracy.

### B. Platinum RTD, Single-Point Air Temperature Duct Sensors:

1. 1000 ohms.
2. Temperature Range: **Minus 50 to 275 deg F.**
3. Probe: Single-point sensor with a stainless-steel sheath.
4. Length: As required by application to achieve tip at midpoint of air tunnel, up to **18 inches.**
5. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
6. Gasket for attachment to duct or equipment to seal penetration airtight.
7. Conduit Connection: **1/2-inch** trade size.

### C. Platinum RTD, Air Temperature Averaging Sensors:

1. 1000 ohms.
2. Temperature Range: **Minus 50 to 275 deg F.**
3. Multiple sensors to provide average temperature across entire length of sensor.
4. Rigid probe of aluminum, brass, copper, or stainless-steel sheath.
5. Flexible probe of aluminum, brass, copper, or stainless-steel sheath and formable to a **4-inch** radius.
6. Length: As required by application to cover entire cross section of air tunnel.
7. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
8. Gasket for attachment to duct or equipment to seal penetration airtight.
9. Conduit Connection: **1/2-inch** trade size.

### D. Platinum RTD Outdoor Air Temperature Sensors:

1. 1000 ohms.
2. Temperature Range: **Minus 50 to 275 deg F.**
3. Probe: Single-point sensor with a stainless-steel sheath.
4. Solar Shield: Stainless steel.
5. Enclosure: NEMA 250, Type 4 or 4X junction box or combination conduit and outlet box with removable cover and gasket.
6. Conduit Connection: **1/2-inch** trade size.

- E. Platinum RTD Space Air Temperature Sensors:
1. 1000 ohms.
  2. Temperature Range: **Minus 50 to 212 deg F.**
  3. Sensor assembly shall include a temperature sensing element mounted under a bright white, non-yellowing, plastic cover.
  4. Provide a mounting plate that is compatible with the surface shape that it is mounted to and electrical box used.
  5. Concealed wiring connection.
- F. Thermal Resistors (Thermistors): Common Requirements:
1. 10,000 ohms at 25 deg C and a temperature coefficient of 23.5 ohms/ohm/deg C.
  2. Two-wire, PTFE-insulated, 22-gage stranded copper leads.
  3. Performance Characteristics:
    - a. Range: **Minus 50 to 275 deg F.**
    - b. Interchangeable Accuracy: At **77 deg F** within **0.5 deg F.**
    - c. Repeatability: Within **0.5 deg F.**
    - d. Drift: Within **0.5 deg F** over 10 years.
    - e. Self-Heating: Negligible.
  4. Transmitter optional, contingent on compliance with end-to-end control accuracy.
- G. Thermistor, Single-Point Duct Air Temperature Sensors:
1. Temperature Range: **Minus 50 to 275 deg F.**
  2. Probe: Single-point sensor with a stainless-steel sheath.
  3. Length: As required by application to achieve tip at midpoint of air tunnel, up to **18 inches** long.
  4. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
  5. Gasket for attachment to duct or equipment to seal penetration airtight.
  6. Conduit Connection: **1/2- inch** trade size.
- H. Thermistor Averaging Air Temperature Sensors:
1. Temperature Range: **Minus 50 to 275 deg F.**
  2. Multiple sensors to provide average temperature across entire length of sensor.
  3. Rigid probe of aluminum, brass, copper, or stainless-steel sheath.
  4. Flexible probe of aluminum, brass, copper, or stainless-steel sheath and formable to a **4-inch** radius.
  5. Length: As required by application to cover entire cross section of air tunnel.
  6. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
  7. Gasket for attachment to duct or equipment to seal penetration airtight.
  8. Conduit Connection: **1/2-inch** trade size.
- I. Thermistor Outdoor Air Temperature Sensors:
1. Temperature Range: **Minus 50 to 275 deg F.**
  2. Probe: Single-point sensor with a stainless-steel sheath.
  3. Solar Shield: Stainless steel.
  4. Enclosure: NEMA 250, Type 4 or 4X junction box or combination conduit and outlet box with removable cover and gasket.
  5. Conduit Connection: **1/2-inch** trade size.

J. Thermistor Space Air Temperature Sensors:

1. Temperature Range: **Minus 50 to 212 deg F.**
2. Sensor assembly shall include a temperature sensing element mounted under a bright white, non-yellowing, plastic cover.
3. Provide a mounting plate that is compatible with the surface shape that it is mounted to and electrical box used.
4. Concealed wiring connection.

2.3 COMBINATION AIR TEMPERATURE SENSOR AND SWITCH

A. Source Limitations: Obtain temperature-measuring sensors and transmitters and airflow from single manufacturer.

B. Combination temperature sensor and switch in same instrument.

C. Air Temperature Switch:

1. Factory preset set point of **38 deg F.** Field-adjustable set point from **30 to 44 deg F.**
2. Responsive to coldest **12-inch** section of sensor length.
3. DPST latching relay rated at 25 A and 120-V ac, with powered controller, coil, and manual rest at panel. Wire one leg to fan start circuit and other leg to signal a remote alarm.

D. Air Temperature Sensor:

1. Temperature-averaging type over sensor length. Length to be determined by installing trade to provide uniform coverage over air tunnel. Consult manufacturer for recommendations.
2. Platinum RTD with a value of 1000 ohms at zero deg C and a temperature coefficient of 0.00385 ohm/ohm/deg C.
3. Accuracy: Within **0.9 deg F.**
4. Output Signal: 4 to 20 mA for connection to remote monitoring.
5. Encase RTDs in a flexible nominal **0.375-inch-** diameter sheath constructed of brass.
6. Lead wires shall be 18-gage AWG copper.
7. Enclosure: NEMA 250, Type 4.

2.4 AIR TEMPERATURE SWITCHES

A. Thermostat and Switch for Low Temperature Control in Duct Applications:

1. Description:
  - a. Two-position control.
  - b. Field-adjustable set point.
  - c. Manual reset.
  - d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Performance:
  - a. Operating Temperature Range: **15 to 55 deg F.**
  - b. Temperature Differential: **5 deg F,** non-adjustable and additive.
  - c. Enclosure Ambient Temperature: **Minus 20 to 140 deg F.**
  - d. Sensing Element Maximum Temperature: **250 deg F.**

- e. Voltage: 120-V ac.
  - f. Current: 16 FLA.
  - g. Switch Type: Two SPDT snap switches operate on coldest 12-inch section along element length.
3. Construction:
- a. Vapor-Filled Sensing Element: Nominal 20 feet long.
  - b. Dual Temperature Scale: Fahrenheit and Celsius visible on face.
  - c. Set-Point Adjustment: Screw.
  - d. Enclosure: Painted metal, NEMA 250, Type 1.
  - e. Electrical Connections: Screw terminals.
  - f. Conduit Connection: 1/2-inch trade size.

B. Thermostat and Switch for High Temperature Control in Duct Applications:

1. Source Limitations: Obtain temperature-measuring sensors and transmitters and airflow from single manufacturer.
2. Description:
  - a. Two-position control.
  - b. Field-adjustable set point.
  - c. Manual reset.
  - d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Performance:
  - a. Temperature Range: 100 to 160 deg F.
  - b. Temperature Differential: 5 deg F.
  - c. Ambient Temperature: Zero to 260 deg F.
  - d. Voltage: 120-V ac.
  - e. Current: 16 FLA.
  - f. Switch Type: SPDT snap switch.
4. Construction:
  - a. Sensing Element: Helical bimetal.
  - b. Enclosure: Metal, NEMA 250, Type 1.
  - c. Electrical Connections: Screw terminals.
  - d. Conduit Connection: 1/2-inch trade size.

## 2.5 AIR TEMPERATURE RTD TRANSMITTERS

- A. Source Limitations: Obtain temperature-measuring sensors and transmitters and airflow from single manufacturer.
- B. House electronics in NEMA 250 enclosure.
1. Duct: Type 3.
  2. Outdoor: Type 4 .
  3. Space: Type 1.
- C. Conduit Connection: 1/2-inch trade size.
- D. Functional Characteristics:
1. Input:
    - a. 1000-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two-wire sensors.

2. Span (Adjustable):
  - a. Space: 40 to 90 deg F.
  - b. Supply Air Cooling and Heating: 40 to 120 deg F.
  - c. Supply Air Cooling Only: 40 to 90 deg F.
  - d. Supply Air Heating Only: 40 to 120 deg F.
  - e. Exhaust Air: 50 to 100 deg F.
  - f. Return Air: 50 to 100 deg F.
  - g. Mixed Air: Minus 40 to 140 deg F.
  - h. Outdoor: Minus 40 to 140 deg F.
3. Output: 4- to 20-mA dc, linear with temperature; RFI insensitive; minimum drive load of 600 ohms at 24-V dc .
4. Zero and span field adjustments, plus or minus 5 percent of span. Minimum span of 50 deg F.
5. Match sensor with temperature transmitter and factory calibrate together.

E. Performance Characteristics:

1. Calibration Accuracy: Within 0.1 percent of the span.
2. Stability: Within 0.2 percent of the span for at least 6 months.
3. Combined Accuracy: Within 0.5 percent.

## 2.6 LIQUID TEMPERATURE SENSORS, HIGH-END COMMERCIAL GRADE

A. RTD:

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. Minco.
2. Resistance temperature sensors shall comply with IEC 60751, Class B requirements.
3. Platinum with a value of 100 ohms at zero deg C and a temperature coefficient of 0.00385 ohm/ohm/deg C.
4. Encase RTD in a Type 316 stainless-steel sheath with a 0.25-inch OD.
5. Provide two -wire, PTFE-insulated, nickel-coated, 22-gage, stranded copper leads.
6. Provide spring-loaded RTDs for thermowell installations.
7. Performance Characteristics:
  - a. Range: Minus 328 to 932 deg F.
  - b. Interchangeable Accuracy: Within 0.54 deg F at 32 deg F.
  - c. Stability: Within 0.05 percent maximum ice-point resistance shift after 1000 hours at 752 deg F.
  - d. Hysteresis: Within 0.04 percent of range.
  - e. Response Time: 62.8 percent of change in 4 seconds with water flowing across sensor at 3 fps.

B. Thermowells:

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. Minco.
2. Stem: Straight or stepped or tapered shank formed from solid bar stock.
3. Material: Type 304 or Type 316 stainless steel.
4. Process Connection: Threaded, NPS 3/4

5. Sensor Connection: Threaded, **NPS 1/2**
6. Bore: Sized to accommodate sensor with tight tolerance between sensor and well.
7. Furnish thermowells installed in insulated pipes and equipment with an extended neck that extends beyond the face of the insulation covering.
8. Length: As required by application and pipe size.
9. Thermowells furnished with heat-transfer compound to eliminate air gap between wall of sensor and thermowell and to reduce time constant.

C. Connection Heads:

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. Minco.
2. Housing: Low-copper cast-aluminum alloy, complying with NEMA 250, Type 4.
3. Terminals: Six or eight as required by sensor.
4. Conduit Connection: **1/2-inch** trade size.
5. Sensor Connection: **NPS 1/2**.

- D. Assembly: Sensor manufacturer shall furnish sensor, thermowell, and sensor connection head to provide a matched assembly.

2.7 LIQUID TEMPERATURE TRANSMITTERS, COMMERCIAL GRADE

- 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. Minco.

- B. House electronics in NEMA 250, Type 4X enclosure.

- C. Enclosure Connection: **1/2-inch** trade size.

D. Functional Characteristics:

1. Input: 100-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two- or three-wire sensors.
2. Default Span (Adjustable):
  - a. Chilled Water: **Zero to 100 deg F**.
3. Output: 4- to 20-mA dc, linear with temperature; RFI insensitive; minimum drive load of 600 ohms at 24-V dc.
4. Zero and span field adjustments, plus or minus 5 percent of span. Minimum span of **50 deg F**.
5. Match sensor with temperature transmitter and factory calibrate together. Each matched sensor and transmitter set shall include factory calibration data traceable to NIST.

E. Performance Characteristics:

1. Calibration Accuracy: Within 0.1 percent of the span.
2. Stability: Within 0.2 percent of the span for at least 6 months.
3. Combined Accuracy: Within 0.5 percent.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 TEMPERATURE INSTRUMENT APPLICATIONS

- A. Air Temperature Sensors:
  - 1. Duct, : Thermistor 1000-ohm platinum RTD.
  - 2. Outdoor, : Thermistor 1000-ohm platinum RTD.
  - 3. Space, : Thermistor 1000-ohm platinum RTD.
- B. Air Temperature Transmitters:
  - 1. Duct, : Air temperature RTD transmitter.
  - 2. Outdoor, : Air temperature RTD transmitter.
  - 3. Space, : Air temperature RTD transmitter.
- C. Liquid and Steam Temperature Sensors:
  - 1. Chilled water System, <Insert unique application> : Liquid and steam temperature sensor, high-end commercial grade .
- D. Liquid and Temperature Transmitters:
  - 1. Chilled water System, : Liquid and steam temperature transmitter, commercial grade .

#### 3.3 INSTALLATION, GENERAL

- A. Install products level, plumb, parallel, and perpendicular with building construction.
- B. Properly support instruments, tubing, piping, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment .
- C. Fastening Hardware:
  - 1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
  - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
  - 3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

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- D. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.
- E. Corrosive Environments:
  - 1. Use products that are suitable for environment to which they are subjected.
  - 2. If possible, avoid or limit use of materials in corrosive environments.
  - 3. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
  - 4. Where instruments are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

### 3.4 ELECTRIC POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

### 3.5 TEMPERATURE INSTRUMENT INSTALLATIONS

- A. Mounting Location:
  - 1. Roughing In:
    - a. Outline instrument mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.
    - b. Provide independent inspection to confirm that proposed mounting locations comply with requirements indicated and approved submittals.
      - 1) Indicate dimensioned locations with mounting height for all surface-mounted products on Shop Drawings.
      - 2) Do not begin installation without submittal approval of mounting location.
    - c. Complete installation rough-in only after confirmation by independent inspection is complete and approval of location is documented for review by Owner and Architect on request.
  - 2. Install switches and transmitters for air and liquid temperature associated with individual air-handling units and associated connected ductwork and piping near air-handling units co-located in air-handling unit system control panel to provide service personnel a single and convenient location for inspection and service.
  - 3. Install liquid and steam temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.

## TEMPERATURE INSTRUMENTS

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4. Install air temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
  5. Mount switches and transmitters on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer's mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.
- B. Special Mounting Requirements:
1. Protect products installed outdoors from solar radiation, building and wind effect with stand-offs and shields constructed of Type 316 stainless .
  2. Temperature instruments having performance impacted by temperature of mounting substrate shall be isolated with an insulating barrier located between instrument and substrate to eliminate effect. Where instruments requiring insulation are located in finished space, conceal insulating barrier in a cover matching the instrument cover.
- C. Mounting Height:
1. Mount temperature instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
  2. Mount switches and transmitters located in mechanical equipment rooms and other similar space not subject to code or state and Federal accessibility requirements within a range of **42 to 72 inches** above the adjacent floor, grade, or service catwalk or platform.
    - a. Make every effort to mount at **60 inches**.
- D. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.
- E. Space Temperature Sensor Installation:
1. Conceal assembly in an electrical box of sufficient size to house sensor and transmitter, if provided.
  2. Install electrical box with a faceplate to match sensor cover if sensor cover does not completely cover electrical box.
  3. In finished areas, recess electrical box within wall.
  4. In unfinished areas, electrical box may be surface mounted if electrical light switches are surface mounted. Use a cast-aluminum electric box for surface-mounted installations.
  5. Align electrical box with other electrical devices such as visual alarms and light switches located in the vicinity to provide a neat and well-thought-out arrangement. Where possible, align in both horizontal and vertical axis.
- F. Outdoor Air Temperature Sensor Installation:
1. Mount sensor in a discrete location facing north.
  2. Protect installed sensor from solar radiation and other influences that could impact performance.
  3. If required to have a transmitter, mount transmitter remote from sensor in an accessible and serviceable location indoors.
- G. Single-Point Duct Temperature Sensor Installation:

1. Install single-point-type, duct-mounted, supply- and return-air temperature sensors. Install sensors in ducts with sensitive portion of the element installed in center of duct cross section and located to sense near average temperature. Do not exceed **24 inches** in sensor length.
2. Install return-air sensor in location that senses return-air temperature without influence from outdoor or mixed air.
3. Rigidly support sensor to duct and seal penetration airtight.
4. If required to have transmitter, mount transmitter remote from sensor at accessible and serviceable location.

H. Averaging Duct Temperature Sensor Installation:

1. Install averaging-type air temperature sensor for temperature sensors located within air-handling units, similar equipment, and large ducts with air tunnel cross-sectional area of **20 sq. ft.** and larger.
2. Install sensor length to maintain coverage over entire cross-sectional area. Install multiple sensors where required to maintain the minimum coverage.
3. Fasten and support sensor with manufacturer-furnished clips to keep sensor taut throughout entire length.
4. If required to have transmitter, mount transmitter in an accessible and serviceable location.

I. Low-Limit Air Temperature Switch Installation:

1. Install multiple low-limit switches to maintain coverage over entire cross-sectional area of air tunnel.
2. Fasten and support sensing element with manufacturer-furnished clips to keep element taut throughout entire length.
3. Mount switches outside of airstream at a location and mounting height to provide easy access for switch set-point adjustment and manual reset.
4. Install on entering side of cooling coil unless otherwise indicated on Drawings.

J. Liquid Temperature Sensor Installation:

1. Assembly shall include sensor, thermowell and connection head.
2. For pipe **NPS 4** and larger, install sensor and thermowell length to extend into pipe between 50 to 75 percent of pipe cross section.
3. For pipe smaller than **NPS 4**:
  - a. Install reducers to increase pipe size to **NPS 4** at point of thermowell installation.
  - b. For pipe sizes **NPS 2-1/2 and NPS 3**, thermowell and sensor may be installed at pipe elbow or tee to achieve manufacturer-recommended immersion depth in lieu of increasing pipe size.
  - c. Minimum insertion depth shall be **2-1/2 inches**.
4. Install matching thermowell.
5. Fill thermowell with heat-transfer fluid before inserting sensor.
6. Tip of spring-loaded sensors shall contact inside of thermowell.
7. For insulated piping, install thermowells with extension neck to extend beyond face of insulation.
8. Install thermowell in top dead center of horizontal pipe positioned in an accessible location to allow for inspection and replacement. If top dead center location is not possible due to field constraints, install thermowell at location along top half of pipe.
9. For applications with transmitters, mount transmitter remote from sensor in an accessible and serviceable location from floor service platform or catwalk.

### 3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Install engraved phenolic nameplate with instrument identification and on face of ceiling directly below instruments concealed above ceilings.

### 3.7 CLEANING

- A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.
- B. Wash and shine glazing.
- C. Polish glossy surfaces to a clean shine.

### 3.8 CHECK-OUT PROCEDURES

- A. Check installed products before continuity tests, leak tests, and calibration.
- B. Check temperature instruments for proper location and accessibility.
- C. Verify sensing element type and proper material.
- D. Verify location and length.
- E. Verify that wiring is correct and secure.

### 3.9 ADJUSTMENT, CALIBRATION, AND TESTING

- A. Description:
  - 1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
  - 2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
  - 3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
  - 4. Equipment and procedures used for calibration shall meet instrument manufacturer's written instructions.
  - 5. Provide diagnostic and test equipment for calibration and adjustment.
  - 6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
  - 7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.

8. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements and to supplement requirements indicated.

B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistance source.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

### 3.10 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Perform according to manufacturer's written instruction.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Prepare test and inspection reports.

### 3.11 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.12 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain temperature instruments.

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- B. Provide a complete set of instructional videos covering each product specified and installed and showing the following:
  - 1. Software programming.
  - 2. Calibration and test procedures.
  - 3. Operation and maintenance requirements and procedures.
  - 4. Troubleshooting procedures.
- C. Coordinate video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.
- D. Record videos on DVD disks.
- E. Owner shall have right to make additional copies of video for internal use without paying royalties.

END OF SECTION 23 09 23.27

## 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. PP-R pipe and fittings.
  - 2. Joining materials.
  - 3. Transition fittings.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
  - 1. Pipe.
  - 2. Fittings.
  - 3. Joining materials.
- B. Delegated-Design Submittal:
  - 1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes.
  - 2. Locations of pipe anchors and alignment guides and expansion joints and loops.
  - 3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
  - 4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Other building services.
  - 2. Structural members.
- B. Qualification Data: For Installer.

- C. Welding certificates.
- D. Field quality-control reports.
- E. Preconstruction Test Reports:
  - 1. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.
- F. Warranty Information:
  - 1. Polypropylene piping manufacturer shall submit documentation of 10-year warranty with coverage for parts, materials, labor, property damage, and personal injury.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Polypropylene Pipe and Fitting Installers: Installers of polypropylene piping shall be certified by manufacturer of pipes and fittings as having been trained and qualified to join polypropylene piping using fusion welding of the same type as specified in Drawings (socket, butt, eletrofusion, fusion outlet).
- B. Steel Support Welding: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

#### 1.6 PRECONSTRUCTION TESTING

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

#### 1.7 WARRANTY

- A. PP-R Manufacturer's Warranty: Manufacturer agrees to repair or replace PP-R pipe and fittings that fail in materials or workmanship within 10 years from date of Substantial Completion.
  - 1. Warranty shall cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system due to defects in materials or manufacturing.
  - 2. Warranty shall be in effect only upon submission by the Contractor to the manufacturer valid pressure/leak test documentation indicating that the system was tested and passed the manufacturer's pressure/leak test.

## 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. Chilled-Water Piping: 160 psig at 50 deg F .
  2. Makeup-Water Piping: 80 psig at 73 deg F .
  3. Condensate-Drain Piping: 150 deg F .
  4. Blowdown-Drain Piping: 180 deg F .
  5. Air-Vent Piping: 180 deg F .

### 2.2 POLYPROPYLENE (PP-R) PIPE AND FITTINGS FOR WATER DISTRIBUTION AND WATER SERVICE

- A. Polypropylene Pipe: ASTM F2389, pipe pressure rating shall comply with temperature and pressure ratings for the project.
1. Polypropylene Fittings: ASTM F2389, socket fusion, butt fusion, electrofusion, or fusion outlet fittings shall be used for fusion-welded joints between pipe and fittings.
  2. Mechanical fittings and transition fittings shall be used where transitions are made to other piping materials or to valves and appurtenances.
  3. Polypropylene pipe shall not be threaded. Threaded transition fittings per ASTM F2389 shall be used where a threaded connection is required.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide products by Aquatherm, NA or comparable product by one of the following:
1. Aquatherm.
  2. Poloplast.
- C. Smoke and Fire Ratings:
1. Where indicated on Drawings that a plenum-rated piping system is needed, the pipe shall be wrapped and/or insulated with standard fiberglass or mineral wool pipe insulation, field installed.
    - a. For domestic hot water or heating water systems, fittings may be left bare, no closer than every 6 ft. of pipe.
    - b. For domestic cold water or chilled water systems, the entire piping system must be wrapped or insulated to prevent condensation.
    - c. Pipe, wrap, or insulation as a system shall meet the requirements of CAN/ULC-S102.2-03, ASTM E84 or UL 2846.
    - d. The system shall have a flame spread classification of less than 25 and smoke development rating of less than 50.
- D. Fire Stopping: Provide fire stopping to both be compatible with the PP-R piping and meet the requirements of ASTM E814 or ULC S115. Pipe insulations or fire-resistive coating shall be removed where the pipe passes through a fire stop and, if required by the firestop manufacturer, for 3 inches beyond the firestop outside of the fire barrier.



- E. When installed in systems with pumps in excess of 7.5 HP, protect piping from excessive heat generated by operating the pump at shut-off conditions. Where the possibility exists that the pump will operate with no flow, the protection method shall be a temperature relief valve or comparable level of protection, set to a maximum temperature of **185 deg F**.

## 2.3 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: **ASTM B88, Type L**.
- B. Copper or Bronze Pressure-Seal Fittings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elkhart Products Corporation.
    - b. Mueller Industries, Inc.
    - c. NIBCO INC.
    - d. Viega LLC.
  - 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**.
- C. Wrought-Copper Unions: ASME B16.22.

## 2.4 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos free, **1/8-inch** maximum thickness unless otherwise indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Welding Filler Metals (Steel Support Welding): Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## 2.5 TRANSITION FITTINGS

- A. Plastic-to-Metal Transitions Fittings for PP-R:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Aquatherm, NA; Transition Fittings or comparable product by one of the following:
  - a. Poloplast .
  
- B. Plastic-to-Metal Transition Fittings:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Charlotte Pipe and Foundry Company.
    - b. IPEX USA LLC.
    - c. KBI (King Bros. Industries).
    - d. Uponor.
    - e. Viega LLC.
  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.
  
- C. Plastic-to-Metal Transition Unions:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Charlotte Pipe and Foundry Company.
    - b. IPEX USA LLC.
    - c. KBI (King Bros. Industries).
    - d. NIBCO INC.
  2. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

### PART 3 - EXECUTION

#### 3.1 PIPING APPLICATIONS

- A. Chilled-water piping, aboveground, NPS 3.5" and smaller , shall be the following:
  1. Polypropylene (PP-R), ASTM F2389, pipe and socket fusion, fusion outlet, or electrofusion fittings. Aquatherm Blue Pipe MF RP SDR 11.
  
- B. Chilled-water piping, aboveground, NPS 4" and larger , shall be the following:
  1. Polypropylene (PP-R), ASTM F2389, pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings. Aquatherm Blue Pipe MF RP SDR 17.6.
  
- C. Chilled-water piping installed belowground and within slabs shall be the following:
  1. Pre-engineered cased piping system with carrier pipe Polypropylene (PP-R), ASTM F2389, pipe and socket fusion, fusion outlet, or electrofusion fittings. Refer to Section 23 21 13.13 Underground Hydronic Piping.
  
- D. Makeup-water piping installed aboveground shall be any of the following:

1. Polypropylene (PP-R), ASTM F2389, pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings.
  2. **Type L**, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
- E. Condensate-Drain Piping: **Type M**, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- F. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- G. Air-Vent Piping:
1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems in accordance with piping manufacturer's written instructions.
  2. Outlet: Polypropylene (PP-R), ASTM F2389, pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings.

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping to permit valve servicing.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Install piping to allow application of insulation.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- K. Install drains, consisting of a tee fitting, **NPS 3/4** ball valve, and short **NPS 3/4** threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- L. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

- M. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- N. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- O. Install valves in accordance with the following:
  - 1. Section 23 05 23.12 "Ball Valves for HVAC Piping."
  - 2. Section 23 05 23.13 "Butterfly Valves for HVAC Piping."
  - 3. Section 23 05 23.14 "Check Valves for HVAC Piping."
- P. Install unions in piping, **NPS 2** and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- Q. Install flanges in piping, **NPS 2-1/2** and larger, at final connections of equipment and elsewhere as indicated.
- R. Comply with requirements in Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
- S. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for identifying piping.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 18 "Escutcheons for HVAC Piping."

### 3.3 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- B. 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: MSS SP-58, Type 52 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.

7. On plastic pipe, isolate riser clamps from building structure by placement of felt or rubber pads between clamp and structure.
- C. Install hangers for copper tubing , with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install hangers for plastic piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping within **12 inches** of each fitting and coupling.
- F. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.4 PIPE JOINT CONSTRUCTION

- A. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- B. Fusion Joints: Fusion join polypropylene pipe in accordance with ASTM D2657, ASTM F2389, and manufacturer's instructions.
- C. Brazed Joints: Construct joints in accordance with AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
- D. Welded Joints (Steel Supports Welding): Construct joints in accordance with AWS D10.12M/D10.12, using qualified processes and welding operators in accordance with "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. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
- G. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

### 3.5 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 valves on each side of control valve.

- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 23 05 19 "Meters and Gages for HVAC Piping."

### 3.6 FIELD QUALITY CONTROL

- A. Prepare hydronic piping in accordance with ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

- B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Hydrostatic testing and documentation of test results for polypropylene piping shall be in accordance with the manufacturer's written instructions and submitted to the manufacturer upon successful completion per warranty requirements.

- C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

## SECTION 23 21 16 - HYDRONIC PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Hydronic specialty valves.
2. Air vents.
3. Strainers.
4. Flexible connectors.

##### B. Related Requirements:

1. Section 23 05 23.12 "Ball Valves for HVAC Piping" for specification and installation requirements for ball valves common to most piping systems.
2. Section 23 05 23.13 "Butterfly Valves for HVAC Piping" for specification and installation requirements for butterfly valves common to most piping systems.
3. Section 23 09 23.11 "Control Valves" for automatic control valve and sensor specifications, installation requirements, and locations.

#### 1.2 ACTION SUBMITTALS

##### A. 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.

#### 1.3 CLOSEOUT SUBMITTALS

- ##### A. Operation and Maintenance Data: For hydronic piping specialties to include in emergency, operation, and maintenance manuals.

#### 1.4 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.

#### 1.5 QUALITY ASSURANCE

- ##### A. Pipe Welding: Qualify procedures and operators in accordance with ASME BPVC, Section IX.

## HYDRONIC PIPING SPECIALTIES 23 21 16 - 1

- B. Pressure-relief and safety-relief valves and pressure vessels bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME BPVC, Section VIII, Division 1.

## PART 2 - PRODUCTS

### 2.1 HYDRONIC SPECIALTY VALVES

A. Bronze, Calibrated-Orifice, Balancing Valves:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Armstrong Fluid Technology.
  - c. Bell & Gossett; a Xylem brand.
  - d. Griswold Controls.
  - e. NIBCO INC.
  - f. Taco Comfort Solutions.
  - g. WATTS.
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 Gauge 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**.

B. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Armstrong Fluid Technology.
  - c. Bell & Gossett; a Xylem brand.
  - d. Griswold Controls.
  - e. NIBCO INC.
  - f. WATTS.
2. Body: Cast-iron or steel body, ball, butterfly, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass- and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gauge Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum **125 psig**.
11. Maximum Operating Temperature: **250 deg F**.

## HYDRONIC PIPING SPECIALTIES

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C. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Bell & Gossett; a Xylem brand.
  - c. NIBCO INC.
  - d. Taco Comfort Solutions.
  - e. WATTS.
  - f. Zurn Industries, LLC.
2. Body: Bronze or brass.
3. Disc: Brass .
4. Seat: Brass .
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPDM.
7. Low inlet-pressure check valve.
8. Inlet Strainer: Stainless Steel , removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size and Capacity: As indicated on Drawings.
11. Operating Pressure: Factory set and field adjustable.

D. Diaphragm-Operated Pressure-Relief Valves: ASME labeled.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Bell & Gossett; a Xylem brand.
  - c. WATTS.
  - d. Zurn Industries, LLC.
2. Body: Bronze or brass.
3. Disc: Brass .
4. Seat: Brass .
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPDM.
7. Valve Seat and Stem: Noncorrosive.
8. Valve Size, Capacity, and Operating Pressure: Comply with ASME BPVC, Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

E. Automatic Flow-Control Valves:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Bell & Gossett; a Xylem brand.
  - c. Griswold Controls.
  - d. Nexus Valve, Inc.; Aalberts Hydronic Flow Control.
  - e. NIBCO INC.
  - f. WATTS.
2. Body: Brass or ferrous metal.
3. Combination Assemblies: Include bronze or brass-alloy ball valve.
4. Identification Tag: Marked with zone identification, valve number, and flow rate.

5. Size and Capacity: For each application, provide a valve with rated capacity equal to or greater than capacity of device being served.
6. Performance: Maintain constant flow within plus or minus 10 percent, regardless of system pressure fluctuations.
7. Minimum CWP Rating: **175 psig** .
8. Maximum Operating Temperature: **200 deg F** .

## 2.2 AIR VENTS

### A. Manual Air Vents:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Bell & Gossett; a Xylem brand.
  - b. Nexus Valve, Inc.; Aalberts Hydronic Flow Control.
  - c. Taco Comfort Solutions.
  - d. WATTS.
2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: **NPS 1/2**.
6. Discharge Connection: **NPS 1/8**.
7. CWP Rating: **150 psig**.
8. Maximum Operating Temperature: **225 deg F**.

### B. Automatic Air Vents:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Bell & Gossett; a Xylem brand.
  - b. Metraflex Company (The).
  - c. Nexus Valve, Inc.; Aalberts Hydronic Flow Control.
  - d. Spirotherm, Inc.
  - e. Taco Comfort Solutions.
  - f. WATTS.
2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: **NPS 1/2**.
6. Discharge Connection: **NPS 1/4**.
7. CWP Rating: **150 psig**.
8. Maximum Operating Temperature: **240 deg F**.

## 2.3 STRAINERS

### A. Y-Pattern Strainers:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Griswold Controls.
  - b. Metraflex Company (The).

## HYDRONIC PIPING SPECIALTIES

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- c. Nexus Valve, Inc.; Aalberts Hydronic Flow Control.
- d. WATTS.
2. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
3. End Connections: Threaded ends for **NPS 2** and smaller; flanged ends for **NPS 2-1/2** and larger.
4. Strainer Screen: Stainless steel, 60-mesh strainer, or perforated stainless steel basket.
5. CWP Rating: **125 psig**.

## 2.4 FLEXIBLE CONNECTORS

### A. Stainless Steel Bellows, Flexible Connectors:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Flexicraft Industries.
  - b. Flo Fab Inc.
  - c. Metraflex Company (The).
2. Body: Stainless steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
3. End Connections: Threaded or flanged to match equipment connected.
4. Performance: Capable of **3/4-inch** misalignment.
5. CWP Rating: **150 psig**.
6. Maximum Operating Temperature: **250 deg F**.

### B. Spherical, Rubber, Flexible Connectors:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Flexicraft Industries.
  - b. Flo Fab Inc.
  - c. Metraflex Company (The).
2. Body: Fiber-reinforced rubber body.
3. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
4. Performance: Capable of misalignment.
5. CWP Rating: **150 psig**.
6. Maximum Operating Temperature: **250 deg F**.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine all piping specialties 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. Examine threads on all devices for form and cleanliness.
- C. 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.

## HYDRONIC PIPING SPECIALTIES

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- D. Do not attempt to repair defective piping specialties; replace with new devices. Remove defective piping specialties from site.

### 3.2 INSTALLATION OF VALVES

- A. Install calibrated-orifice balancing valve at each branch connection to return main.
- B. Install calibrated-orifice, balancing valve in the return pipe of each heating or cooling terminal.
- C. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.
- D. Install pressure-relief and safety-relief valves at hot-water generators and elsewhere as required by ASME BPVC. Pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME BPVC, Section VIII, Division 1, for installation requirements.

### 3.3 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 manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Vent and purge air from hydronic system, and ensure that existing expansion tank is properly charged with air to suit system Project requirements.

END OF SECTION 23 21 16

## SECTION 23 25 13 - WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes the following water treatment for closed-loop hydronic systems:
  - 1. Chemicals.

#### 1.3 DEFINITIONS

- A. RO: Reverse osmosis.
- B. TDS: Total dissolved solids consist of salts and other materials that combine with water as a solution.
- C. TSS: Total suspended solids include both organic and inorganic solids that are suspended in the water. These solids may include silt, plankton, and industrial wastes.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for the following products:
  - 1. Chemical material safety data sheets.
  - 2. Inhibited propylene glycol.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Water-Analysis Provider Qualifications: Verification of experience and capability of HVAC water-treatment service provider.
- B. Field quality-control reports.
- C. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in "Performance Requirements" Article.
- D. Water Analysis: Illustrate water quality available at Project site.

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- E. Before and After Chilled water closed loop system water analysis.

## 1.6 QUALITY ASSURANCE

- A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider, capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

## PART 2 - PRODUCTS

### 2.1 HVAC WATER-TREATMENT MANUFACTURERS

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Garratt Callahan.
  - 2. Nalco; an Ecolab company.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Provide all hardware, chemicals, and other material necessary to maintain HVAC water quality in all systems, as indicated in this Specification. Water quality for hydronic systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of hydronic equipment without creating a hazard to operating personnel or the environment.
- B. Base HVAC water treatment on quality of water available at Project site, hydronic system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
- C. Closed hydronic systems, including chilled water shall have the following water qualities:
  - 1. pH: Maintain a value within 7.5 to 8.5 .
  - 2. Alkalinity: Maintain a maximum value of 600 ppm as CaCO<sub>3</sub> .
  - 3. Steel Corrosion Inhibitors: Provide sufficient inhibitors to limit mild steel corrosion to 2.5 mils per year. Maintain soluble iron concentrations at or below 1 mg/L.
  - 4. Yellow Metal Corrosion Inhibitor: Provide sufficient copper and brass corrosion inhibitors to limit copper corrosion to 0.1 mils per year. Maintain soluble copper concentrations at or below 0.5 mg/L.
  - 5. Scale Control: Provide softened water for initial fill and makeup. Where softened water is not used, provide sufficient scale inhibitors to prevent formation of scale and maintain all scale-forming material in solution.
  - 6. Dispersants: Provide sufficient dispersants to prevent sedimentation of fine particulate matter.
  - 7. Microbiological Limits:
    - a. Total Aerobic Plate Count: Maintain a maximum value of 10,000 cfus .
    - b. Total Anaerobic Plate Count: Maintain a maximum value of 50 cfus .
    - c. Nitrate Reducers: Maintain a maximum value of 25 cfus .
    - d. Sulfate Reducers: Maintain a maximum value of 10 cfus .
    - e. Iron Bacteria: Maintain a maximum value of 5 cfus .

## WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

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## 2.3 CHEMICALS

- A. Chemicals shall be as recommended by water-treatment system manufacturer, compatible with piping system components and connected equipment, and able to attain water quality specified in "Performance Requirements" Article.

## 2.4 INHIBITED PROPYLENE GLYCOL

- 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. Dow Chemical Company (The).
2. Dynalene.
3. Fremont Industries.
4. Houghton Chemical Corp.

- B. Inhibited Propylene Glycol:

1. Propylene glycol with inhibitor additive, to provide freeze protection for heat-transfer fluid and corrosion protection for carbon steel, brass, copper, stainless steel, and cast-iron piping and fittings.
2. Inhibitor creates a passive layer on all surfaces that contact propylene glycol to prevent corrosion and stabilizes fluid pH, to compensate for acids formed from glycol degradation.
3. pH value shall be maintained between 7.5 to 8.5 .
4. Concentrated inhibited propylene glycol is to be 95.5 percent propylene glycol by weight and 4.5 percent performance additives.
5. Concentrated inhibited propylene glycol is mixed with water in proper proportion specified by the manufacturer to provide freeze protection to **minus 20 deg F** . Premixed heat-transfer fluid may be used, or glycol/water mixture may be prepared at the time of installation. Use only deionized water for mixing.
6. Provide only propylene glycol that is specifically blended for HVAC application. Automotive-type antifreeze is unacceptable.

## PART 3 - EXECUTION

### 3.1 WATER ANALYSIS

- A. Perform an analysis of supply water to determine quality of water available at Project site.

### 3.2 FIELD QUALITY CONTROL

- A. **Manufacturer's Field Service:** Engage a factory-authorized service representative to treat chilled water in the closed loop system.

- B. **Tests and Inspections:**

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.

## WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

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2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
  3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of hydronic systems' startup procedures.
  4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
  5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
  7. 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 test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
  8. Repair leaks and defects with new materials, and retest piping until no leaks exist.
- C. Equipment will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. At four -week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis, advising Owner of changes necessary to adhere to "Performance Requirements" Article.
- F. Comply with ASTM D3370 and with the following standards:
1. Silica: ASTM D859.
  2. Acidity and Alkalinity: ASTM D1067.
  3. Iron: ASTM D1068.
  4. Water Hardness: ASTM D1126.

### 3.3 MAINTENANCE SERVICE

- A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above, to inhibit corrosion and scale formation for hydronic piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion and shall include the following:
1. Initial water analysis and HVAC water-treatment recommendations.
  2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
  3. Periodic field service and consultation.
  4. Customer report charts and log sheets.
  5. Laboratory technical analysis.
  6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

## WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

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3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

END OF SECTION 23 25 13

## SECTION 23 29 23 - 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 VFDs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

#### 1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. CPT: Control power transformer.
- C. EMI: Electromagnetic interference.
- D. IGBT: Insulated-gate bipolar transistor.
- E. LAN: Local area network.
- F. LED: Light-emitting diode.
- G. MCP: Motor-circuit protector.
- H. NC: Normally closed.
- I. NO: Normally open.
- J. OCPD: Overcurrent protective device.
- K. PCC: Point of common coupling.
- L. PID: Control action, proportional plus integral plus derivative.
- M. PWM: Pulse-width modulated.
- N. RFI: Radio-frequency interference.
- O. TDD: Total demand (harmonic current) distortion.
- P. THD(V): Total harmonic voltage demand.

- Q. VFD: Variable-frequency drive.

#### 1.4 SUBMITTALS

- A. Product Data: For each type and rating of VFD indicated. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.
- B. Shop Drawings: 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.
1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Each installed unit's type and details.
    - b. Factory-installed devices.
    - c. Enclosure types and details.
    - d. Nameplate legends.
    - e. Short-circuit current (withstand) rating of enclosed unit.
    - f. Features, characteristics, ratings, and factory settings of each VFD and installed devices.
  2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.
- C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFCs. Show VFC 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.
- D. Qualification Data: For qualified testing agency.
- E. Product Certificates: For each VFD, from manufacturer.
- F. Source quality-control reports.
- G. Field quality-control reports.
- H. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  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.
- I. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.

- J. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

#### 1.5 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.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store in a space that is clean and dry. Protect units from dirt, water, debris, and traffic.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than 14 deg F and not exceeding 104 deg F.
  - 2. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F
  - 3. Humidity: Less than 95 percent (noncondensing).
  - 4. Altitude: Not exceeding 3300 feet.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFDs, including clearances between VFDs, and adjacent surfaces and other items.

#### 1.8 COORDINATION

- A. Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:
  - 1. Torque, speed, and horsepower requirements of the load.
  - 2. Ratings and characteristics of supply circuit and required control sequence.
  - 3. Ambient and environmental conditions of installation location.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

#### 1.9 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: Two years from date of Substantial Completion for "standard" VFDs..

#### 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.
  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 for each size and type of magnetic controller installed.
  5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

### PART 2 - PRODUCTS

#### 2.1 "STANDARD" VARIABLE FREQUENCY DRIVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Danfoss Inc. Model VLT
  2. Yaskawa Electric America, Inc. Model E7
- B. General Requirements for VFDs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.
- C. Application: Constant torque and variable torque.
- D. VFD Description: Variable-frequency power converter (rectifier, dc bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
  1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
  2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
  3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.
- E. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

- F. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
- G. Unit Operating Requirements:
  - 1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFD input voltage rating.
  - 2. Input AC Voltage Unbalance: Not exceeding 3 percent.
  - 3. Input Frequency Tolerance: Plus or minus 3 percent of VFD frequency rating.
  - 4. Minimum Efficiency: 98 percent at 60 Hz, full load.
  - 5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
  - 6. Minimum Short-Circuit Current (Withstand) Rating: 100 kA.
  - 7. Ambient Temperature Rating: Not less than 14 deg F and not exceeding 104 deg F.
  - 8. Ambient Storage Temperature Rating: Not less than minus 4 deg F (and not exceeding 140 deg.
  - 9. Humidity Rating: Less than 95 percent (noncondensing).
  - 10. Altitude Rating: Not exceeding 3300 feet.
  - 11. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for instantaneously.
  - 12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
  - 13. Speed Regulation: Plus or minus 5 percent.
  - 14. Output Carrier Frequency: Selectable; at or above 5 kHz without derating.
  - 15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
- H. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.
- I. Isolated Control Interface: Allows VFDs to follow remote-control signal over a minimum 40:1 speed range.
  - 1. Signal: Electrical.
- J. Internal Adjustability Capabilities:
  - 1. Minimum Speed: 5 to 25 percent of maximum rpm.
  - 2. Maximum Speed: 80 to 100 percent of maximum rpm.
  - 3. Acceleration: 0 - 1000 seconds.
  - 4. Deceleration: 0 – 1000 seconds.
  - 5. Current Limit: 30 to minimum of 150 percent of maximum rating.
- K. Self-Protection and Reliability Features:
  - 1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
  - 2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
  - 3. Under- and overvoltage trips.
  - 4. Inverter overcurrent trips.
  - 5. VFD and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFD and motor thermal characteristics, and for providing VFD overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved.
  - 6. Critical frequency rejection, with three selectable, adjustable deadbands.

7. Instantaneous line-to-line and line-to-ground overcurrent trips.
  8. Loss-of-phase protection.
  9. Reverse-phase protection.
  10. Short-circuit protection.
  11. Motor overtemperature fault.
- L. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- M. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
- N. Bidirectional Autospeed Search: Capable of starting VFD into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- O. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- P. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- Q. Integral Input Disconnecting Means and OCPD: NEMA AB 1, thermal-magnetic circuit breaker with pad-lockable, door-mounted handle mechanism.
1. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFD input current rating, whichever is larger.
  2. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.

## 2.2 CONTROLS AND INDICATION

- A. Status Lights: Door-mounted LED indicators displaying the following conditions:
1. Power on.
  2. Run.
  3. Overvoltage.
  4. Line fault.
  5. Overcurrent.
  6. External fault.
- B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
- C. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
  2. Running log of total power versus time.
  3. Total run time.
  4. Fault log, maintaining last ten faults with time and date stamp for each.
- D. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFD door and connected to display VFD parameters including, but not limited to:
1. Output frequency (Hz).
  2. Motor speed (rpm).
  3. Motor status (running, stop, fault).
  4. Motor current (amperes).
  5. Motor torque (percent).
  6. Fault or alarming status (code).
  7. PID feedback signal (percent).
  8. DC-link voltage (V dc).
  9. Set point frequency (Hz).
  10. Motor output voltage (V ac).
- E. Control Signal Interfaces:
1. Electric Input Signal Interface:
    - a. A minimum of two programmable analog inputs: 0- to 10-V dc or 4- to 20-mA dc. Operator-selectable.
    - b. A minimum of six multifunction programmable digital inputs.
  2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:
    - a. 0- to 10-V dc.
    - b. 4- to 20-mA dc.
    - c. Potentiometer using up/down digital inputs.
    - d. Fixed frequencies using digital inputs.
  3. Output Signal Interface: A minimum of one programmable analog output signal. 0- to 10-V dc or 4- to 20-mA dc operator-selectable, which can be configured for any of the following:
    - a. Output frequency (Hz).
    - b. Output current (load).
    - c. DC-link voltage (V dc).
    - d. Motor torque (percent).
    - e. Motor speed (rpm).
    - f. Set point frequency (Hz).
  4. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
    - a. Motor running.
    - b. Set point speed reached.
    - c. Fault and warning indication (overtemperature or overcurrent).
    - d. PID high- or low-speed limits reached.
- F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.
1. Number of Loops: Two.



- G. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display VFD status and alarms and energy usage. Allows VFD to be used with an external system within a multidrop LAN configuration; settings retained within VFD's nonvolatile memory.
  - 1. Network Communications Ports: Ethernet and RS-422/485.
  - 2. Embedded BAS Protocols for Network Communications for communication with project specific BAS; protocols accessible via the communications ports.

## 2.3 LINE CONDITIONING AND FILTERING

- A. Input Line Conditioning: provide input filtering, as required, to limit TDD at input terminals of all VFDs to less than 8 percent and THD(V) to 5 percent.
- B. Output Filtering: Sine-wave filter greater than 98% efficient .
- C. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2 .
- D. EMI/RFI Filtering: To ensure interference-free operation at all times .

## 2.4 BYPASS SYSTEMS

- A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.
- B. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic control system feedback.
- C. Bypass Controller: Three-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter input and output and permit safe testing and troubleshooting of the power converter, both energized and de-energized, while motor is operating in bypass mode.
  - 1. Bypass Contactor: Load-break, NEMA-rated contactor.
  - 2. Input and Output Isolating Contactors: Non-load-break, IEC NEMA-rated contactors.
  - 3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.
- D. Bypass Contactor Configuration: Reduced-voltage (autotransformer) type.
  - 1. NORMAL/BYPASS selector switch.
  - 2. HAND/OFF/AUTO selector switch.
  - 3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFC while the motor is running in the bypass mode.
  - 4. Contactor Coils: Pressure-encapsulated type.
    - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

- b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
- 5. Control Circuits: 120 -V ac; obtained from integral CPT, with primary fuses, with CPT of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.
  - a. CPT Spare Capacity: 100 VA.
- 6. Overload Relays: NEMA ICS 2.
  - a. Melting-Alloy Overload Relays:
    - 1) Inverse-time-current characteristic.
    - 2) Class 10 tripping characteristic.
    - 3) Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
  - b. NC isolated overload alarm contact.
  - c. External overload reset push button.

## 2.5 "MICRO" VARIABLE FREQUENCY DRIVES

### A. Manufacturers

- 1. Danfoss VLT-Micro.
- 2. Yaskawa V-1000.

### B. Description: VFD factory packaged in an enclosure with overcurrent and overload protection. Arranged to provide variable-speed control of three-phase induction motors.

### C. Design and Rating: Match load type.

### D. Output Rating: Three-phase, 10-60Hz.

### E. Unit operating requirements:

- 1. Input AC Voltage: +/-10% of rating.
- 2. Input Frequency: +/-5% of rating.
- 3. Min. Efficiency: 98% at 60Hz.
- 4. Displacement Power Factor: 0.98.
- 5. Ambient Service Temp: 14°F-104°F.
- 6. Humidity Rating: Less than 95% (non-condensing)
- 7. Starting Torque: Min 100%
- 8. Speed regulation: +/- 1%.
- 9. Ramp times: 0-3600 seconds.

### F. Automatic Reset/Restart: Attempt up to 3 restarts after drive fault or power interruption.

### G. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain English digital display to allow complete programming, operating, monitoring and diagnostic capability.

### H. Control Signed Interface

- 1. Inputs
  - a. 2 analog, 0-10V or 0/4-20mA.

- b. 6 digital/pulse.
  2. Outputs
    - a. 1 analog, 0/4-20mA
    - b. 3 digital
    - c. 1 relay
- I. BAS Interface: Factory-installed hardware and software to enable BAS to monitor, control, and display VFD status, alarms, and energy usage.
  1. Network Communications Ports: Ethernet
  2. BAS Protocols: As required for communication with project specific BAS.

## 2.6 ENCLOSURES

- A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
  1. Dry and Clean Indoor Locations: Type 1.
  2. Outdoor Locations: Type 3R.
  3. Kitchen Wash down Areas: Type 4X, stainless steel.
  4. Other Wet or Damp Indoor Locations: Type 4.
  5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
- B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFD as "Plenum Rated."

## 2.7 ACCESSORIES

- A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.
  1. Push Buttons, Pilot Lights, and Selector Switches: Standard-duty, type.
    - a. Push Buttons: shrouded types; maintained.
    - b. Pilot Lights: LED types; push to test.
    - c. Selector Switches: Rotary type.
    - d. Stop and lockout push-button stations are no longer allowed by NFPA 70 as a means of isolating controllers or motors for personnel safety during maintenance; however, they are still required by some end users and Owners. Retain subparagraph below only if required by the end user or Owner.
- B. NC bypass contactor auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
  1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

- E. Supplemental Digital Meters:
  - 1. Elapsed-time meter.
  - 2. Kilowatt meter.
  - 3. Kilowatt-hour meter.
- F. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, Type 4, Type 4, and Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- G. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

## 2.8 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect VFDs according to requirements in NEMA ICS 61800-2.
  - 1. Test each VFC while connected to a motor that is comparable to that for which the VFD is rated.
  - 2. Verification of Performance: Rate VFDs according to operation of functions and features specified.
- B. VFDs will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFDs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.
- B. Examine VFC before installation. Reject VFDs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. 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.
- B. Wall-Mounting Controllers: Install VFDs on walls with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor unless otherwise indicated,

and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

- C. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.
  - 1. Curbs and roof penetrations are specified in Division 7 Section "Roof Accessories."
  - 2. Structural-steel channels are specified in Division 15 Section "Hangers and Supports for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in each fusible-switch VFD.
- F. Install fuses in control circuits if not factory installed. Comply with requirements in Division 16 Section "Fuses."
- G. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- I. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Identify VFDs, components, and control wiring. Comply with requirements for identification specified in Division 15 Section "Mechanical Identification."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each VFD with engraved nameplate.
  - 3. Label each enclosure-mounted control and pilot device.
- B. Operating Instructions: Frame printed operating instructions for VFDs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFD units.

### 3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between VFDs and remote devices and facility's central-control system.
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic control devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic control devices that have no safety functions when switches are in manual-control position.
2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

### 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. Perform tests and inspections.
  1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  1. Inspect VFD, wiring, components, connections, and equipment installation.
  2. Test insulation resistance for each VFD element, component, connecting motor supply, feeder, and control circuits.
  3. Test continuity of each circuit.
  4. Verify that voltages at VFD locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Engineer before starting the motor(s).
  5. Test each motor for proper phase rotation.
  6. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  7. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. VFDs will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies the VFD. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

### 3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  1. Complete installation and startup checks according to manufacturer's written instructions.

### 3.7 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Engineer before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers.
- E. Set field-adjustable circuit-breaker trip ranges as specified in Division 16 Section "Overcurrent Protective Device Coordination Study."
- F. Set field-adjustable pressure switches.

### 3.8 PROTECTION

- A. Replace VFDs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

### 3.9 DEMONSTRATION

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

END OF SECTION 23 29 23

## 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. Double-wall rectangular ducts and fittings.
3. Single-wall round ducts and fittings.
4. Double-wall round ducts and fittings.
5. Sheet metal materials.
6. Duct liner.
7. Sealants and gaskets.
8. Hangers and supports.

B. Related Sections:

1. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 23 31 16 "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
3. Section 23 33 00 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

#### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. 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.

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8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations , including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Welding certificates.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
  1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
  2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7 .
- C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

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- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- F. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

## 2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. For ducts with longest side less than **36 inches**, select joint types in accordance with Figure 2-1.
  - 2. For ducts with longest side **36 inches** or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
  - 3. Where specified for specific applications, all joints shall be welded.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." All longitudinal seams shall be Pittsburgh lock seams unless otherwise specified for specific application.
  - 1. Where specified for specific applications, all joints shall be welded.
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - 1. McGill AirFlow LLC.
  - 2. MKT Metal Manufacturing.

3. Sheet Metal Connectors, Inc.
  4. Spiral Pipe of Texas (SPOT)
- B. Rectangular Ducts: Fabricate ducts with indicated dimensions for clear internal dimensions of the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- D. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. For ducts with longest side less than **36 inches**, select joint types in accordance with Figure 2-1.
  2. For ducts with longest side **36 inches** or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
  3. Where specified for specific applications, all joints shall be welded.
- E. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." All longitudinal seams shall be Pittsburgh lock seams unless otherwise specified for specific application.
1. Where specified for specific applications, all joints shall be welded.
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Maximum Thermal Conductivity: **0.27 Btu x in./h x sq. ft. x deg F** at **75 deg F** mean temperature.
  2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
  3. Coat insulation with antimicrobial coating.
  4. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Inner Duct: Minimum **24-gauge** solid galvanized sheet steel.

## 2.4 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
1. Construct ducts of galvanized sheet steel unless otherwise indicated.

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2. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Linx Industries (formerly Lindab).
  - b. McGill AirFlow LLC.
  - c. Spiral Pipe of Texas (SPOT).
  
- B. **Transverse Joints:** Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  1. Transverse Joints in Ducts Larger Than **60 Inches** in Diameter: Flanged.
  
- C. **Longitudinal Seams:** Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  1. Fabricate round ducts larger than **90 inches** in diameter with butt-welded longitudinal seams.
  2. Fabricate flat-oval ducts larger than **72 inches** in width (major dimension) with butt-welded longitudinal seams.
  
- D. **Tees and Laterals:** Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.5 DOUBLE-WALL ROUND DUCTS AND FITTINGS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  1. Linx Industries (formerly Lindab).
  2. McGill AirFlow LLC.
  3. Spiral Pipe of Texas (SPOT).
  
- B. **Outer Duct:** Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
  1. Construct ducts of galvanized sheet steel unless otherwise indicated.
  
- C. **Transverse Joints:** Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than **60 Inches** in Diameter: Flanged.
  2. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
    - a. Fabricate round ducts larger than **90 inches** in diameter with butt-welded longitudinal seams.
    - b. Fabricate flat-oval ducts larger than **72 inches** in width (major dimension) with butt-welded longitudinal seams.
  3. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Inner Duct: Minimum **24-gauge** solid galvanized sheet steel.
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Maximum Thermal Conductivity: **0.27 Btu x in./h x sq. ft. x deg F** at **75 deg F** mean temperature.
  2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
  3. Coat insulation with antimicrobial coating.
  4. Cover insulation with polyester film complying with UL 181, Class 1.

## 2.6 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: **G90**.
  2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.
- E. 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.

## METAL DUCTS

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- 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**.

## 2.7 DUCT LINER

- A. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534/C 534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Aeroflex USA.
  - b. Armacell LLC.
  - c. Ductmate Industries, Inc.
  - d. K-Flex USA.
2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

- B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, **0.106-inch-** diameter shank, length to suit depth of insulation indicated with integral **1-1/2-inch** galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from **0.016-inch-** thick galvanized steel ; with beveled edge sized as required to hold insulation securely in place, but not less than **1-1/2 inches** in diameter.

- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Secure liner with mechanical fasteners **4 inches** from corners and at intervals not exceeding **12 inches** transversely; at **3 inches** from transverse joints and at intervals not exceeding **18 inches** longitudinally.
7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
  - a. Fan discharges.
  - b. Intervals of lined duct preceding unlined duct.
8. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other

## METAL DUCTS

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buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## 2.8 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  2. Tape Width: **3 inches**.
  3. Sealant: Modified styrene acrylic.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. Maximum Static-Pressure Class: **10 inch wg**, positive and negative.
  7. Service: Indoor and outdoor.
  8. Service Temperature: **Minus 40 to plus 200 deg F**.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
- C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
  2. Solids Content: Minimum 65 percent.
  3. Shore A Hardness: Minimum 20.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. VOC: Maximum 75 g/L (less water).
  7. Maximum Static-Pressure Class: **10 inch wg**, positive and negative.
  8. Service: Indoor or outdoor.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
  2. Type: S.
  3. Grade: NS.
  4. Class: 25.
  5. Use: O.
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of **3 cfm/100 sq. ft. at 1-inch wg** and shall be rated for **10-inch wg** static-pressure class, positive or negative.
  2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.9 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," **Table 5-1**, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
  1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.



- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of **1 inch**, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least **1-1/2 inches**.
- J. Install fire , combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.
- K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- M. Elbows: Use long-radius elbows wherever they fit.
  - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
  - 2. Fabricate 90-degree round elbows with a minimum of three segments for **12 inches** and smaller and a minimum of five segments for **14 inches** and larger.
- N. Branch Connections: Use lateral or conical branch connections.

### 3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

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- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### 3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR TYPE 1 COMMERCIAL KITCHEN GREASE HOOD EXHAUST DUCT

- A. Refer to Section 23 35 33 Listed Kitchen Ventilation System Exhaust Ducts.
- B. Install ducts in accordance with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operation"; SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; and SMACNA's "Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines" unless otherwise indicated.
- C. Install all ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- D. All ducts exposed to view shall be constructed of stainless steel as per "Duct Schedule" Article. All ducts concealed from view shall be stainless steel as per "Duct Schedule" Article.
- E. All joints shall be welded and shall be telescoping, bell, or flange joint as per NFPA 96.
- F. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of **12 feet** in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings.
- G. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

### 3.4 ADDITIONAL INSTALLATION REQUIREMENTS FOR LABORATORY EXHAUST AND FUME HOOD EXHAUST DUCTS

- A. Install ducts in accordance with NFPA 45, "Fire Protection for Laboratories Using Chemicals."
- B. Install exhaust ducts without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to hood or inlet. Where indicated on Drawings, install trapped drain piping.
- C. Connect duct to fan, fume hood, and other equipment indicated on Drawings.

### 3.5 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.7 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.8 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

### 3.9 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:

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- a. Supply Ducts with a Pressure Class of **3- Inch wg** or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
  - b. Return Ducts with a Pressure Class of **3- Inch wg** or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
  - c. Exhaust Ducts with a Pressure Class of **3- Inch wg** or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
  - d. Outdoor-Air Ducts with a Pressure Class of **3- Inch wg** or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  4. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
  5. Test for leaks before applying external insulation.
  6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
  7. Give seven days' advance notice for testing.
- C. Duct system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.10 STARTUP

- A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

### 3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
  1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
- B. Supply Ducts:
  1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units :
    - a. Pressure Class: Positive **1- inch wg**.
    - b. Minimum SMACNA Seal Class: C.
    - c. SMACNA Leakage Class for Rectangular: 16.
    - d. SMACNA Leakage Class for Round and Flat Oval: 8 .
  2. Ducts Connected to Constant-Volume Air-Handling Units :
    - a. Pressure Class: Positive **2- 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 .

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3. Ducts Connected to Variable-Air-Volume Air-Handling Units :
    - a. Pressure Class: Positive **3- inch wg.**
    - b. Minimum SMACNA Seal Class: A .
    - c. SMACNA Leakage Class for Rectangular: 4 .
    - d. SMACNA Leakage Class for Round and Flat Oval: 2 .
- C. Return Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units :
    - a. Pressure Class: Positive or negative **1- inch wg.**
    - b. Minimum SMACNA Seal Class: C.
    - c. SMACNA Leakage Class for Rectangular: 16.
    - d. SMACNA Leakage Class for Round and Flat Oval: 8 .
  2. Ducts Connected to Air-Handling Units :
    - a. Pressure Class: Positive or negative **2- inch wg.**
    - b. Minimum SMACNA Seal Class: B .
    - c. SMACNA Leakage Class for Rectangular: 8 .
    - d. SMACNA Leakage Class for Round and Flat Oval: 4 .
- D. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative **1- inch wg.**
    - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 16.
    - d. SMACNA Leakage Class for Round and Flat Oval: 8 .
  2. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
    - a. Refer to Section 23 35 33 Listed Kitchen Ventilation System Exhaust Ducts.
    - b. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
    - c. Concealed: Type 304, stainless-steel sheet, No. 2D finish .
    - d. Welded seams and joints.
    - e. Pressure Class: Positive or negative **4- inch wg.**
    - f. Airtight/watertight.
  3. Ducts Connected to Fans Exhausting Fume Hood, Laboratory, and Process (ASHRAE 62.1, Class 3 and Class 4) Air:
    - a. Type 304, stainless-steel sheet.
      - 1) Exposed to View: No. 4 finish.
      - 2) Concealed: No. 2B finish.
    - b. Pressure Class: Positive or negative **6- inch wg.**
    - c. Welded seams and joints.
    - d. Airtight/watertight.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units :
    - a. Pressure Class: Positive or negative **1- inch wg.**
    - b. Minimum SMACNA Seal Class: .
    - c. SMACNA Leakage Class for Rectangular: 16.
    - d. SMACNA Leakage Class for Round and Flat Oval: 8 .
  2. Ducts Connected to Air-Handling Units :
    - a. Pressure Class: Positive or negative **2- inch wg.**
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 8 .

d. SMACNA Leakage Class for Round and Flat Oval: 4 .

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.

G. Liner:

1. Supply-Air Ducts: Flexible elastomeric , 1-1/2 inch(es) thick.
2. Return-Air Ducts: Flexible elastomeric , 1-1/2 inch(es) thick.
3. Transfer Ducts: Flexible elastomeric , 1-1/2 inch(es) thick.

H. Double-Wall Duct Interstitial Insulation:

1. Supply-Air Ducts: 2 inch(es) thick.
2. Return-Air Ducts: 2 inch(es) thick.
3. Exhaust-Air Ducts: 1 2 inch(es) thick.

I. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Velocity 1000 fpm or Lower:
    - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
    - 2) Mitered Type RE 4 without vanes.
  - b. Velocity 1000 to 1500 fpm:
    - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  - c. Velocity 1500 fpm or Higher:
    - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
  - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
    - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
    - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
    - 4) Radius-to Diameter Ratio: 1.5.

- b. Round Elbows, **12 Inches** and Smaller in Diameter: Stamped or pleated.
- c. Round Elbows, **14 Inches** and Larger in Diameter: Standing seam or Welded.

J. Branch Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
  - a. Rectangular Main to Rectangular Branch: 45-degree entry.
  - b. Rectangular Main to Round Branch: Conical spin in.
- 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
  - a. Velocity **1000 fpm** or Lower: 90-degree tap.
  - b. Velocity **1000 to 1500 fpm**: Conical tap.
  - c. Velocity **1500 fpm** or Higher: 45-degree lateral.

END OF SECTION 23 31 13

## SECTION 23 33 00 - AIR DUCT ACCESSORIES

### PART 1 - GENERAL

#### 1.1 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. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Smoke dampers.
5. Combination fire and smoke dampers.
6. Flange connectors.
7. Turning vanes.
8. Remote damper operators.
9. Duct-mounted access doors.
10. Flexible connectors.
11. Duct accessory hardware.

- B. Related Requirements:

1. Section 23 33 46 "Flexible Ducts" for insulated and non-insulated flexible ducts.
2. Section 28 31 "Voice Evacuation Fire-Alarm System" 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. Control-damper installations.
  - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor-damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
  - e. Include diagrams for power, signal, and control wiring.



#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, or BIM model, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.
- 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 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 90A and NFPA 90B.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

#### 2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cesco Products; a division of MESTEK, Inc.
  - 2. Greenheck Fan Corporation.
  - 3. Nailor Industries Inc.
  - 4. Ruskin Company.
- B. Description: Gravity balanced.
- C. Performance:
  - 1. Maximum Air Velocity: 3000 fpm .
  - 2. Maximum System Pressure: 2 inches wg .
  - 3. AMCA Certification: Test and rate in accordance with AMCA 511.

4. Leakage:
  - a. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
- D. Construction:
  1. Frame:
    - a. Hat shaped.
    - b. 16-gauge- thick, galvanized sheet steel , with welded or mechanically attached corners and mounting flange.
  2. Blades:
    - a. Multiple single-piece blades.
    - b. End pivoted, maximum 6-inch width, 16-gauge- thick, galvanized sheet steel with sealed edges.
  3. Blade Action: Parallel.
- E. Blade Seals: Extruded vinyl, mechanically locked.
- F. Blade Axles:
  1. Material: Galvanized steel.
- G. Tie Bars and Brackets: Galvanized steel.
- H. Return Spring: Adjustable tension.
- I. Bearings: Steel ball Brass sleeve.
- J. Accessories:
  1. Adjustment device to permit setting for varying differential static pressure.
  2. Counterweights and spring-assist kits for vertical airflow installations.
  3. Chain pulls.

## 2.3 BAROMETRIC RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Cesco Products; a division of MESTEK, Inc.
  2. Greenheck Fan Corporation.
  3. Nailor Industries Inc.
  4. Ruskin Company.
- B. General Requirements:
  1. Suitable for horizontal or vertical mounting.
  2. Maximum Air Velocity: 1000 fpm .
  3. Maximum System Pressure: 2 inches wg .
- C. Construction:

1. Frame: Hat shaped, **0.093-inch-** thick extruded aluminum , with welded corners or mechanically attached and mounting flange.
2. Blades:
  - a. Multiple, **0.050-inch-** thick aluminum sheet .
  - b. Maximum Width: **6 inches.**
  - c. Action: Parallel.
  - d. Balance: Gravity.
  - e. Eccentrically pivoted.
3. Blade Seals: Vinyl .
4. Blade Axles: Nonferrous metal .
5. Tie Bars and Brackets:
  - a. Material: Aluminum .
  - b. Rattle free with 90-degree stop.
6. Bearings: Synthetic .

D. Pressure Adjustment: Return spring or counter weight with adjustable tension.

E. Accessories:

1. Flange on intake.
2. Adjustment device to permit setting for varying differential static pressures.
3. .

## 2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Cesco Products; a division of MESTEK, Inc.
  - b. Greenheck Fan Corporation.
  - c. Nailor Industries Inc.
  - d. Ruskin Company.
2. Performance:
  - a. Leakage Rating Class III: Leakage not exceeding **40 cfm/sq. ft.** against **1-inch wg** differential static pressure.
3. Construction:
  - a. Linkage out of airstream.
  - b. Suitable for horizontal or vertical airflow applications.
4. Frames:
  - a. Hat-shaped, **16-gauge-** thick, galvanized sheet steel .
  - b. Mitered and welded corners.
  - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
  - a. Multiple or single blade.
  - b. Parallel- or opposed-blade design.
  - c. Stiffen damper blades for stability.
  - d. Galvanized steel; **16 gauge** thick.
6. Blade Axles: Galvanized steel .
7. Bearings:
  - a. Molded synthetic .
  - b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.

8. Tie Bars and Brackets: Galvanized steel.
9. Locking device to hold damper blades in a fixed position without vibration.

B. Jackshaft:

1. Size: **1-inch** diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle, made of **3/32-inch**- thick zinc-plated steel, and a **3/4-inch** hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

## 2.5 SMOKE DAMPERS

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

1. Greenheck Fan Corporation.
2. Ruskin Company.

B. General Requirements:

1. Label to indicate conformance to UL 555 and UL 555S by an NRTL.
2. Label to indicate conformance to NFPA 80 and NFPA 90A by an NRTL.
3. Unless otherwise indicated, use parallel-blade configuration.
4. Factory or field assemble multiple damper sections to provide a single damper assembly of size required by the application.
5. Factory install damper actuator by damper manufacturer as integral part of damper assembly. Coordinate actuator location, mounting, and electrical requirements with damper manufacturer.

C. Performance:

1. AMCA Certification: Test and rate in accordance with AMCA Publication 511.
2. Leakage:
  - a. Class IA: Leakage shall not exceed **3 cfm/sq. ft.** against **1-inch wg** differential static pressure.
3. Pressure Drop: **0.05 inch wg** at **1500 fpm** across a **24-by-24-inch** damper when tested in accordance with AMCA 500-D, Figure 5.3.
4. Velocity: Up to **3000 fpm**.
5. Temperature: **Minus 25 to plus 180 deg F**.
6. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.

D. Construction:

1. Suitable for horizontal or vertical airflow applications.

2. Linkage out of airstream.
  3. Frame:
    - a. Hat shaped.
    - b. Galvanized sheet steel , with interlocking, gusseted or mechanically attached corners and mounting flange.
    - c. Gauge in accordance with UL listing.
  4. Blades:
    - a. Roll-formed, horizontal, airfoil , galvanized sheet steel .
    - b. Maximum width and gauge in accordance with UL listing.
  5. Blade Edging Seals:
    - a. Silicone rubber.
  6. Blade Jamb Seal: Flexible stainless steel, compression type.
  7. Blade Axles: **1/2-inch** diameter; galvanized steel ; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings. Linkage is to be mounted out of airstream.
  8. Bearings:
    - a. Oil-impregnated stainless steel sleeve .
- E. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone caulking; gauge in accordance with UL listing.
- F. Damper Actuator - Electric:
1. Electric - 24 V ac.
  2. UL 873, plenum rated.
  3. Designed to operate in smoke-control systems complying with UL 555S requirements.
  4. Two position with fail-safe spring return.
    - a. Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
    - b. Maximum 15-second full-stroke closure.
    - c. Minimum 90-degree drive rotation.
  5. Clockwise or counterclockwise drive rotation as required for application.
  6. Environmental Operating Range:
    - a. Temperature: **Minus 40 to plus 130 deg F.**
    - b. Humidity: 5 to 95 percent relative humidity noncondensing.
  7. Environmental Enclosure: NEMA 2.
  8. Actuator to be factory mounted and provided with single-point wiring connection.
- G. Controllers, Electrical Devices, and Wiring:
1. Comply with requirements for electrical devices and connections specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC."
  2. Electrical Connection: 24 V, 60 Hz .
- H. Accessories:
1. Auxiliary switches for signaling or position indication.
  2. Test and reset switches , damper mounted.
  3. Smoke Detector: Integral, factory wired for single-point connection.

## 2.6 COMBINATION FIRE AND SMOKE DAMPERS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. Cesco Products; a division of MESTEK, Inc.
  2. Greenheck Fan Corporation.
  3. Ruskin Company.
- B. General Requirements:
1. Label to indicate conformance to UL 555 and UL 555S by an NRTL.
  2. Label to indicate conformance to NFPA 80 and NFPA 90A by an NRTL.
  3. Unless otherwise indicated, use parallel-blade configuration.
- C. Closing rating in ducts up to 6-inch wg static pressure class and minimum **2000 fpm** velocity.
- D. Fire Rating: 1-1/2 hours.
- E. Performance:
1. AMCA Certification: Test and rate in accordance with AMCE Publication 511.
  2. Leakage:
    - a. Class II: Leakage shall not exceed **10 cfm/sq. ft.** against **1-inch wg** differential static pressure.
  3. Pressure Drop: **0.09 in. wg** at **1500 fpm** across a **24-by-24-inch** damper when tested in accordance with AMCA 500-D, Figure 5.3.
  4. Velocity: Up to **2000 fpm**.
  5. Temperature: **Minus 25 to plus 350 deg F**.
  6. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
- F. Construction:
1. Suitable or horizontal or vertical airflow applications.
  2. Linkage out of airstream.
  3. Frame:
    - a. Hat shaped.
    - b. Galvanized sheet steel , with interlocking, gusseted corners and mounting flange.
    - c. Gauge is to be in accordance with UL listing.
  4. Blades:
    - a. Roll-formed, horizontal, , galvanized sheet steel .
    - b. Maximum width and gauge in accordance with UL listing.
  5. Blade Edging Seals:
    - a. Silicone rubber.
  6. Blade Jamb Seal: Flexible stainless steel, compression type.
  7. Blade Axles: **1/2-inch-** diameter; galvanized steel ; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of airstream.
  8. Bearings:
    - a. Oil-impregnated stainless steel sleeve .
- G. Mounting Sleeve:
1. Factory installed, galvanized sheet steel.

2. Length to suit wall or floor application with factory-furnished silicone caulking.
3. Gauge in accordance with UL listing.

H. Heat-Responsive Device:

1. Electric resettable device and switch package, factory installed, rated.

I. Master control panel for use in dynamic smoke-management systems.

J. Damper Actuator - Electric:

1. Electric - 24 V ac.
2. UL 873, plenum rated.
3. Designed to operate in smoke-control systems complying with UL 555S requirements.
4. Two position with fail-safe spring return.
  - a. Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
  - b. Maximum 15-second full-stroke closure.
  - c. Minimum 90-degree drive rotation.
5. Clockwise or counterclockwise drive rotation as required for application.
6. Environmental Operating Range:
  - a. Temperature: **Minus 40 to plus 130 deg F.**
  - b. Humidity: 5 to 95 percent relative humidity noncondensing.
7. Environmental Enclosure: NEMA 2.
8. Actuator to be factory mounted and provided with single-point wiring connection.

K. Controllers, Electrical Devices, and Wiring:

1. Comply with requirements for electrical devices and connections specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC."
2. Electrical Connection: 24 V, 60 Hz .

L. Accessories:

1. Auxiliary switches for signaling or position indication.
2. Test and reset switches , damper mounted.
3. Smoke Detector: Integral, factory wired for single-point connection.

## 2.7 FLANGE CONNECTORS

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

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc.
3. Elgen Manufacturing.
4. Ward Industries; a brand of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

- D. Gauge and Shape: Match connecting ductwork.

## 2.8 DUCT SILENCERS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. Price Industries.
  2. Vibro-Acoustics.
- B. General Requirements:
1. Factory fabricated.
  2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.
  3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
  4. Bearing AMCA's Certified Ratings Seal for prefabricated silencer sound and air performance.
- C. Shape:
1. Rectangular straight with splitters or baffles.
  2. Round straight with center bodies or pods.
  3. Rectangular elbow with splitters or baffles.
  4. Round elbow with center bodies or pods.
  5. Rectangular transitional with splitters or baffles.
- D. Rectangular Silencer Outer Casing: ASTM A653/A653M, G90 , galvanized sheet steel, 0.040 inch thick.
- E. Round Silencer Outer Casing: ASTM A653/A653M, G90 , galvanized sheet steel.
1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 22 gauge thick.
  2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 20 gauge thick.
  3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 18 gauge thick.
  4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 16 gauge thick.
- F. Inner Casing and Baffles: ASTM A653/A653M, G90 galvanized sheet metal, 22 gauge thick, and with 1/8-inch- diameter perforations.
- G. Special Construction:
1. Suitable for outdoor use.
  2. High transmission loss .
- H. Connection Sizes: Match connecting ductwork unless otherwise indicated.
- I. Principal Sound-Absorbing Mechanism:
1. Controlled impedance membranes and broadly tuned resonators without absorptive media.



2. Dissipative type with fill material.
    - a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression .
    - b. Erosion Barrier: Polymer bag enclosing fill, heat-sealed before assembly.
  3. Lining: None .
- J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
1. Joints: Continuously welded or flanged connections.
  2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
  3. Reinforcement: Cross or trapeze angles for rigid suspension.
- K. Accessories:
1. Integral 1-1/2 -hour fire damper with access door. Access door to be high transmission loss to match silencer.
  2. Factory-installed end caps to prevent contamination during shipping.
  3. Removable splitters.
  4. Airflow-measuring devices.
- L. Source Quality Control:
1. Test in accordance with ASTM E477.
  2. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000 fpm face velocity.
  3. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

## 2.9 TURNING VANES

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. Aero-Dyne Sound Control Co.
  2. CL WARD & Family Inc.
  3. Ductmate Industries, Inc.
  4. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Fabricate curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 4-3, "Vaness and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- D. Vane Construction:

1. Double wall.

## 2.10 REMOTE DAMPER OPERATORS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  1. Metropolitan Air Technology
  2. United Enertech.
  3. Young Regulator Company.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Copper .
- D. Cable: Stainless steel .
- E. Wall-Box Mounting: Recessed .
- F. Wall-Box Cover-Plate Material: Stainless steel.

## 2.11 DUCT-MOUNTED ACCESS DOORS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  1. Cesco Products; a division of MESTEK, Inc.
  2. Ductmate Industries, Inc.
  3. Flexmaster U.S.A., Inc.
  4. Greenheck.
  5. Ruskin Company.
- B. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2 (7-2M), "Duct Access Doors and Panels," and Figure 7-3, "Access Doors - Round Duct."
  1. Door:
    - a. Double wall, rectangular.
    - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    - c. **24-gauge-** thick galvanized steel or **0.032-inch** thick aluminum or **24-gauge-** thick stainless steel door panel.
    - d. Vision panel.
    - e. Hinges and Latches: **1-by-1-inch** butt or piano hinge and cam latches.
    - f. Fabricate doors airtight and suitable for duct pressure class.
  2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
    - a. **24-gauge-** thick galvanized steel or **0.032-inch-** thick aluminum frame.
  3. Number of Hinges and Locks:
    - a. Access Doors Less Than **12 Inches** Square: No hinges and two sash locks.
    - b. Access Doors up to **18 Inches** Square: Continuous and two sash locks.
    - c. Access Doors up to **24 by 48 Inches**: Continuous and two compression latches with outside and inside handles.

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- d. Access Doors Larger Than **24 by 48 Inches**: Continuous and two compression latches with outside and inside handles.

## 2.12 FLEXIBLE CONNECTORS

- A. **Manufacturers**: Subject to compliance with requirements, provide products by one of the following:
  1. CL WARD & Family Inc.
  2. Ductmate Industries, Inc.
  3. Duro Dyne Inc.
  4. DynAir; a Carlisle Company.
  5. Elgen Manufacturing.
  6. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Materials: Flame-retardant or noncombustible fabrics.
- E. Coatings and Adhesives: Comply with UL 181, Class 1.
- F. Metal-Edged Connectors: Factory fabricated with a fabric strip **3-1/2 inches** wide attached to two strips of **2-3/4-inch-** wide, **0.028-inch-** thick, galvanized sheet steel or **0.032-inch-** thick aluminum sheets. Provide metal compatible with connected ducts.
- G. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
  1. Minimum Weight: **26 oz./sq. yd.** .
  2. Tensile Strength: **480 lbf/inch** in the warp and **360 lbf/inch** in the filling.
  3. Service Temperature: **Minus 40 to plus 200 deg F.**
- H. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
  1. Minimum Weight: **24 oz./sq. yd.** .
  2. Tensile Strength: **530 lbf/inch** in the warp and **440 lbf/inch** in the filling.
  3. Service Temperature: **Minus 50 to plus 250 deg F.**

## 2.13 DUCT ACCESSORY HARDWARE

- A. **Manufacturers**: Subject to compliance with requirements, provide products by one of the following:
  1. CL WARD & Family Inc.
  2. Ductmate Industries, Inc.
  3. Duro Dyne Inc.
  4. DynAir; a Carlisle Company.

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5. Elgen Manufacturing.
6. Ward Industries; a brand of Hart & Cooley, Inc.

- B. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- C. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## 2.14 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
  1. Galvanized Coating Designation: **G90**.
  2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4D finish for exposed ducts.
- C. Aluminum Sheets: Comply with **ASTM B209**, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, one-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with **ASTM B221**, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless steel ducts.
- F. Tie Rods: Galvanized steel, **1/4-inch** minimum diameter for lengths **36 inches** or less; **3/8-inch** minimum diameter for lengths longer than **36 inches**.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers (control dampers for fans with 2,000 cfm or more) at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.

- E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  - 1. Install steel volume dampers in steel ducts.
  - 2. Install aluminum volume dampers in aluminum ducts.
- F. Set dampers to fully open position before testing, adjusting, and balancing.
- G. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.
- H. Install fire and smoke dampers in accordance with UL listing.
- I. Connect ducts to duct silencers rigidly.
- J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Upstream and downstream from duct filters.
  - 3. At outdoor-air intakes and mixed-air plenums.
  - 4. At drain pans and seals.
  - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 7. Upstream from turning vanes.
  - 8. Upstream or downstream from duct silencers.
  - 9. For grease ducts, install at locations and spacing as required by NFPA 96.
  - 10. Control devices requiring inspection.
  - 11. Elsewhere as indicated.
- K. Install access doors with swing against duct static pressure.
- L. 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.
- M. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- N. Install flexible connectors to connect ducts to equipment.

- O. For fans developing static pressures of **5 inches wg** and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- P. Install duct test holes where required for testing and balancing purposes.
- Q. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of **1/4-inch** movement during start and stop of fans.
- R. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- S. Connect diffusers or light troffer boots to ducts with maximum 72 inches lengths of flexible duct clamped or strapped in place.

### 3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Operate dampers to verify full range of movement.
  - 2. Inspect locations of access doors, and verify that size and location of access doors are adequate to perform required operation.
  - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and that proper heat-response device is installed.
  - 4. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
  - 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 33 00

## SECTION 23 33 46 - FLEXIBLE DUCTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Insulated flexible ducts.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For flexible ducts.
  - 1. Include plans showing locations and mounting and attachment details.

### 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.
- C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."
- D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

#### 2.2 INSULATED FLEXIBLE DUCTS

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

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1. Flexmaster U.S.A., Inc. Product model: 1M.
  2. Thermaflex; a Flex-Tek Group company. Product model: M-KE.
- B. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  2. Velocity Rating: 5000 fpm minimum.
  3. Temperature Range: Minus 20 to plus 250 deg F.
  4. Insulation R-Value: R8.

### 2.3 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
- C. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- D. Connect diffusers or light troffer boots to ducts directly or with maximum 72-inch lengths of flexible duct clamped or strapped in place.
- E. Connect flexible ducts to metal ducts with draw bands .
- F. Install duct test holes where required for testing and balancing purposes.
- G. Installation:
1. Install ducts fully extended.
  2. Do not bend ducts across sharp corners.
  3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
  4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
  5. Install flexible ducts in a direct line, without sags, twists, or turns.
- H. Supporting Flexible Ducts:
1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.

## FLEXIBLE DUCTS

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2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of **72 inches** o.c.

END OF SECTION 23 33 46

**FLEXIBLE DUCTS**  
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## SECTION 23 34 23 - HVAC POWER VENTILATORS

### PART 1 - GENERALa

#### 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. Ceiling-mounted ventilators.
  2. Centrifugal ventilators - roof downblast.
  3. Centrifugal ventilators - roof upblast.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
  2. Rated capacities, operating characteristics, and furnished specialties and accessories.
  3. Certified fan performance curves with system operating conditions indicated.
  4. Certified fan sound-power ratings.
  5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  6. Material thickness and finishes, including color charts.
  7. Dampers, including housings, linkages, and operators.
  8. Prefabricated roof curbs.
  9. Fan speed controllers.
- B. Shop Drawings:
1. Include plans, elevations, sections, and attachment details.
  2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  3. Include diagrams for power, signal, and control wiring.
  4. Design Calculations: Calculate requirements for selecting vibration isolators.
- C. Delegated Design Submittal: For unit hangars and supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.

## HVAC POWER VENTILATORS

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2. Wind Restraint Details: Detail fabrication and attachment of wind restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, or BIM model, drawn to scale, showing the items described in this Section and coordinated with all building trades.
- B. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For HVAC power ventilators to include in normal and emergency operation, and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.
- C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- E. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design vibration isolation, supports, , including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- F. Wind Performance: Air-handling units shall withstand the effects of wind determined in accordance with to ASCE/SEI 7 .
  1. Basic Wind Speed: 140 mph.
  2. Building Classification/Risk Category: E/III.

#### 2.2 CEILING-MOUNTED VENTILATORS

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

### HVAC POWER VENTILATORS

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1. Greenheck Fan Corporation.
  2. Loren Cook Company.
  3. PennBarry.
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel removable for service.
- D. Back-draft damper: Integral.
- E. Grille: Painted aluminum, louvered grille with flange on intake and thumbscrew or spring retainer attachment to fan housing.
- F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- G. Accessories:
1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
  3. Isolation: Rubber-in-shear vibration isolators.
  4. Manufacturer's standard roof jack or wall cap, and transition fittings.

### 2.3 CENTRIFUGAL VENTILATORS - ROOF DOWNBLAST

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Corporation.
  2. Loren Cook Company.
  3. PennBarry.
- B. Housing: Downblast; removable spun-aluminum dome top and outlet baffle ; square, one-piece aluminum base with venturi inlet cone.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades .
- D. Accessories:
1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
  3. Bird Screens: Removable, **1/2-inch** mesh, aluminum or brass wire.
  4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
- E. Prefabricated Roof Curbs: Galvanized steel; mitered and welded corners; **1-1/2-inch**- thick, rigid, fiberglass insulation adhered to inside walls; and **1-1/2-inch** wood nailer. Size as required to suit roof opening and fan base.

## HVAC POWER VENTILATORS

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1. Configuration: Built-in raised cant and mounting flange Manufactured to accommodate roof slope.
2. Overall Height: **12 inches** .
3. Sound Curb: Curb with sound-absorbing insulation.
4. Pitch Mounting: Manufacture curb for roof slope.
5. Metal Liner: Galvanized steel.
6. Mounting Pedestal: Galvanized steel with removable access panel.

## 2.4 CENTRIFUGAL VENTILATORS - ROOF UPBLAST

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Corporation.
  2. Loren Cook Company.
  3. PennBarry.
- B. Configuration: Centrifugal roof upblast, grease hood kitchen ventilator.
- C. 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.
  2. Provide grease collector.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades .
- E. Accessories:
1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
  3. Bird Screens: Removable, **1/2-inch** mesh, aluminum or brass wire.
  4. Mounting Pedestal: Galvanized steel with removable access panel.
  5. Restaurant Kitchen Exhaust: UL 762 listed for grease-laden air exhaust.
- F. Prefabricated Kitchen Exhaust Roof Curbs: Galvanized steel; mitered and welded corners; ventilation openings on all sides to ventilate curb interstitial space. Size as required to suit roof opening and fan base.
1. Configuration: Built-in raised cant and mounting flange manufactured to accommodate roof slope.
  2. Overall Height: **12 inches** .
  3. Hinged sub-base to provide access to damper or as cleanout for grease applications.
  4. Pitch Mounting: Manufacture curb for roof slope.
  5. Metal Liner: Galvanized steel.
  6. Mounting Pedestal: Galvanized steel with removable access panel.
  7. Vented Curb: For kitchen exhaust; **12-inch-** high galvanized steel; unlined, with louvered vents in vertical sides.
  8. NFPA 96 code requirements for commercial cooking operations.
  9. Kitchen Hood Exhaust: UL 762 listed for grease-laden air.

## HVAC POWER VENTILATORS

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## 2.5 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

## 2.6 SOURCE QUALITY CONTROL

- A. AMCA Certification for Fan Sound Performance Rating: Test, rate, and label in accordance with AMCA 311.
- B. AMCA Certification for Fan Aerodynamic Performance Ratings: Test, rate, and label in accordance with AMCA 211.
- C. AMCA Certification for Fan Energy Index (FEI): Test, rate, and label in accordance with AMCA 211.
- D. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Install power ventilators level and plumb.
- B. Equipment Mounting:
  - 1. Secure roof-mounted fans to roof curbs with zinc-plated hardware. See Section 07 72 00 "Roof Accessories" for installation of roof curbs.
  - 2. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
  - 3. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

### 3.2 DUCTWORK CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 33 00 "Air Duct Accessories."

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### 3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
  - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."

### 3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 26 05 23 "Control-Voltage Electrical Power Cables."

### 3.5 STARTUP SERVICE:

- A. Perform startup service.
  - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
  - 2. Verify that shipping, blocking, and bracing are removed.
  - 3. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
  - 4. Verify that cleaning and adjusting are complete.
  - 5. For direct-drive fans, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
  - 6. 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 confirm proper motor rotation and unit operation, 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.

### 3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Lubricate bearings.
- C. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

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3.7 CLEANING

- A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
  - 1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 2. Test and adjust controls and safeties.
  - 3. Fans and components will be considered defective if they do not pass tests and inspections.
  - 4. Prepare test and inspection reports.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 23 34 23

HVAC POWER VENTILATORS

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## SECTION 23 35 33 - LISTED KITCHEN VENTILATION SYSTEM EXHAUST 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. Listed grease ducts.
  - 2. Access doors.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for listed grease ducts.
- B. Shop Drawings: For listed grease ducts.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Detail fabrication and assembly of hangers and seismic restraints.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

#### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
  - 2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in listed grease ducts and field-fabricated grease ducts.

## LISTED KITCHEN VENTILATION SYSTEM EXHAUST DUCTS

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## PART 2 - PRODUCTS

### 2.1 LISTED GREASE DUCTS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. AMPCO Stacks.
  2. Jeremias, Inc.
  3. Metal-Fab, Inc.
  4. Selkirk Corporation.
- B. Description: Factory-fabricated, -listed, and -labeled, double-wall ducts tested according to UL 1978 and rated for **500 deg F** continuously, or **2000 deg F** for 30 minutes; with positive or negative duct pressure and complying with NFPA 211.
- C. Construction: Inner shell and outer jacket separated by at least a **1-inch** annular space filled with high-temperature, ceramic-fiber insulation.
1. Inner Shell: ASTM A 666, Type 304 stainless steel.
  2. Outer Jacket: Aluminized steel where concealed. Stainless steel where exposed.
- D. Gaskets and Flanges: Ensure that gaskets and sealing materials are rated at **1500 deg F** minimum.
- E. Hood Connectors: Constructed from same material as grease duct with internal or external continuously welded or brazed joints.
- F. Accessories: Tees, elbows, increasers, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly. Include unique components required to comply with NFPA 96 including cleanouts, transitions, adapters, and drain fittings.
- G. Grease Duct Supports: Construct duct bracing and supports from non-combustible material.
1. Design bracing and supports to carry static and seismic loads within stress limitations of the International Building Code.
  2. Ensure that bolts, screws, rivets and other mechanical fasteners do not penetrate duct walls.
- H. Comply with ASTM E 2336.
- I. Factory Tests: Test and inspect fire resistance of grease duct system according to ASTM E 2336.

### 2.2 ACCESS DOORS

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

## LISTED KITCHEN VENTILATION SYSTEM EXHAUST DUCTS

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1. 3M.
  2. ACUDOR Products, Inc.
  3. Ductmate Industries, Inc.
- B. Description: Factory-fabricated, -listed, and -labeled, double-wall access doors tested according to UL 1978 and rated for 500 deg F continuously, or 2000 deg F for 30 minutes; with positive or negative duct pressure and complying with NFPA 211.
1. Construction: 0.0625 inch ASTM A 666, Type 304 stainless-steel inner shell and aluminized-steel outer cover with two handles.
  2. Fasteners: Stainless-steel bolts and wing nuts.
    - a. Ensure that bolts do not penetrate interior of duct space.
  3. Maintenance Access Door Dimensions: 7 x 7 inches .
  4. Door Label: Mark door with uppercase lettering as follows: "ACCESS PANEL. DO NOT OBSTRUCT."

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 INSTALLATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Comply with requirements in Section 07 72 00 "Roof Accessories."
- B. Coordinate connections to kitchen exhaust hoods with requirements in Section 23 38 13 "Commercial-Kitchen Hoods."
- C. Coordinate connections to exhaust fans with requirements in Section 233416 "Centrifugal HVAC Fans."
- D. Coordinate firestopping where grease ducts penetrate fire separations with requirements in Section 07 84 13 "Penetration Firestopping."
- E. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211 and UL 2221, whichever is most stringent.
- F. Install airtight maintenance access doors where indicated.
- G. Connections: Make grease duct connections according to the International Mechanical Code.
  1. Grease duct to exhaust fan connections: Connect grease ducts to inlet side of fan using flanges, gaskets, and bolts.
  2. Grease duct to hood connections:

### LISTED KITCHEN VENTILATION SYSTEM EXHAUST DUCTS

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- a. Make grease duct to hood joints connections using internal or external continuously welded or brazed joints.
- H. Support ducts at intervals recommended by manufacturer to support weight of ducts and accessories, without applying loading on kitchen hoods.
  - 1. Securely attach supports and bracing to structure.
- I. Grease Duct Enclosures: Comply with requirements of the International Building Code and ASTM E 2336.
- J. Coordinate fire-rated enclosure construction with Section 09 21 16.23 "Gypsum Board Shaft Wall Assemblies."
- K. Repair damage to adjacent materials caused by listed kitchen ventilation system exhaust ducts installation.

### 3.3 FIELD QUALITY CONTROL

- A. Perform air leakage test before concealment of any portion of the grease duct system.
  - 1. Notify Owner a minimum of 7 days before test is performed.

END OF SECTION 23 35 33

## LISTED KITCHEN VENTILATION SYSTEM EXHAUST DUCTS

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## SECTION 23 36 00 - AIR TERMINAL UNITS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Modulating, single-duct air terminal units.
  2. Casing liner.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of air terminal unit.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
  2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For air terminal units.
1. Include plans, elevations, sections, and mounting details.
  2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  3. Include diagrams for power, signal, and control wiring.
  4. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Delegated Design Submittal: For vibration isolation and supports, indicated to comply with performance requirements and design criteria, including analysis data.
1. Materials, fabrication, assembly, and spacing of hangers and supports.
  2. Design Calculations: Calculate requirements for selecting vibration isolators, supports, .

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, indicating the items described in this Section, and coordinated with all building trades.
- B. Field quality-control reports.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.

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1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
  - a. Instructions for resetting minimum and maximum air volumes.
  - b. Instructions for adjusting software set points.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a Qualified Electrical Testing Laboratory, and marked for intended location and application.
- B. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."
- D. Delegated Design: design vibration isolation , supports, , using performance requirements and design criteria indicated.

### 2.2 MODULATING, SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Nailor Industries Inc.
  2. Price Industries.
  3. Titus.
- B. Description: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: Minimum 22-gauge- thick galvanized steel.
  1. Casing Liner: Comply with requirements in "Casing Liner" Article below for "Casing Liner, Flexible Elastomeric" Paragraph .
  2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
  3. Air Outlet: S-slip and drive connections.
  4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
- D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
  1. Maximum Damper Leakage: AHRI 880 rated, 3 percent of nominal airflow at 6-inch wg inlet static pressure.
- E. Velocity Sensors: Multipoint array with velocity inlet sensors.

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- F. Attenuator Section: Casing material and thickness matching associated air terminal unit casing. Provide absorptive attenuator integral with the air terminal unit, with noise transmission loss performance as required in schedules on Drawings.
- G. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless steel, machine-staked terminals secured with stainless steel hardware. Provide electric-resistance heating coils for air terminal units scheduled on Drawings.
  - 1. SCR controlled.
  - 2. Access door interlocked disconnect switch.
  - 3. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable).
  - 4. Nickel chrome 80/20 heating elements.
  - 5. Airflow switch for proof of airflow.
  - 6. Fuses in terminal box for overcurrent protection (for coils of more than 48 A).
  - 7. Magnetic contactor for each step of control (for three-phase coils).
- H. Electronic Controls:
  - 1. Electronic Damper Actuator: 24 V, powered closed, spring-return open .
  - 2. Electronic Thermostat: Wall-mounted electronic type with temperature set-point display in Fahrenheit and Celsius.
  - 3. Electronic Air Volume Controller: Pressure-independent analog electronic controller, factory calibrated and field adjustable to minimum and maximum air volumes; provides consistent airflow to the space in response to electronic thermostat signal while compensating for inlet static-pressure variations of up to **4 inches wg**; includes a multipoint velocity sensor at air inlet.
- I. Direct Digital Controls:
  - 1. Terminal Unit Controller, Section 23 09 23: Controller is to be factory mounted and wired by air terminal manufacturer; unit controllers, integrated actuators, and room sensors to be furnished under Section 23 09 23 "Direct Digital Controls (DDC) for HVAC."
- J. Control Sequence: See Drawings for control sequences.

## 2.3 CASING LINER

- A. Casing Liner, Flexible Elastomeric: Flexible elastomeric duct liner fabricated of preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
  - 1. Minimum Thickness: 1-inch .
  - 2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
  - 3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
  - 4. Liner shall insulate entire terminal unit, including the heating section.

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## 2.4 SOURCE QUALITY CONTROL

- A. AHRI 880 Certification: Test, rate, and label assembled air terminal units in accordance with AHRI 880.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Comply with Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" and Section 23 31 13 "Metal Ducts" for hangers and supports.
- B. Install air terminal units according to NFPA 90A.
- C. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

### 3.2 PIPING CONNECTIONS

- A. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.

### 3.3 DUCTWORK CONNECTIONS

- A. Comply with requirements in Section 23 31 13 "Metal Ducts" for connecting ducts to air terminal units.
- B. Make connections to air terminal units with flexible connectors complying with requirements in Section 23 33 00 "Air Duct Accessories."

### 3.4 ELECTRICAL CONNECTIONS

- A. Install field power to each air terminal unit electrical power connection. Coordinate with air terminal unit manufacturer and installers.
- B. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- C. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- D. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- E. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."

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### 3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 26 05 23 "Control-Voltage Electrical Power Cables."

### 3.6 IDENTIFICATION

- A. Label each air terminal unit with drawing designation, nominal airflow, maximum and minimum factory-set airflows. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

### 3.7 STARTUP SERVICE

- A. Perform startup service.
  - 1. Complete installation and startup check in accordance with manufacturer's written instructions.
  - 2. Verify that inlet duct connections are 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 ADJUSTING

- A. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for air terminal unit testing, adjusting, and balancing.

### 3.9 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. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Air terminal unit will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 23 36 00

AIR TERMINAL UNITS  
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## SECTION 23 37 13.13 - AIR DIFFUSERS

### 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. Rectangular and square ceiling diffusers.
2. Perforated diffusers.
3. High-capacity drum louver diffusers.

B. Related Requirements:

1. Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
2. Section 23 37 13.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.

#### 1.3 ACTION SUBMITTALS

A. 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 Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

#### 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. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

## AIR DIFFUSERS

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## PART 2 - PRODUCTS

### 2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Nailor Industries Inc.
  2. Price Industries.
  3. Titus, a division of Air System Components; Johnson Controls, Inc.
- B. Devices shall be specifically designed for variable-air-volume flows.
- C. Material: Aluminum.
- D. Finish: Baked enamel, white .
- E. Face Size: **24 by 24 inches** or **12 by 12 inches** Refer to drawings and schedule .
- F. Face Style: Plaque.
- G. Mounting: Surface or T-bar Mounting panel. Refer to drawings and schedule.
- H. Pattern: Fixed .
- I. Dampers: None.

### 2.2 PERFORATED DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Nailor Industries Inc.
  2. Price Industries.
  3. Titus, a division of Air System Components; Johnson Controls, Inc.
- B. Devices shall be specifically designed for variable-air-volume flows.
- C. Material: Steel backpan and pattern controllers, with aluminum face.
- D. Finish: Baked enamel, white .
- E. Face Size: **12 by 12 inches** or **24 by 24 inches** Refer to drawings and schedule .
- F. Duct Inlet: Round .
- G. Face Style: Flush .
- H. Mounting: Surface or T-bar .
- I. Pattern Controller: None.

## AIR DIFFUSERS

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- J. Dampers: . None.

### 2.3 HIGH-CAPACITY DRUM LOUVER DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Nailor Industries Inc.
  - 2. Price Industries.
  - 3. Titus, a division of Air System Components; Johnson Controls, Inc.
- B. Airflow Principle: Extended distance for high airflow rates.
- C. Material: Aluminum, heavy gage extruded.
- D. Finish: White baked acrylic.
- E. Border: 1-1/4-inch width with countersunk screw holes.
- F. Gasket between drum and border.
- G. Body: Drum shaped; adjustable vertically.
- H. Blades: Individually adjustable horizontally.
- I. Mounting: Surface to duct .
- J. Accessories:
  - 1. Opposed-blade steel damper.
  - 2. Duct-mounting collars with countersunk screw holes.

### 2.4 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.

## AIR DIFFUSERS

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### 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.

### 3.3 ADJUSTING

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13.13

## SECTION 23 37 13.23 - 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 SUMMARY

- A. Section Includes:
  - 1. Adjustable blade face registers and grilles.
- B. Related Requirements:
  - 1. Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
  - 2. Section 23 37 13.13 "Air Diffusers" for various types of air diffusers.

#### 1.3 ACTION SUBMITTALS

- A. 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. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

#### 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. Method of attaching hangers to building structure.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  - 5. Duct access panels.
- B. Source quality-control reports.

## REGISTERS AND GRILLES

23 37 13.23 - 1

## PART 2 - PRODUCTS

### 2.1 REGISTERS

#### A. Adjustable Blade Face Register :

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Nailor Industries Inc.
  - b. Price Industries.
  - c. Titus, a division of Air System Components; Johnson Controls, Inc.
2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Horizontal spaced **3/4 inch** apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Vertical spaced **3/4 inch** apart.
7. Frame: **1-1/4 inches** wide.
8. Mounting: Concealed.
9. Damper Type: Adjustable opposed blade.
10. Accessories:
  - a. Rear-blade gang operator.

### 2.2 GRILLES

#### A. Adjustable Blade Face Grille :

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Nailor Industries Inc.
  - b. Price Industries.
  - c. Titus, a division of Air System Components; Johnson Controls, Inc.
2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: spaced **3/4 inch** apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Vertical spaced **3/4 inch** apart.
7. Frame: **1-1/4 inches** wide.
8. Mounting: Concealed.

### 2.3 SOURCE QUALITY CONTROL

- #### A. Verification of Performance: Rate registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

## REGISTERS AND GRILLES

23 37 13.23 - 2



### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install registers and grilles level and plumb.
- B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, 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 registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

#### 3.3 ADJUSTING

- A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13.23

## REGISTERS AND GRILLES

23 37 13.23 - 3

## SECTION 23 38 13 - COMMERCIAL-KITCHEN HOODS

### 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-kitchen hoods, Type I.
- B. Related Requirements:
  - 1. Section 23 35 33 "Listed Kitchen Ventilation System Exhaust Ducts" for fire-rated ducts connecting to kitchen hoods.

#### 1.3 DEFINITIONS

- A. Listed Hood: A hood, factory fabricated and tested for compliance with UL 710 by a testing agency acceptable to authorities having jurisdiction.
- B. Type I Hood: A hood designed for grease exhaust applications.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Hoods.
  - 2. Filters/baffles.
  - 3. Fire-suppression systems.
  - 4. Luminaires.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer.
  - 1. Shop Drawing Scale: **1/4 inch = 1 foot** .
  - 2. Show plan view, elevation view, sections, roughing-in dimensions, service requirements, duct connection sizes, and attachments to other work.
  - 3. Show cooking equipment plan and elevation to confirm minimum code-required overhang.
  - 4. Indicate performance, exhaust and makeup air airflow, and pressure loss at actual Project-site elevation.
  - 5. Show control cabinets.
  - 6. Show fire-protection cylinders, piping, actuation devices, and manual control devices.

## COMMERCIAL-KITCHEN HOODS

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7. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
8. Design Calculations: Calculate requirements for selecting seismic restraints.
9. Include diagrams for power, signal, and control wiring.
10. Duct Connections: Detail connections between ducts and hoods, including access doors and panels.
11. Piping Diagrams: Detail fire-suppression piping and components and differentiate between manufacturer-installed and field-installed piping. Include roughing-in requirements for drain connections. Show cooking equipment plan and elevation to illustrate fire-suppression nozzle locations.
  - a. Piping Diagram Scale: **1/4 inch = 1 foot** .

## 1.5 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. Coordination Drawing Scale: **1/4 inch = 1 foot** .
  2. Suspended ceiling assembly components.
  3. Structural members to which equipment will be attached.
  4. Roof framing and support members for duct penetrations.
  5. Items penetrating finished ceiling including the following:
    - a. Luminaires.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Moldings on hoods and accessory equipment.
- B. Welding certificates.
- C. Field quality-control reports.

## 1.6 QUALITY ASSURANCE

- A. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D 1.1M, "Structural Welding Code - Steel," for hangers and supports; and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for joint and seam welding.

## 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.

## COMMERCIAL-KITCHEN HOODS

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## 2.2 HOOD MATERIALS

- A. Stainless-Steel Sheet: ASTM A666, Type 304.
1. Minimum Thickness: Double wall, 18 gauge .
  2. Finish: Comply with SSINA's "Finishes for Stainless Steel" for recommendations for applying and designating finishes.
    - a. Finish shall be free from tool and die marks and stretch lines and shall have uniform, directionally textured, polished finish indicated, free of cross scratches. Grain shall run with long dimension of each piece.
  3. Concealed Stainless-Steel Surfaces: ASTM A480/A480M, No. 2B finish (bright, cold-rolled, unpolished finish).
  4. Exposed Surfaces: ASTM A480/A480M, No. 3 finish (intermediate polished surface) .
  5. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- B. Sealant: ASTM C920; Type S, Grade NS, Class 25, Use NT. Elastomeric sealant shall be NSF certified for commercial-kitchen hood application. Sealants, when cured and washed, shall comply with requirements in 21 CFR 177.2600, for use in areas that come in contact with food.
1. Color: As selected by Architect from manufacturer's full range.
  2. Backer Rod: Closed-cell polyethylene, in diameter larger than joint width.
- C. Sound Dampening: NSF-certified, non-absorbent, hard-drying, sound-deadening compound for permanent adhesion to metal in minimum **1/8-inch** thickness that does not chip, flake, or blister.
- D. Gaskets: NSF certified for end-use application indicated; of resilient rubber, neoprene, or PVC that is nontoxic, stable, odorless, nonabsorbent, and unaffected by exposure to foods and cleaning compounds, and that passes testing according to UL 710.

## 2.3 GENERAL HOOD FABRICATION REQUIREMENTS

- A. Welding: Use welding rod of same composition as metal being welded. Use methods that minimize distortion and develop strength and corrosion resistance of base metal. Make ductile welds free of mechanical imperfections such as gas holes, pits, or cracks.
1. Welded Butt Joints: Full-penetration welds for full-joint length. Make joints flat, continuous, and homogenous with sheet metal without relying on straps under seams, filling in with solder, or spot welding.
  2. Grind exposed welded joints flush with adjoining material and polish to match adjoining surfaces.
  3. Where fasteners are welded to underside of equipment, finish reverse side of weld smooth and flush.
  4. Coat concealed stainless-steel welded joints with metallic-based paint to prevent corrosion.
  5. After zinc-coated steel is welded, clean welds and abraded areas and apply SSPC-Paint 20, high-zinc-dust-content, galvanizing repair paint to comply with ASTM A780/A780M.
- B. For metal butt joints, comply with SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."

### COMMERCIAL-KITCHEN HOODS

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- C. Where stainless steel is joined to a dissimilar metal, use stainless-steel welding material or fastening devices.
- D. Form metal with break bends that are not flaky, scaly, or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing, and finishing.
- E. Sheared Metal Edges: Finish free of burrs, fins, and irregular projections.
- F. In food zones, as defined in NSF, fabricate surfaces free from exposed fasteners.
- G. Cap exposed fastener threads, including those inside cabinets, with stainless-steel lock washers and stainless-steel cap (acorn) nuts.
- H. Fabricate pipe slots on equipment with turned-up edges sized to accommodate service and utility lines and mechanical connections.
- I. Fabricate enclosures, including panels, housings, and skirts, to conceal service lines, operating components, and mechanical and electrical devices including those inside cabinets unless otherwise indicated.
- J. Fabricate equipment edges and backsplashes according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."
- K. Fabricate enclosure panels to ceiling and wall as follows:
  - 1. Fabricate panels on all exposed side(s) with same material as hood, and extend from ceiling to top of hood canopy and from canopy to wall.
  - 2. Wall Offset Spacer: Minimum of **3 inches**.
  - 3. Wall Shelves and Overshelves: Fabricate according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines," with minimum **0.0625-inch** thick, stainless-steel shelf tops.

#### 2.4 EXHAUST HOOD FABRICATION, TYPE I HOOD

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - 1. Captive-Aire Systems.
  - 2. Greenheck Fan Corporation.
- B. Weld all joints exposed to grease with continuous welds, and make filters/baffles or grease extractors and makeup air diffusers easily accessible for cleaning.
  - 1. Fabricate hoods according to NSF 2, "Food Equipment."
  - 2. Hoods shall be listed and labeled, according to UL 710, by a testing agency acceptable to authorities having jurisdiction.
  - 3. Duct Collars: Minimum **0.0598-inch** thick steel at least **3 inches** long, continuously welded to top of hood and at corners.
- C. Hood Configuration: Exhaust and makeup air.

#### COMMERCIAL-KITCHEN HOODS

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1. Makeup air shall be introduced through laminar-flow-type, perforated metal panels on front of hood canopy.
- D. Hood Style: Wall-mounted canopy and Single-island canopy .
- E. Filters/Baffles: Removable, stainless-steel . Fabricate stainless steel for filter frame and removable collection cup and pitched trough. Exposed surfaces shall be pitched to drain to collection cup. Filters/baffles shall be tested according to UL 1046, "Safety for Grease Filters for Exhaust Ducts," by an NRTL acceptable to authorities having jurisdiction.
- F. Luminaires: Recessed , LED luminaires and lamps with lenses sealed vapor tight. Wiring shall be in conduit on hood exterior. **70 fc** at **30 inches** above finished floor.
1. Light switches shall be mounted on front panel of hood canopy .
  2. Luminaires: LED complying with UL 1598.
- G. Hood Controls: Wall-mounting control cabinet, factory wired to control groups of adjacent hoods, and fabricated of stainless steel.
1. Exhaust Fan: On-off switches shall start and stop the exhaust fan. Interlock exhaust fan with makeup air supply fan to operate simultaneously. Interlock exhaust fan with fire-suppression system to operate fan(s) during fire-suppression-agent release and to remain in operation until manually stopped. Include red pilot light to indicate fan operation.
  2. Exhaust Fan Interlock: Factory wire the exhaust fan starters in a single control cabinet for adjacent hoods to operate together.
  3. Photocell and Temperature Control, Variable Speed: Vary speed of makeup air and exhaust-air fans with variable-frequency controllers, based on temperature at hood discharge and opacity of smoke in hood. Interlock fan control with fire-suppression system to operate at high speed during fire-suppression-agent release and to remain in high-speed operation until manually stopped. Provide air-purge fan and conduit to photocell and reflector to avoid grease accumulation that will negatively affect performance of system. Controller shall limit exhaust-duct velocity between 1500 fpm and 2500 fpm . Controller shall limit supply quantity to 12% of scheduled cfm for proper operation of makeup air unit.
  4. High-Temperature Control: Alarm shall sound and cooking equipment shall shut down before hood discharge temperature rises to actuation temperature of fire-suppression system.

## 2.5 FIRE-SUPPRESSION SYSTEM, WET CHEMICAL

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. Ansul by Johnson Controls Company.
  2. Badger Fire Protection.
  3. Pyro-Chem; Tyco Fire Suppression & Building Products.
- B. Description: Engineered distribution piping designed for automatic detection and release or manual release of fire-suppression agent by hood operator. Fire-suppression system shall be listed and labeled for complying with NFPA 17A, "Wet Chemical Extinguishing Systems," by a qualified testing agency acceptable to authorities having jurisdiction.

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1. Steel Pipe, **NPS 2** and Smaller: ASTM A53/A53M, Type S, Grade A, Schedule 40, plain ends.
2. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
3. Piping, fusible links and release mechanism, tank containing the suppression agent, and controls shall be factory installed. Controls shall be in stainless-steel control cabinet mounted on hood . Furnish manual pull station for wall mounting. Exposed piping shall be covered with chrome-plated aluminum tubing. Exposed fittings shall be chrome plated.
4. Liquid Extinguishing Agent: Noncorrosive, low-pH liquid.
5. Furnish electric-operated gas shutoff valve with clearly marked open and closed indicator for field installation.
6. Fire-suppression system controls shall be integrated with controls for fans, lights, and fuel supply and located in a single cabinet for each group of hoods immediately adjacent.
7. Wiring shall have color-coded, numbered terminal blocks and grounding bar. Spare terminals for fire alarm, optional wiring to start fan with fire alarm, red pilot light to indicate fan operation, and control switches shall all be factory wired in control cabinet with relays or starters. Include spare terminals for fire alarm, and wiring to start fan with fire alarm.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION, GENERAL

- A. Coordinate equipment layout and installation with adjacent Work, including luminaires, HVAC equipment, plumbing, and fire-suppression system components.
- B. Complete field assembly of hoods where required.
  1. Make closed butt and contact joints that do not require filler.
  2. Grind field welds on stainless-steel equipment smooth, and polish to match adjacent finish. Comply with welding requirements in "General Hood Fabrication Requirements" Article.
- C. Install hoods and associated services with clearances and access for maintaining, cleaning, and servicing hoods, filters/baffles, grease extractor, and fire-suppression systems according to manufacturer's written instructions and requirements of authorities having jurisdiction.
- D. Make cutouts in hoods where required to run service lines and to make final connections, and seal openings according to UL 1978.
- E. Securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners unless otherwise indicated.

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- F. Install hoods to operate free from vibration.
- G. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at **48 inches** o.c. maximum.
- H. Install sealant in joints between equipment and abutting surfaces with continuous joint backing unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.
- I. Install lamps, with maximum recommended wattage, in equipment with integral lighting.
- J. Set initial temperatures, and calibrate sensors.
- K. Set field-adjustable switches.

### 3.3 CONNECTIONS

- A. Connect ducts according to requirements in Section 23 33 00 "Air Duct Accessories." Install flexible connectors on makeup air supply duct. Weld exhaust-duct connections with continuous liquidtight joint.
- B. Install fire-suppression piping for remote-mounted suppression systems according to NFPA 17A, "Wet Chemical Extinguishing Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Commercial-kitchen hoods will be considered defective if they do not pass tests and inspections.
- C. 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-kitchen hoods.

END OF SECTION 23 38 13

## COMMERCIAL-KITCHEN HOODS

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## SECTION 23 74 16.13 - PACKAGED, LARGE-CAPACITY, ROOFTOP AIR-CONDITIONING 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 packaged, large-capacity, rooftop air conditioning units (RTUs) with the following components:
  - 1. Casings.
  - 2. Fans, drives, and motors.
  - 3. Coils.
  - 4. Air filtration.
  - 5. Dampers.
  - 6. Electrical power connections.
  - 7. Controls.
  - 8. Roof curbs.
  - 9. Accessories.

#### 1.3 DEFINITIONS

- A. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, large-capacity, rooftop air-conditioning units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each RTU.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
  - 3. Include unit dimensions and weight.
  - 4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
  - 5. Fans:
    - a. Include certified fan-performance curves with system operating conditions indicated.
    - b. Include certified fan-sound power ratings.
    - c. Include fan construction and accessories.
    - d. Include motor ratings, electrical characteristics, and motor accessories.

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6. Include certified coil-performance ratings with system operating conditions indicated.
7. Include filters with performance characteristics.
8. Include gas furnaces with performance characteristics.
9. Include factory selection calculations for each antimicrobial ultraviolet lamp installation.
10. Include dampers, including housings, linkages, and operators.

B. Shop Drawings: For each packaged, large-capacity, rooftop air-conditioning units.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For RTU supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.
2. Detail mounting, securing, and flashing of roof curb. Indicate coordinating requirements with roof membrane system.
3. Wind- Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. System startup reports.
- C. Field quality-control reports.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

## 1.7 WARRANTY

- A. Warranty: Manufacturer agrees to repair or replace components of outdoor, semi-custom, air-handling unit that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: One year(s) from date of Substantial Completion. Parts and Labor.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of RTUs and components.
- C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE 15 Compliance: For refrigeration system safety.
- E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. UL Compliance: Comply with UL 1995.
- G. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design mounting and restraints for RTUs, including comprehensive engineering analysis.
  - 1. Design RTU supports to comply with wind performance requirements.
- H. Wind-Restraint Performance:
  - 1. Basic Wind Speed: 140 mph .
  - 2. Building Classification Category: III .
  - 3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

### 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AAON.
  - 2. Carrier Global Corporation.
  - 3. Daikin Applied.
  - 4. Trane.

### 2.3 UNIT CASINGS

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

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B. Double-Wall Construction:

1. Outside Casing Wall: Galvanized steel , minimum 24 gauge thick with manufacturer's standard finish , with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
2. Inside Casing Wall: G90-coated galvanized steel, minimum 24 gauge thick.
3. Floor Plate: G90 galvanized steel , minimum 16 gauge thick.
  - a. Units with less than or equal to 2,200 cfm: minimum 16 gauge base.
  - b. Units greater than 2,200 cfm: minimum 14 gauge base.
4. Casing Insulation:
  - a. Materials: Injected polyurethane foam insulation.
  - b. Casing Panel R-Value: Minimum 13 .
  - c. Insulation Thickness: 2 inches.
  - d. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roof of unit.

C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

D. Static-Pressure Classifications:

1. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

E. Panels and Doors:

1. Panels:
  - a. Fabrication: Formed and reinforced with same materials and insulation thickness as casing.
  - b. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
  - c. Gasket: Neoprene, applied around entire perimeters of panel frames.
  - d. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components. Dimensions to be at least 10 inches wide by full height of unit casing up to a maximum height of 60 inches .
2. Access Doors:
  - a. Hinges: A minimum of two ball-bearing hinges or stainless steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.
  - b. Gasket: Neoprene, applied around entire perimeters of panel frames.
  - c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components. Dimensions to be at least 10 inches wide by full height of unit casing up to a maximum height of 60 inches .
3. Locations and Applications:
  - a. Fan Section: Doors .
    - 1) Less than or equal to 2,200 cfm: Removable safety access panel.

- 2) Greater than 2,200 cfm: Access door and removable safety access panel.
- b. Coil Section: Inspection and access door.
- c. Damper Section: Doors.
- d. Filter Section: Doors large enough to allow periodic removal and installation of filters.
- e. Mixing Section: Doors.

F. Condensate Drain Pans:

1. Location: Each type of cooling coil .
2. Construction:
  - a. Single-wall, 304 stainless steel sheet.
3. Drain Connection:
  - a. Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
  - b. Minimum Connection Size: NPS 1 .
4. Slope: Minimum 0.125-in./ft. slope , to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
5. Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1 .
6. Width: Entire width of water producing device.
7. Depth: A minimum of 2 inches deep.
8. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

2.4 FANS, DRIVES, AND MOTORS

- A. Fan and Drive Assemblies: Unit shall include direct drive, unhooded, backward curved, plenum supply fans. Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower, mounted on rubber isolators.
- B. Drives, Direct: Factory-mounted, direct drive.
- C. Motors:
  1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
  2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  3. Enclosure Type: Open, dripproof .
  4. Efficiency: Premium efficient as defined in NEMA MG 1.
  5. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
  6. Motor shall include shaft grounding.

2.5 COILS

- A. General Requirements for Coils:

1. Comply with AHRI 410.
2. Fabricate coils section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. Coils shall not act as structural component of unit.

B. Supply-Air Hydronic Coil:

1. Chilled-Water Coils: Continuous circuit .
  - a. Piping Connections: Flanged , same end of coil.
  - b. Tube Material: Copper .
  - c. Fin Type: Plate.
  - d. Fin Material: Aluminum .
  - e. Fin and Tube Joint: Mechanical bond Silver brazed.
  - f. Headers:
    - 1) Seamless copper tube with brazed joints, prime coated.
  - g. Frames: Channel frame, minimum 0.052-inch- thick galvanized steel.
  - h. Coil Working-Pressure Ratings: 200 psig , 325 deg F .
  - i. Coating: None .

## 2.6 AIR FILTRATION

A. Panel Filters:

1. Description: Pleated factory-fabricated, self-supported, disposable air filters with holding frames.
2. Filter Unit Class: UL 900.
3. Media: Interlaced glass, synthetic or cotton fibers coated with nonflammable adhesive and antimicrobial coating.
4. Filter-Media Frame: Beverage board with perforated metal retainer, or metal grid, on outlet side.

## 2.7 DAMPERS

- A. Outdoor- and Return-Air Dampers (Units 2,200 CFM and less): Unit shall include 0-100% adjustable, motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 15 cfm of leakage per sq. ft. of damper area when subjected to 2 inches w.g. air pressure differential across the damper. Unit shall include outside air opening bird screen, outside air hood with rain lip and a return air connection.
- B. Outdoor- and Return-Air Dampers (Units larger than 2,200 CFM): Unit shall include 100% motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge and end seals. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 2 AMCA certified, in accordance with AMCA Standard 511. Damper assembly shall be controlled by spring return, 2 position actuator. Unit shall include outside air opening bird screen and outside air hood.
- C. Electronic Damper Operators:

1. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
2. Electronic damper position indicator shall have visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
3. Operator Motors:
  - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
  - b. Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
  - c. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
6. Size dampers for running torque calculated as follows:
  - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
  - b. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
  - c. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
7. Coupling: V-bolt and V-shaped, toothed cradle.
8. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
9. Fail-Safe Operation: Mechanical, spring-return mechanism with external, manual gear release on nonspring-return actuators.
10. Proportional Signal: 2 to 10 V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
11. Temperature Rating: Minus 22 to plus 122 deg F .

## 2.8 ELECTRICAL POWER CONNECTIONS

- A. RTU shall have a single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection. Unit shall have a 5kAIC SCCR.

## 2.9 CONTROLS

- A. Basic Unit Controls:
  1. Control-voltage transformer.
  2. Unit shall be provided with a terminal strip for control by DDC.

## 2.10 ROOF CURBS

- A. Wind and Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site. Comply with

requirements in Section 23 05 48 "Vibration and Seismic Controls for HVAC" for wind-load requirements.

- B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
  - 1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
    - a. Materials: ASTM C 1071, Type I or II.
    - b. Thickness: 2 inches.
  - 2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
    - a. Liner Adhesive: Comply with ASTM C 916, Type I.
    - b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
    - c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
- C. Curb Height: 14 inches above roof line. Coordinate total height with roof manufacturer.

#### 2.11 ACCESSORIES

- A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. The outlet shall be energized even if the unit main disconnect is open.
- B. Outdoor air intake weather hood with moisture eliminator where required.
- C. Thermal dispersion outside airflow measuring station integral to outside air damper.

#### 2.12 MATERIALS

- A. Steel:
  - 1. ASTM A36/A36M for carbon structural steel.
  - 2. ASTM A568/A568M for steel sheet.
- B. Stainless Steel:
  - 1. Manufacturer's standard grade for casing.
  - 2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.
- C. Galvanized Steel: ASTM A653/A653M.
- D. Aluminum: ASTM B209.



## 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 RTUs.
- B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where RTUs will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Roof Curb: Install on roof structure, level and secure, according to NRCA's "NRCA Roofing Manual: Membrane Roof Systems." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 07 72 00 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing with anchor bolts suitable for wind performance criteria. Coordinate size and location of roof curb with actual equipment provided.

### 3.3 PIPING CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to RTU, allow space for service and maintenance.
- C. Connect piping to unit mounted on vibration isolators with flexible connectors.
- D. Connect condensate drain pans using NPS 1-1/4 , ASTM B88, Type M copper tubing. Extend to nearest equipment or roof drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- E. Chilled-Water Piping: Comply with applicable requirements in Section 23 21 13 "Hydronic Piping" and Section 23 21 16 "Hydronic Piping Specialties." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

### 3.4 DUCT CONNECTIONS

- A. Comply with duct installation requirements specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
  - 1. Install ducts to terminate at top of roof curb.
  - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under the entire roof curb.

3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 23 33 00 "Air Duct Accessories."
4. Install return-air duct continuously through roof structure.

### 3.5 ELECTRICAL CONNECTIONS

- A. Connect electrical wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  1. Nameplate shall be laminated acrylic or melamine plastic signs as specified in Section 26 05 53 "Identification for Electrical Systems."
  2. Locate nameplate where easily visible.

### 3.6 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 26 05 23 "Control-Voltage Electrical Power Cables."

### 3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions.
  1. Inspect for visible damage to unit casing.
  2. Inspect for visible damage to furnace combustion chamber.
  3. Inspect for visible damage to compressor, coils, and fans.
  4. Inspect internal insulation.
  5. Verify that labels are clearly visible.
  6. Verify that clearances have been provided for servicing.
  7. Verify that controls are connected and operable.
  8. Verify that filters are installed.
  9. Remove packing from vibration isolators.
  10. Verify lubrication on fan and motor bearings.
  11. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
  12. Start unit according to manufacturer's written instructions.
    - a. Do not operate below recommended low-ambient temperature.
    - b. Complete startup sheets and attach copy with Contractor's startup report.
  13. Inspect and record performance of interlocks and protective devices; verify sequences.

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14. Operate unit for an initial period as recommended or required by manufacturer.
15. Adjust and inspect high-temperature limits.
16. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
17. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
18. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
  - a. Supply-air volume.
  - b. Return-air volume.
  - c. Relief-air volume.
  - d. Outdoor-air intake volume.
19. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

### 3.8 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.
- C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.9 CLEANING

- A. After completing system installation and testing, adjusting, and balancing RTUs and air-distribution systems and after completing startup service, clean RTUs internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

### 3.10 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. RTU will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.11 DEMONSTRATION

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

END OF SECTION 23 74 16.13

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## SECTION 23 81 26 - SPLIT-SYSTEM AIR-CONDITIONERS

### 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 split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
  - 3. Delegated-Design Submittal: For condensing unit equipment rail supports, comply with performance requirements and design criteria indicated on plans, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
    - a. Detail mounting, securing, and flashing of equipment rails to roof structure. Indicate coordinating requirements with roof membrane system.
    - b. Wind-Restraint Details: Detail fabrication and attachment of wind restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

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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. Filters: One set(s) for each air-handling 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. ASHRAE Compliance:
  - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

1.8 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. For Compressor: Five year(s) from date of Substantial Completion.
    - b. For Parts: One year(s) from date of Substantial Completion.
    - c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Carrier Corporation.
  - 2. Daikin.
  - 3. Mitsubishi Electric & Electronics USA, Inc.
  - 4. Trane.

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## 2.2 INDOOR UNITS (5 TONS OR LESS)

### A. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
4. Fan: Direct drive, centrifugal.
5. Fan Motors:
  - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
  - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
  - c. Enclosure Type: Totally enclosed, fan cooled.
  - d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
  - e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Condensate Drain Pans:
  - a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
  - b. Single-wall, galvanized -steel sheet.
  - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
  - d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
8. Air Filtration Section:
  - a. General Requirements for Air Filtration Section:
    - 1) Comply with NFPA 90A.
    - 2) Minimum MERV according to ASHRAE 52.2.

## 2.3 OUTDOOR UNITS (5 TONS OR LESS)

### A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
  - a. Compressor Type: Scroll.
  - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
  - c. Refrigerant: R-410A .
  - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

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3. Fan: Aluminum-propeller type, directly connected to motor.
4. Motor: Permanently lubricated, with integral thermal-overload protection.
5. Low Ambient Kit: Permits operation down to 45 deg F.
6. Mounting Base: Built-in cant equipment rails on roof.

## 2.4 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- D. Condensate pump and drain hose.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 07 72 00 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
  1. Install roof-mounted condensing unit on built-in cant equipment rails. Comply with the wind performance requirements for roof mounted equipment specified on plans.
  2. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

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### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

### 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.

### 3.5 DEMONSTRATION

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

END OF SECTION 23 81 26



## SECTION 23 82 39.16 - PROPELLER UNIT HEATERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes propeller unit heaters with electric-resistance heating coils.

#### 1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. PTFE: Polytetrafluoroethylene plastic.
- C. TFE: Tetrafluoroethylene plastic.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include location and size of each field connection.
  - 4. Include details of anchorages and attachments to structure and to supported equipment.
  - 5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
  - 6. Indicate location and arrangement of piping valves and specialties.
  - 7. Indicate location and arrangement of integral controls.
  - 8. Wiring Diagrams: Power, signal, and control wiring.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

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## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - 1. Berko.
  - 2. Markel Products.
  - 3. Redd-i.
  - 4. Rosemex Products.

### 2.2 DESCRIPTION

- A. Assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.
- 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 UL 2021.
- D. Comply with UL 823.

### 2.3 PERFORMANCE REQUIREMENTS

### 2.4 HOUSINGS

- A. Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

### 2.5 COILS

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant

## PROPELLER UNIT HEATERS 23 82 39.16 - 2

metallic sheath with fins no closer than **0.16 inch**. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed **550 deg F** at any point during normal operation.

1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

## 2.6 FAN AND MOTOR

- A. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
- B. Motor: Permanently lubricated, multispeed . Comply with requirements in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

## 2.7 CONTROLS

- A. Control Devices:
  1. Unit -mounted, fan-speed switch.
  2. Unit -mounted thermostat.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install propeller unit heaters to comply with NFPA 90A.
- B. Install propeller unit heaters level and plumb.
- C. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers . Hanger rods and attachments to structure are specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Section 23 05 48.13 "Vibration Controls for HVAC."

### 3.3 CONNECTIONS

- A. Install piping adjacent to machine to allow service and maintenance.
- B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
  - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Adjust initial temperature set points.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.6 DEMONSTRATION

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

END OF SECTION 23 82 39.16

## SECTION 26 00 10

### ELECTRICAL GENERAL REQUIREMENTS

#### PART 1 – GENERAL

##### 1.01 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions, Division 1 Specification Sections and all relevant documents shall form a part of this Division of the Specifications and shall be incorporated in this Section and each Division 26 Section hereinafter as if repeated verbatim herein. All conditions imposed by these documents shall be applicable to all portions of the work under this Division. Certain specific paragraphs of said references may be referred to hereinafter in this Division. These references are intended to point out specific items to the Contractor, but in no way relieve him of the responsibility of reading and complying with all relevant parts of the entire Specification.
- B. The Contractor shall examine and coordinate with all Contract Drawings and Specifications, and all Addenda issued. Failure to comply shall not relieve him of responsibility. The omission of details of other portions of the work from this Division shall not be used as a basis for a request for additional compensation.
- C. The specific features and details for other portions of the work related to the construction in progress or to the existing building(s) shall be determined by examination at the site.

##### 1.02 SCOPE OF WORK

- A. The requirements contained in this Section apply to all work performed under Division 26 of these Specifications.
- B. The work covered by this Division of the Specifications comprises the furnishing of labor, material, equipment, transportation, tools and services, and performing operations required for, and reasonably incidental to, the installation of the work in accordance with the applicable Contract Documents, and subject to the terms and conditions of the Contract.
- C. Refer to other Divisions of the Specifications for related work.

##### 1.03 DEFINITION OF "CONTRACTOR"

- A. Where the word "Contractor" is used under any Section of this Division of the Specifications, it shall mean the Contractor engaged to execute the work included under that Section.

##### 1.04 RESPONSIBILITY OF THE CONTRACTOR

- A. The Contractor shall be responsible for all work of every description in connection with this Division of the Specifications. The Contractor shall specifically and distinctly assume, and does so assume, all risk for damage or injury from whatever cause to property or person used or employed on or in

connection with this work and of all damages or injury to any person or property wherever located, resulting from an action or operation under the Contract in connection with the work, and undertake the responsibility to defend the Owner against all claims on account of any such damage or injury.

- B. The Contractor will be held responsible for the satisfactory execution and completion of the work in accordance with the true intent of the Contract Documents. The Contractor shall provide without extra charge all incidental items required as part of the work, even though it may not be specifically indicated. If the Contractor has reason for objecting to the use of any material, equipment, device or method of construction as indicated, he shall make report of such objections to the Owner's Representative, obtain proper approval and adjustment to the Contract, and shall proceed with the work.

#### 1.05 TERMINOLOGY

- A. Whenever the words "furnish", "provide", "furnish and install", "provide and install", and similar phrases occur, it is the intent that the materials, equipment and devices described be furnished, installed and connected under this Division, complete for operation, unless specifically noted to the contrary.
- B. It is also the intent, unless specifically noted to the contrary, that all materials, equipment and devices described and specified under this Division of the Specifications be similarly furnished, installed and connected under this Division, whether or not a phrase as described in the preceding paragraph has been actually included.

#### 1.06 ORDINANCES, PERMITS AND CODES

- A. It shall be the Contractor's duty to perform the work and provide the materials covered by these specifications in conformance with all ordinances and regulations of all authorities having jurisdiction.
- B. All work herein shall conform to all applicable laws, ordinances and regulations of the local utility companies.
- C. The Contractor shall obtain and pay for all permit and connection fees as required for the complete installation of the specified systems, equipment, devices and materials.
- D. The Contractor shall obtain permits, plan checks, inspections and approvals applicable to the work as required by the regulatory authorities. Fees and costs of any nature whatsoever incidental to these permits, inspections and approvals shall be assumed and paid by the Contractor. The pro-rata costs, if any, for utilities serving this property will be paid for by the Owner and shall not be included as part of this Contract.
- E. The work shall be in accordance with, but shall not be limited to, the requirements of:
  - 1. National Fire Protection Association
  - 2. National Electrical Code
  - 3. National Safety Code

4. State of Texas Safety Code
5. Local County and City Building Codes
6. State of Texas Building Codes

F. Codes and standards referred to are minimum standards. Where the requirements of the Drawings or Specifications exceed those of the codes and regulations, the Drawings and Specifications govern.

#### 1.07 MATERIALS, EQUIPMENT AND DEVICE DESCRIPTION

- A. Materials, equipment and devices shall be of the best quality customarily applied in quality commercial practice, and shall be the products of reputable manufacturers. Each major component shall bear a nameplate giving the name and address of the manufacturer, and the catalog number or designation of the component.
- B. Materials, equipment and devices furnished under this Division of the Specifications shall be essentially the standard product of the specified manufacturer, or where allowed, an alternate manufacturer. Where two or more units of the same kind or class of a specific item are required, these shall be the products of a single manufacturer; however, the component parts of the item need not be the products of one manufacturer.
- C. In describing the various materials, equipment and devices, in general each item will be described singularly, even though there may be a multiplicity of identical items. Also, where the description is only general in nature, exact sizes, duties, space arrangements, horsepower requirements and other data shall be determined by reference to the Contract Documents.
- D. Space allocations for materials, equipment and devices have been made on the basis of present and known future requirements and the dimensions of items of equipment or devices of a particular manufacturer whether indicated or not. The Contractor shall verify that all materials, equipment and devices proposed for use on this project are within the constraints of the allocated space.

#### 1.08 QUALITY ASSURANCE

- A. Materials, equipment and devices shall be new and of the quality specified, and shall be free from defects at the time of installation. Materials, equipment and devices damaged in shipment or otherwise damaged or found defective prior to acceptance by the Owner shall not be repaired at the job site, but shall be replaced with new materials, equipment or devices identical with those damaged, unless specifically approved otherwise by the Owner's Representative.
- B. Wherever a UL standard has been established for a particular type of material, equipment or device, each item of such material, equipment or device provided on this project shall meet the requirements of the UL standard in every way, and shall be UL listed and labeled.

#### 1.09 REFERENCE STANDARDS

- A. Materials, equipment, devices and workmanship shall comply with applicable local, county, state and national codes, laws and ordinances, utility company regulations and industry standards.
- B. In case of differences between building codes, state laws, local ordinances, industry standards,

utility company regulations and the Contract Documents, the most stringent shall govern. The Contractor shall promptly notify the Owner's Representative in writing of any such difference. Should the Contractor perform any work that does not comply with local codes, laws and ordinances, industry standards or other governing regulations, the work shall be corrected of noncompliance deficiencies with the Contractor bearing all costs.

- C. In addition to the aforementioned ordinances, industry standards published by the following organizations shall apply:

*AABM*-American Association of Battery Manufacturers

*AIA*-American Institute of Architects

*ANSI*-American National Standards Institute

*ASTM*-American Society for Testing and Materials

*CBM*-Certified Ballast Manufacturers Association

*ETL*-Electrical Testing Laboratories

*FM*-Factory Mutual

*ICEA*-Insulated Cable Engineers Associated

*IEEE*-Institute of Electrical and Electronic Engineers

*IES*-Illuminating Engineering Society

*IRI*-Industrial Risk Insurance

*NBS*-National Bureau of Standards

*NEC*-National Electrical Code

*NECA*-National Electrical Contractors Association

*NEMA*-National Electrical Manufacturers Association

*NESC*-National Electrical Safety Code

*NETA*-National Electrical Testing Association

*NFPA*-National Fire Protection Association

*UL*-Underwriters Laboratories

- D. Where the Contract Documents exceed the above requirements, the Contract Documents shall govern. In no case shall work be installed contrary to or below the minimum legal standards.

#### 1.10 DRAWINGS AND SPECIFICATIONS

- A. The interrelation of the Drawings (including the schedules) and the Specifications are as follows:



1. The Drawings establish quantities, locations, dimensions and details of materials, equipment and devices. The schedules on the Drawings indicate the capacities, characteristics and components.
  2. The Specifications provide written requirements for the quality, standard and nature of the materials, equipment, devices and construction systems.
- B. The Drawings and Specifications shall be considered as being compatible; therefore, the work called for by one and not by the other shall be furnished and installed as though called for by both. Resolution of conflicts between Drawings and Specifications shall be as follows:
1. If the Drawings and Specifications disagree in themselves, or with each other, the Contractor's pricing shall be based on furnishing and installing the most expensive combination of quality and quantity of work indicated. In the event of this type of disagreement, the resolution shall be determined by the Architect/Engineer.
  2. The Contractor shall be responsible for bringing any conflicts in the Drawings and the Specifications to the attention of the Architect/Engineer prior to any work being performed.
  3. Materials, equipment and devices called for on the Drawings and not indicated herein, shall be completely provided and installed as though it were fully described herein.
  4. Materials, equipment and devices called for herein shall be completely provided and installed, whether or not it is fully detailed, scheduled or indicated on the Drawings.
- C. The Contractor shall examine the Drawings and Specifications of the other portions of the work for fixtures and finishes in connection with this work. The Contractor shall carefully examine the Drawings to determine the general construction conditions, and shall familiarize himself with all limitations caused by such conditions.
- D. When discrepancies exist between scale and dimension, or between the Drawings of the various portions of the work, they shall be called to the attention of the Architect/Engineer for further instruction, whose instructions shall be final and binding and work promptly resumed without any additional cost to the Owner.
- E. Review the construction details of the building(s) as illustrated on the Drawings of the various portions of the work and be guided thereby. Route conduits and set all boxes as required by the pace of the general construction.
- F. The Drawings diagrammatically show the sizes and locations of the various equipment and devices, and the sizes of the major interconnecting wires, without showing exact details as to elevations, offsets, control wiring and other installation requirements. Carefully layout the work at the site to conform to the architectural and structural conditions, to avoid obstructions and to permit proper grading of pipe associated with other portions of the work. Determine the exact location of equipment and devices and connections thereto by reference to the submittals and rough-in drawings, and by measurements at the site. Make minor relocations necessitated by the conditions at the site, or directed by the Architect/Engineer, without additional cost to the Owner.
- G. The Drawings and Specifications are intended to describe and illustrate systems which will not interfere with the structure of the building(s), fit into the available spaces, and insure complete and

satisfactory operating installations. Prepare installation drawings for all critical areas illustrating the installation of the work in this Division as related to the work of all other Divisions and correct all interferences with the other portions of the work or with the building structures before the work proceeds.

- H. The Drawings do not indicate the existing electrical installations other than to identify modifications or extensions thereto. Visit the site and ascertain the conditions to be met and the work to be accomplished in removing and modifying the existing work, and in installing the new work. Failure to comply with this shall not constitute grounds for any additional payment in connection with removing or modifying any part of the existing installation or installing any new or temporary work under this Division.

#### 1.11 SHOP DRAWINGS AND SUBMITTAL DATA

- A. Process shop drawings and submittal data to insure that the proposed materials, equipment and devices conform to the requirements of the Contract Documents, and that there are no omissions or duplications. Provide layouts, fabrication information and data for systems, materials, equipment and devices proposed for the project.
- B. Shop drawings shall be drawn on a scale not less than 1/4 inch equals 1 foot showing actual dimensions. Shop drawings shall include, but not be limited to:
  - 1. Switchboard
  - 2. Distribution Panelboards
  - 3. Lighting/Appliance Panelboards
- C. Submittal data (manufacturer's catalog data) shall include, but not be limited to:
  - 1. Equipment: switchboard, panelboards, transformers, disconnect switches, circuit breakers, fuses, etc.
  - 2. Materials: conduit, conductors, connectors, supports, etc.
  - 3. Lighting fixtures and lamps.
  - 4. Wiring devices.
  - 5. All Specification sections requiring electrical submittals.
- D. The submittal data shall not consist of manufacturer's catalogs or cut sheets that contain no indication of the exact item offered. The submission on individual items shall designate the exact item offered.
- E. Do not submit detailed quantitative listings of materials, equipment and devices. It is the Contractor's responsibility to provide proper sizes and quantities to conform with Contract Documents.
- F. **Submittals shall be furnished in a USB drive as one complete e-book in PDF format organized with dividers indicating each specification section. All submitted data shall reference specification**

**sections. Piece-mail electronic submittals via e-mail and/or hard copy submittals shall not be acceptable.**

- G. The Contractor shall submit shop drawings whenever equipment proposed varies in physical size and arrangement from that indicated thus causing rearrangement of equipment space, where tight spaces require extreme coordination between this work and other work, where called for elsewhere in these Specifications and where specifically requested by the Architect/ Engineer. Shop drawings shall be prepared at a scale of not less than 1/4 inch equals 1 foot.

#### 1.12 SUBSTITUTIONS

- A. Where a single manufacturer is mentioned by trade name or manufacturer's name, unless specifically noted otherwise, it is the only manufacturer that will be accepted.
- B. Where multiple manufacturers are listed, none other than those manufacturers will be accepted.
- C. It shall be understood that space allocations have been made on the basis of present and known future requirements and the dimensions of items of equipment or devices of a particular manufacturer whether indicated or not. If any item of equipment or device is offered in substitution which differs substantially in dimension or configuration from that indicated on the Drawings or specifications, provide as part of the submittal 1/4 inch equals 1 foot scaled drawings showing that the substitute can be installed in the space available without interfering with other portions of the work or with access for operations and maintenance in the completed project.
- D. Where substitute equipment or devices requiring different arrangement or connections from that indicated is accepted by the Architect/Engineer, install the equipment or devices to operate properly and in harmony with the intent of the Contract Documents, making all incidental changes in piping, ductwork or wiring resulting from the equipment or device selection without any additional cost to the Owner. The Contractor shall pay all additional costs incurred by other portions of the work in connection with the substituted equipment or device.
- E. The Architect/Engineer reserves the right to call for samples of any item of material, equipment or device offered in substitution, together with a sample of the specific item when, in their opinion, the quality of the item and/or the appearance is involved, and it is deemed that an evaluation of the item may be better made by visual inspection.
- F. When any request for a substitution of material, equipment or device is submitted and rejected, the item named in the Contract Documents shall be furnished. Repetitive submittal of substitutions for the same item will not be considered.

#### 1.13 INSTALLATION DRAWINGS

- A. Prepare installation drawings for coordinating the work of this Division with the work of other Divisions, to illustrate its concealment in finished spaces, to avoid obstructions, and to demonstrate the adaptability of any item of material, equipment or device in the space upon which the Contract Documents are based.
- B. Use these drawings in the field for the actual installation of this work. Provide three (3) copies, not for approval, to the Architect/Engineer for his information, review and record.

#### 1.14 WORKMANSHIP AND INSTALLATION

- A. In no case shall the Contractor provide a class of material, equipment, device or workmanship less than that required by the Contract Documents or applicable codes, regulations, ordinances or standards. All modifications which may be required by a local authority having legal jurisdiction over all or any part of the work shall be made by the Contractor without any additional charge. In all cases where such authority requires deviations from the requirements of the Drawings or Specifications, the Contractor shall report same to the Owner's Representative and shall secure his approval before the work is started.
- B. The work shall be performed by properly licensed technicians skilled in their respective trades. All materials, equipment and devices shall be installed in accordance with the recommendations of the manufacturer and in the best standard practice to bring about results of a first class condition.
- C. The NECA "Standards of Installation" as published by the National Electrical Contractors Association shall be considered a part of these Specifications, except as specifically modified by other provisions contained in these Specifications.

#### 1.15 WARRANTY

- A. All materials, equipment, devices and workmanship shall be warranted for a period of one year from the date of acceptance by the Architect/Engineer for beneficial use by the Owner, except that where specific equipment is noted to have extended warranties. The warranty shall be in accordance with AIA Document A201. The Contractor shall be responsible for the proper registration of these warranties so that the Owner can make all proper claims should future need develop.
- B. The Contractor shall furnish to the Architect/Engineer for transmittal to the Owner, the name, address and telephone number of those persons responsible for service on systems and equipment covered by the warranty.

#### 1.16 OPERATION PRIOR TO ACCEPTANCE

- A. When any equipment is operable, and it is to the advantage of the Contractor to operate the equipment, the Contractor may do so provided that he properly supervises the operation, and retains full responsibility for the equipment operated. Regardless of whether or not the equipment has or has not been operated, the Contractor shall clean the equipment properly, make required adjustments and complete punch list items before final acceptance by the Owner.

#### 1.17 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide the services of competent engineers and/or technicians acceptable to the Architect/Engineer to instruct other representatives of the Owner in the complete and detailed operation of each item of equipment or device of all the various electrical systems. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a letter of release, acknowledged by the Owner or his authorized representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.
- B. The Contractor shall be fully responsible for proper maintenance of equipment and systems until

the instructions have been given to the Owner's personnel and the letter of release acknowledged.

- C. In providing the instructions to the Owner's personnel, the written operating and maintenance manuals shall be followed in all instances, and the Owner's personnel shall be familiarized with such manuals. Operating and maintenance manuals used for instructions shall include wiring diagrams, manufacturer's operating and maintenance instructions, parts lists (with sources identified), and other data as appropriate for each system.

#### 1.18 SCHEDULE AND SEQUENCE OF WORK

- A. The Contractor shall meet and cooperate with the Owner and Architect/Engineer to schedule and sequence this work so as to insure meeting scheduled completion dates and avoid delaying other portions of the work. Work requiring special sequencing shall be at no additional cost to the Owner and shall have no impact on the schedule.

#### 1.19 INSPECTIONS AND CERTIFICATIONS

- A. Obtain timely inspections of the installation by the regulatory authorities. Remedy any deficiencies to the satisfaction of the inspecting official.
- B. Upon final completion of the work, obtain certificates of acceptance from the regulatory authorities. Deliver the certificates to the Architect/Engineer for transmission to the Owner.

#### 1.20 EQUIPMENT INSTALLATION

- A. Install equipment and devices in a manner to permit access to all surfaces or components, requiring such access, without the need to disassemble other unrelated parts of the work.
- B. Equipment specified to be factory assembled and tested prior to shipment shall not be disassembled at the job site and reassembled at its final location. Apparatus not so specified may be disassembled and reassembled in the proper location.
- C. Furnish all scaffolding, rigging and hoisting required for the installation of all the work.
- D. Large equipment assemblies and components which will be installed in the building, and which are too large to permit access through doorways, stairways or shafts, shall be brought to the site and placed in the appropriate spaces before the enclosing structure is complete.

#### 1.21 EQUIPMENT FOUNDATIONS

- A. Where indicated on the Drawings, provide foundations for electrical equipment. This shall consist of concrete housekeeping pads constructed in accordance with the details on the Drawings, these Specifications, manufacturer's recommendations and Division 3.
- B. All pad, unless noted otherwise, shall be 4" high and extend a maximum 2" beyond the actual equipment size. Coordinate the proper size of the pad with the equipment furnished. Furnish all anchor bolts and other accessories required for casting the concrete pad. After the equipment is set on the pad, the equipment shall be fully grouted to the pad and all void spaces shall be filled with a non-shrinking grout.

#### 1.22 SLEEVES

- A. Each conduit, regardless of material, which passes through a concrete slab, masonry wall, or roof or portion of the building structure shall be free from the structure and shall pass through a sleeve.
- B. All sleeves shall be constructed from electrical-metallic tubing or equivalent weight galvanized steel tubing and shall be flush on both sides of the surface penetrated, unless noted otherwise. All sleeves penetrating the roof areas shall extend a minimum 10 inches above the roof with approved weatherproof counterflashing attached to the conduit above the roof. All sleeves penetrating floors shall extend a minimum of 6 inches above the finished floors. The sleeves shall be sized to allow free passage of the conduit to be inserted.
- C. Sleeves passing through walls or floors on or below grade or in moist areas shall be constructed of galvanized rigid steel and shall be designed with a suitable flange in the center to form a waterproof passage. After the conduit has been installed in the sleeves, the void space around the conduit shall be caulked with jute twine and filled with an asphalt-base compound to insure a waterproof penetration.

#### 1.23 ESCUTCHEONS

- A. In each finished space, provide a chromium plated, sectional escutcheon on each conduit, or hanger rod penetrating a wall, floor or ceiling.
- B. Size escutcheons and collars to fit snugly around conduit and rods.
- C. Where required, provide escutcheons with set screws so that they fit snugly against the finished surface.

#### 1.24 ACCESS PANELS

- A. Provide wall and ceiling access panels for unrestricted access to all concealed electrical equipment items and devices installed behind furrings, chases or non-removable suspended ceilings.
- B. Access panels shall be UL listed and labeled as required to suit the fire rating of the surface in which installed, with mounting straps, concealed hinges, screwdriver locks, 180 degree open door design, 16 gauge steel construction and door and frame finished in prime coat finish. Panels shall be 12-inch by 12-inch minimum size, but shall be larger as the access requirement of the concealed electrical equipment item or device increases.

#### 1.25 EXCAVATION, TRENCHING AND BACKFILLING

- A. All excavating, trenching and backfilling shall generally be performed in accordance with the procedures and using the materials as described in Division 2. Provide all excavation required in connection with the installation of the work under this Division. After the work has been installed, tested and approved, backfill all excavations with suitable material.
- B. Bottoms of trenches shall be cut to grade. Should rock be encountered, same shall be excavated to a depth of six (6) inches below bottom of conduit and space shall be filled and tamped as specified hereinafter. Should it be required to lay conduit on fill, fill shall first be compacted.
- C. All conduit shall be installed promptly after excavation has been done so as to keep excavations open as short a time as possible.

- D. Trenches shall be excavated to the required depths. Depth of cover shall be as required by the NEC or as indicated on Drawings. Keep banks of trenches as nearly vertical as possible, and provide adequate shoring where required.
- E. When excavation is below the shale or subgrade level, backfill with granular fill or approved backfill material from the site to a depth of 12 inches above top of conduit, but in no case less than 1'-0" below the subgrade surface. The remainder of backfill to the shale or subgrade surface shall be an impervious material and shall be compacted at not less than 95 percent of the maximum dry density as defined by ASTM D-698. At all times, the top of the subgrade shall be kept in such condition that it will drain readily and effectively. A mud slab shall be placed over excavation where required by the Drawings or Specifications. Backfill above the subsurface shall be granular fill or approved select backfill from site.
- F. Beyond building walls or above the shale or subgrade level, backfill with sand or granular fill to a depth of 12 inches above top of conduit and remainder of trench filled with approved select backfill material from the site.
- G. Bottoms of trenches shall be tamped hard and graded to secure the maximum fall. Where rock is excavated below the bottom of the conduit, and before laying the conduit, fill the space between the bottom of the conduit and the rock surface with sand, thoroughly tamped.
- H. Trenches dug in fill shall have the conduit supported down to load-bearing soil. After conduits have been inspected and approved by the Owner's Representative, trenches shall be filled with approved backfill material which shall be firmly compacted, flooded if necessary and thoroughly tamped. Do not backfill with any fill containing rocks, frozen earth or debris.
- I. Include the cutting of all sidewalks, streets and other pavements and repairing the openings in them to return the surface to approximately its original condition.

#### 1.26 CUTTING AND PATCHING

- A. Cut all openings required to install the work or to repair any defective work. This cutting shall be performed under the Architect's/Engineer's direction and due diligence exercised to avoid cutting openings larger than required or in the wrong locations.
- B. No cutting or drilling of any sort will be permitted in the webs of prestressed, precast concrete structural elements. Use core drills or power driven saws to cut openings in the flanges of other such elements; the use of reciprocating drills will not be permitted. The cutting of structural members without first having received written permission from the Architect/ Engineer is prohibited.
- C. Where openings are cut in fire-rated walls or floors, seal the annular space between the work installed and the fire-rated construction. Sealant, as applied, shall be fire rated to maintain the fire rating of the construction penetrated. Sealant shall be re-enterable (before fire) to alter penetrations. Apply in strict accordance with manufacturer's instructions.

#### 1.27 SEALING OF PENETRATIONS

- A. All penetrations in horizontal or vertical fire-rated construction shall be sealed using approved fire-rated sealing materials equivalent to the following:

1. Foam: Dow Corning 3-6548 RTV silicone foam, liquid component Part 4 (black) and liquid component Part B (off-white).
  2. Sealant: Dow Corning 96-081 RTV silicone adhesive sealant.
  3. Damming Materials: Mineral fiberboard, mineral fiber matting, mineral fiber putty, plywood or particle board, as selected by applicator.
- B. Preparation: Remove combustible materials and loose impediments from penetration opening and involved surfaces. Remove free liquid and oil from penetration surfaces.
- C. Installation: In accordance with manufacturer's instructions, install damming materials and sealant to cover and seal penetration openings; inject foam mixtures into openings.
- 1.28 PROTECTION OF APPARATUS
- A. At all times take every precaution to properly protect apparatus from damage due to dust, dirt, water, etc. or from damage due to physical forces. Include the erection of temporary shelters as required, to adequately protect any apparatus stored at the site, the cribbing of any apparatus directly above the construction, and the covering of apparatus in the incomplete building with tarpaulins or other protective covering. Failure on the part of the Contractor to comply with the above to the entire satisfaction of the Architect/Engineer will be sufficient cause for the rejection of the pieces of apparatus in question.
- B. Responsibility for the protection of apparatus extend also to existing apparatus involved in this Division of the work, whether such apparatus is designated to be used temporarily and later removed, or is to be reused as a part of the permanent installation. Erect temporary sheltering structures, provide temporary bracing and supports, or cover equipment as required or directed to afford proper protection for that equipment.
- C. The Contractor shall protect this work and the work of all other Contractors from damage by his work or workmen and shall make good any damage thus caused. He shall also be responsible for the proper protection of his equipment, machinery, materials and accessories delivered and installed on the job.
- 1.29 INSTALLATION AND CONNECTION OF OTHER DIVISION'S EQUIPMENT
- A. Verify the electrical requirements of all equipment furnished under other Divisions, separate contracts, or by the Owner. Install conduit, power wiring, control wiring, devices, etc. as required for complete operation of all equipment.
- 1.30 OPTION TO RELOCATE OUTLETS AND RELATED DEVICES
- A. The location of power, data and telephone outlets, wall switches and other related devices may be relocated at the Owner's option, at no additional cost to the Owner, to a point within 10 feet of their present location provided the Contractor is notified prior to installation.
- 1.31 COOPERATION AND CLEAN-UP
- A. It shall be the responsibility of the Contractor to cooperate fully to keep the job site in a clean and



safe condition. Upon the completion of the job, the Contractor shall immediately remove all of his tools, equipment, surplus materials and debris.

- B. After the installation is complete, and before the equipment is energized, clean the interior and exterior of all equipment thoroughly. Clean equipment, removing all debris, rubbish and foreign materials. Each component shall be cleaned and all dust and other foreign material removed. Components shall be cleaned of oxidation. The inside and outside of all switchgear shall also be wiped clean with a lemon-oil rag after all other cleaning is complete.
- C. Any portion of the work requiring touch-up finishing shall be so finished to equal the specified finish on the product.

### 1.32 RECORD DRAWINGS AND DOCUMENTATION FOR OWNER

- A. The Contractor shall obtain at his own expense a complete set of blue-line prints on which to keep an accurate record of the installation of all materials, equipment and devices covered by the Contract. The record drawings shall indicate the location of all equipment and devices, and the routing of all systems. All piping and conduit buried in concrete slabs, walls and below grade shall be located by dimension; both horizontally and by vertical elevation, unless a surface mounted device in each space indicates the exact location. Obtain one complete reproducible set of the original drawings on which to neatly, legibly and accurately transfer all project related notations and deliver these drawings to the Architect/Engineer at job completion before final payment and delivery to the Owner. The above data, with the exception of the record drawings, shall be delivered prior to final acceptance.
- B. The Contractor shall accumulate in duplicate during the job progress, the following data prepared in indexed 3-ring loose leaf, hard-back binders sized for 8-1/2 inch by 11 inch sheets. No binder shall exceed 3-1/2 inches thick. This data shall be turned over to the Architect/Engineer for review and subsequent delivery to the Owner prior to final acceptance.
  - 1. Warranties, guarantees and manufacturer's directions on material, equipment and devices covered by the Contract.
  - 2. Approved lighting fixture brochures, wiring diagrams and control diagrams.
  - 3. Copies of approved submittals and shop drawings.
  - 4. Operating instructions for major apparatus and recommended maintenance procedures.
  - 5. Copies of all other data and/or drawings required during construction.
  - 6. Repair parts list of major apparatus, including name, address and telephone number of local supplier or representative.
  - 7. Tag charts and diagrams hereinbefore specified.

1.33 FINAL OBSERVATION

- A. The purpose of the final observation is to determine whether the Contractor has completed the construction in accordance with the Contract Documents and that in the Owner Representative's opinion the installation is satisfactory for final acceptance by the Owner.
- B. It shall be the responsibility of the Contractor to assure that the installation is ready for final acceptance prior to calling upon the Architect/Engineer to make a final observation.

END OF SECTION 26 00 10

SECTION 26 05 19  
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.
- B. Related Sections include the following:
- C.
  - 1. Section 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- 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. Alcan Products Corporation; Alcan Cable Division.
  - 2. American Insulated Wire Corp.; a Leviton Company.
  - 3. General Cable Corporation.
  - 4. Senator Wire & Cable Company.
  - 5. Southwire Company.
  - 6. Encore.
- C. Copper Conductors: Comply with NEMA WC 70.
- D. Conductor Insulation: Comply with NEMA WC 70 for Types THW THHN-THWN and SO.

2.2 CONNECTORS AND SPLICES

- 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. AFC Cable Systems, Inc.
  - 2. Hubbell Power Systems, Inc.
  - 3. O-Z/Gedney; EGS Electrical Group LLC.
  - 4. 3M; Electrical Products Division.
  - 5. Tyco Electronics Corp.
- C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.
- F. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- I. Branch Circuits Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.
- J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- K. Class 1 Control Circuits: Type THHN-THWN, in raceway.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

### 3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

### 3.7 FIELD QUALITY CONTROL

- A. Torque test conductor connections and terminations to manufacturer's recommended values.
- B. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

- C. Conductors in vertical conduits or raceways shall be supported in the manner set forth in the appropriate section of the latest revision of the National Electrical Code. Lighting fixtures shall not be used for raceways for circuits other than parallel wiring of fixtures.
- D. Conductors may be run in parallel on sizes 1/0 to 500 MCM inclusive provided all paralleled conductors are the same size, length, and type of insulation. Except as otherwise shown on drawings, no more than three conductors may be run in parallel, and they shall be so arranged and terminated as to insure equal division of the total current between all conductors involved. Where parallel connection is contemplated, approval of the Owner's representative must be obtained before installation is made.

### 3.8 TESTING AND ACCEPTANCE

- A. Before final acceptance, the Contractor shall make voltage, insulation, and load tests, necessary to demonstrate to the Owner's representative the satisfactory installation and proper performance of all circuits.
- B. Test feeder conductors clear of faults. Insulation-resistance test shall be conducted per NETA – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems. Test results below 50 megohms shall be cause for rejection of the wiring installation. Replace and retest all such rejected conductor. At the completion of this project, the Contractor shall provide for the Owner three (3) complete and finally corrected sets of working drawings. These sets of working drawings shall be new, unused and in good condition, and shall include the nature, destination, path, size and type of wire and all other characteristics for complete identification of each and every conduit and circuit.



END OF SECTION 26 05 19

## SECTION 26 05 26

### GROUNDING AND BONDING 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. Section Includes: Grounding systems and equipment.
- B. Section includes grounding systems and equipment, plus the following special applications:
  - 1. Underground distribution grounding.
  - 2. Ground bonding common with lightning protection system (where specified).

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
  - 1. Test wells.
  - 2. Ground rods.
  - 3. Grounding arrangements and connections for separately derived systems.
  - 4. Grounding for sensitive electronic equipment.
- C. Qualification Data: For qualified testing agency and testing agency's field supervisor.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Instructions for periodic testing and inspection of grounding features at test wells grounding connections for separately derived systems.
    - a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
    - b. Include recommended testing intervals.

#### 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. Comply with UL 467 for grounding and bonding materials and equipment.

### PART 2 - PRODUCTS

#### 2.1 CONDUCTORS

- A. Insulated Conductors: [Copper] [or] [tinned-copper] wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, [1/4 by 4 inches (6.3 by 100 mm)] in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

#### 2.2 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

- D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

## 2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
  - 1. Bury at least 24 inches (600 mm) below grade.
  - 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.
- E. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

### 3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.

- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

### 3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. Feeders and branch circuits.
  - 2. Lighting circuits.
  - 3. Receptacle circuits.
  - 4. Single-phase motor and appliance branch circuits.
  - 5. Three-phase motor and appliance branch circuits.
  - 6. Flexible raceway runs.
  - 7. Armored and metal-clad cable runs.
  - 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
  - 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
  - 10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- G. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
  - 1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
  - 2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch (6.3-by-100-by-300-mm) grounding bus.
  - 3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- H. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

### 3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: (REFER TO PLANS FOR EQUIPMENT REQUIRING XIT GROUNDING SYSTEM). Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.
- G. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
  2. Bury ground ring not less than 24 inches (600 mm) from building's foundation.
- 3.5 LABELING
- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

### 3.6 FIELD QUALITY CONTROL

#### A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
  - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
  - b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

#### B. Grounding system will be considered defective if it does not pass tests and inspections.



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.

##### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

##### 1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. 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 times the applied force.

##### 1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel slotted support systems.

- B. Shop Drawings: 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. Equipment supports.

#### 1.6 QUALITY ASSURANCE

- A. Comply with NFPA 70.

#### 1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07.

### 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Tyco International, Ltd.
  - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  - 4. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

- D. 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.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. 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. 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) Hilti Inc.
      - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
  - 2. Mechanical-Expansion Anchors: Insert-wedge-type, 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. 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) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Hilti Inc.
      - 3) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
  - 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 Division 05 Section "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 NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) 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, IMC, 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 (90 kg).
- 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 or threaded through wall.
  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 (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
  6. To Steel: Beam clamps complying with MSS SP-69.
  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.
- 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 Division 05 Section "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 (100 mm) 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 Division 03 Section "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.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Comply with requirements in Division 09 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

### RACEWAY AND BOXES 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 raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
  - 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

##### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. NBR: Acrylonitrile-butadiene rubber.
- G. RNC: Rigid nonmetallic conduit.

##### 1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Custom enclosures and cabinets.

2. For handholes and boxes for underground wiring, including the following:
  - a. Duct entry provisions, including locations and duct sizes.
  - b. Frame and cover design.
  - c. Grounding details.
  - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
  - e. Joint details.
  
- C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  1. Structural members in the paths of conduit groups with common supports.
  2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

#### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  
- B. Comply with NFPA 70.

### PART 2 - PRODUCTS

#### 2.1 METAL CONDUIT AND TUBING

- 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. AFC Cable Systems, Inc.
  2. Alflex Inc.
  3. Allied Tube & Conduit; a Tyco International Ltd. Co.
  4. Anamet Electrical, Inc.; Anaconda Metal Hose.
  5. Electri-Flex Co.
  6. Manhattan/CDT/Cole-Flex.
  7. Maverick Tube Corporation.
  8. O-Z Gedney; a unit of General Signal.
  9. Wheatland Tube Company.
  
- C. Rigid Steel Conduit: ANSI C80.1.
  
- D. IMC: ANSI C80.6.

- E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
  - 1. Comply with NEMA RN 1.
  - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- F. EMT: ANSI C80.3.
- G. FMC: Zinc-coated steel
- H. LFMC: Flexible steel conduit with PVC jacket.
- I. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
  - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
  - 2. Fittings for EMT: Steel -screw or compression type.
  - 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- J. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

## 2.2 NONMETALLIC CONDUIT AND TUBING

- 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. AFC Cable Systems, Inc.
  - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
  - 3. CANTEX Inc.
  - 4. CertainTeed Corp.; Pipe & Plastics Group.
  - 5. Lamson & Sessions; Carlon Electrical Products.
  - 6. RACO; a Hubbell Company.
  - 7. Thomas & Betts Corporation.
- C. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- D. LFNC: UL 1660.
- E. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.
- F. Fittings for LFNC: UL 514B.

### 2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

- 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. Arnco Corporation.
  - 2. Endot Industries Inc.
  - 3. IPEX Inc.
  - 4. Lamson & Sessions; Carlon Electrical Products.
  - 5.
- C. Description: Comply with UL 2024; flexible type, approved for plenum installation.

### 2.4 METAL WIREWAYS

- 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. Cooper B-Line, Inc.
  - 2. Hoffman.
  - 3. Square D; Schneider Electric.
  - 4. Wiremolp.
  - 5. Cabolafil.
- C. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 or 3R, unless otherwise indicated.
- D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- E. Wireway Covers: As indicated.
- F. Finish: Manufacturer's standard enamel finish.

### 2.5 SURFACE RACEWAYS: (As indicated on drawings)

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.

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. Thomas & Betts Corporation.
  - b. Walker Systems, Inc.; Wiremold Company (The).
  - c. Wiremold Company (The); Electrical Sales Division.
  
- B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.
  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. Butler Manufacturing Company; Walker Division.
    - b. Hubbell Incorporated; Wiring Device-Kellems Division.
    - c. Lamson & Sessions; Carlon Electrical Products.
    - d. Panduit Corp.
    - e. Walker Systems, Inc.; Wiremold Company (The).
    - f. Wiremold Company (The); Electrical Sales Division.

## 2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
  2. EGS/Appleton Electric.
  3. Erickson Electrical Equipment Company.
  4. Hoffman.
  5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
  6. O-Z/Gedney; a unit of General Signal.
  7. RACO; a Hubbell Company.
  8. Robroy Industries, Inc.; Enclosure Division.
  9. Scott Fetzer Co.; Adalet Division.
  10. Spring City Electrical Manufacturing Company.
  11. Thomas & Betts Corporation.
  12. Walker Systems, Inc.; Wiremold Company (The).
  13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
  
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
  
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
  
- D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

- E. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular. (As indicated on drawings)
  - F. Nonmetallic Floor Boxes: Nonadjustable, round.
  - G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
  - H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.
  - I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
    - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
    - 2. Nonmetallic Enclosures: Plastic or fiberglass.
  - J. Cabinets:
    - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
    - 2. Hinged door in front cover with flush latch and concealed hinge.
    - 3. Key latch to match panelboards.
    - 4. Metal barriers to separate wiring of different systems and voltage.
    - 5. Accessory feet where required for freestanding equipment.
- 2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING (REFER TO PLANS FOR ADDITIONAL REQUIREMENTS)
- A. Description: Comply with SCTE 77.
    - 1. Color of Frame and Cover: Gray.
    - 2. Configuration: Units shall be designed for flush burial and have open 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." or "Data/Comm"
    - 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
    - 7. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed.
  - B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
    - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
      - a. Armorcast Products Company.
      - b. Carson Industries LLC.

- c. CDR Systems Corporation.
      - d. NewBasis.
      - e. Highline
    - C. 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. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings 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.
        - e. Highline.
    - D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of hot-dip galvanized-steel diamond plate.
      - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
        - a. Carson Industries LLC.
        - b. Christy Concrete Products.
        - c. Nordic Fiberglass, Inc.
        - d. Highline.
- 2.8 SLEEVES FOR RACEWAYS
- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
  - B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
  - C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
  - D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07.
- 2.9 SLEEVE SEALS
- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - 1. Advance Products & Systems, Inc.
    - 2. Calpico, Inc.
    - 3. Metraflex Co.
    - 4. Pipeline Seal and Insulator, Inc.

- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
  - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 2. Pressure Plates: Carbon steel Include two for each sealing element.
  - 3. 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.

### PART 3 - EXECUTION

#### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
  - 1. Exposed Conduit: Rigid steel conduit.
  - 2. Concealed Conduit, Aboveground: EMT
  - 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
  - 6. Application of Handholes and Boxes for Underground Wiring:
    - a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
    - b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.
    - c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.
- B. Comply with the following indoor applications, unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
  - 3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
  - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  - 6. Damp or Wet Locations: Rigid steel conduit.



7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT or cable tray. All conduits shall have plastic bushing at the ends.
  8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT
  9. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable EMT.
  10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations. HUBS to match conduit.
- C. Minimum Raceway Size: 1/2-inch.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
  2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

### 3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation. Use conduit caps to protect installed conduit against entrance of dirt and moisture before area is dried in and cable or wire are not immediately installed. Tape covering of conduit ends is not acceptable.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
  2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  3. Change from Type EPC-40-PVC to rigid steel conduit, before rising above the floor.

4. Elbows larger than 1/2" or on runs longer than 50' shall be rigid steel.
  5. Tape all GRC with 2" overlapping tape where underground or where in contact with concrete.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
  - J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
  - K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.
  - L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
    1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
    2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
    3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
  - M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
    1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
    2. Where otherwise required by NFPA 70.
  - N. Expansion-Joint Fittings: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).
    1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
      - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C temperature change.
      - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
      - c. Indoor Spaces: Connected with the Outdoors without Physical Separation: [125 deg F (70 deg C) temperature change.
      - d. Attics: 135 deg F (75 deg C) temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.
  3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
  4. Unless expansion fitting has internal bonding braid, a green insulated grounding conductor shall be pulled in conduit.
- O. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC in damp or wet locations not subject to severe physical damage.
- P. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- Q. Set metal floor boxes level and flush with finished floor surface.
- R. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
  2. Install backfill as specified in Division 31 Section "Earth Moving."
  3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31.
  4. Install manufactured 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.
  5. 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 (75 mm) of concrete.
    - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment

pad or foundation. Install insulated grounding bushings on terminations at equipment.

### 3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) 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 conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### 3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
  - 1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
  - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- L. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

### 3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.7 FIRESTOPPING (REFER TO DRAWING FOR ADDITIONAL FIRESTOPPING EZ-PATH SYSTEM REQUIREMENTS)

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07.

### 3.8 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

## SECTION 26 05 33.01 – PLUG-IN RACEWAY SYSTEM

### PART 1 - GENERAL

#### 1.1 SUMMARY-SCOPE

This specification covers the electrical characteristics and general requirements for a Plug-In Raceway System.

- A. Starline Plug-In Raceway, hereafter referred to as 'Raceway', is an electrical distribution system using a continuous plug-in busway design with an enclosed pathway for power distribution and communication wiring. Plug-in modules contain receptacles to provide power with/without circuit protection at the point of use. Plug-in modules can be added to or removed from the Raceway without shutting down power, as designed for energized insertion per UL857. The Raceway also has an optional channel to run cabling for voice, data, multi-media, low voltage, and optical fiber cables or other similar items.

#### 1.2 STANDARDS

Raceway is designed and manufactured to the following standards:

- A. Underwriters Laboratories Standard, UL 857 – The common UL, CSA, and ANCE Standard for Busway that is derived from the fifth edition of CSA Standard C22.2 No. 27, the twelve edition of UL 857, and the second edition of NMX-J-148-1998-ANCE
- B. National Electric Code (NEC) – Article 368 – Busway
- C. National Electric Code (NEC) Article 386 Surface Metal Raceways
- D. cETLus
- E. NFPA 70 – National Fire Protection Agency
- F. Low Voltage Directive (73/23/EEC) including Amendment (93/68/EEC)
- G. Low Voltage Switchgear and Controlgear Assemblies, Part 1: Type Tested and partially type tested Assemblies, IEC 60439 1
- H. Low Voltage Switchgear and Controlgear Assemblies, Part 2: Particular Requirements Busbar Trunking systems (Busway), IEC 60439 2
- I. IEC 61534-1 requirement for Powertrack (PT) system

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include data on features, components, ratings, and performance.
- B. Shop Drawings: For Plug-In Raceway include:



1. Detail equipment assemblies and indicate dimensions, weights, and location and identification of each field connection.
  2. Wiring Connection: For power and monitoring wiring.
  3. Orientation of Plug-In units face in final installation.
  4. Include Plug-In Schedule with detailed description.
  5. Product Data sheets.
  6. Installation Instructions Drawings.
- C. Manufacturer Certificates: For each product, from manufacturer.
- D. Operation and Maintenance Data: For Plug-In Raceway System include in operation and maintenance manuals.

#### 1.4 MAINTENANCE MATERIAL AND SPARE PARTS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Plug-in Units
  2. Field cut kits can be distributed to customize the length of the Raceway in the field.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firms regularly engaged in the manufacture of Raceway systems, boxes and fittings of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years. Provide raceways and boxes produced by a manufacturer listed in this section.
- B. Electrical Raceways, Boxes, and Components: Comply with requirements of applicable local codes, NEC, UL, ETL, NEMA and IEC Standards pertaining to busway, raceways, boxes, and components. Listed and labeled in accordance with UL857 and NFPA 70, Article 100.

#### 1.6 WARRANTY

- A. Warranty: The Raceway manufacturer shall guarantee the entire system against defective material and workmanship for a period of one (1) year from date of shipment.
- B. Manufacturer shall agree to repair or replace components that fail in materials or workmanship within specified warranty period. Warranty shall include all labor, material, and related expenses to restore system and/ or components from failures.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver raceway system in factory labeled packages.

- B. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
- C. Protect from damage due to weather, excessive temperature, and construction operations.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURER

- A. Basis of Specification is Starline Plug-In Raceway as manufactured by Universal Electric Corporation.
- B. Provide Starline Plug-In Raceway as manufactured by Universal Electric Corporation, 168 Georgetown Rd., Canonsburg, PA 15317: toll-free 1-800-245-6378, telephone 724-597-7800, fax 724-916-2221; www.StarlinePower.com. NO KNOWN EQUAL.

### 2.2 STARLINE PLUG-IN RACEWAY

- A. Starline Plug-In Raceway assembly: Model Series 20A & 60A (domestic) power and data configurations.

### 2.3 PRODUCT DESCRIPTION AND COMPONENTS

- A. Raceway system that shall be provided as 4 pole, (3Ph plus N) rated up to 208 Vac power-data duel channel configurations.
- B. The 20A and 60A continuous surface mounted busway shall use a plug-in type module that allows for the direct plug-in of modules that contain various types of receptacles. Circuit breakers shall be provided as part of the plug-in modules.
- C. This system is intended for field installation in accordance with Article 368 of the National Electrical Code (NEC) and installation instructions provided by the manufacturer.
- D. Enclosure: Indoor use only. Approved for floor, wall, or ceiling mount.
- E. Grounding: Provided by the metal enclosure or by copper ground conductor on request.
- F. Support: To be supported every 32 inches (813mm) max
- G. Short Circuit Rating: 10,000 RMS symmetrical amperes.
- H. System type & Amperage (power only single channel OR power-data duel channel, 20 or 60A.

#### a. Sections and Fittings

- 3 Phase 120/208 Vac or Vdc maximum, 100% rated Power Only (single channel) @ 20

- or 60 Amp (domestic)
- 3 Phase 120/208 Vac or Vdc maximum, 100% rated Power-Data (dual channel) @ 20  
or 60 Amp (domestic)

b. Conductor Materials

20 Amp series uses bare copper; 60 Amp uses tin  
plated copper wire  
x – Raceway length  
y – EMI Shield option;

U = Unshielded or  
S = Shielded

c. Joint Kits

d. End Caps

e. Elbows

f. Power End Feeds or Center Feeds

Providing components unassembled allows installers to field customize as required.  
Installer can configure for left hand, right hand, top or rear wire entry points. All units  
rated at 120/208 20 & 60 Amps (domestic)

g. Plug-In Module

Plug-in modules can be provided with circuit breaker overcurrent protection at the  
point of use. The circuit breakers and receptacles are factory wired and ordered to  
meet the user's power requirements.

h. The Raceway cover consist of either plug-in modules or blank cover filler sections.

## PART 3 - EXECUTION

### 3.1 PREPARATION AND INSTALLATION

- A. Layout drawings of the Raceway system should be approved prior to installation.  
Note: Raceway is intended for any surface indoor applications in well controlled dry  
environments, it should not be installed in wet areas.
- i. Manufacturer's instructions for installing Raceway and fittings should be followed  
by the installer.
  - ii. All wall surfaces or other permanent structures to which Raceway is mounted,  
should be completed prior to installation.
    - 1. Raceway Support: Starline Plug-In Raceway should be supported at  
intervals not exceeding 32 inches (813mm) or in accordance with  
manufacturer's installation sheets.

- iii. d. Accessories
- iv. Provide accessories as required for a complete installation, including insulated bushings and inserts when required by manufacturer.
- v. e. Unused Openings
- vi. Close unused Raceway openings using manufacturers' recommended accessories such as covers, end caps and other such accessories.

### 3.2 CLEANING AND PROTECTION

- A. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer.
- B. Protect raceways and boxes until installation, commissioning and testing.
- C. Starline Plug-In Raceway is manufactured by Universal Electric Corporation, 168 Georgetown Rd., Canonsburg, PA 15317. Toll-free phone: 1-800-245-6378; telephone: 724-597-7800; fax: 724-916-2221; [www.uecorp.com](http://www.uecorp.com), No known equal.

### 3.3 FIELD QUALITY CONTROL

- A. Installing Contractor Inspections:
  - 1. Comply with manufacturer's written instructions.
  - 2. Inspect interiors of enclosures, including the following:
    - a. Integrity of mechanical and electrical connections.
    - b. Component type and labeling verification.
    - c. Ratings of installed components.
- B. Installing Contractor to prepare inspection reports.

END OF SECTION 26 05 33.01

## 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. Division 07 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.
- B. LEED Submittals:
  - 1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
  - 2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products 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."

### 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 (0.6-mm) 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 (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
    - b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

## 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 one of the following:
  - 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 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 (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.4 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 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 Division 07.
    - 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.
  - 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 (25-mm) 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 (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

#### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. 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 53

### IDENTIFICATION 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. Section Includes:
  1. Identification for raceways.
  2. Identification of power and control cables.
  3. Identification for conductors.
  4. Underground-line warning tape.
  5. Warning labels and signs.
  6. Instruction signs.
  7. Equipment identification labels.
  8. Miscellaneous identification products.

##### 1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

##### 1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

##### 1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- F. Write-On Tags: Polyester tag, [0.010 inch (0.25 mm)] [0.015 inch (0.38 mm)] <Insert dimension> thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

### 2.2 FLOOR MARKING TAPE

- A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

### 2.3 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
  - 1. 3.5 mils and 6" wide.
  - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - 3. Polyethylene tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

- B. Color and Printing:
  - 1. Inscriptions for Red-Colored Tapes: BURIED ELECTRIC LINE, CAUTION.
  - 2. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

## 2.4 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
  - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
  - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
  - 3. Nominal size, 7 by 10 inches (180 by 250 mm).
- D. Metal-Backed, Butyrate Warning Signs:
  - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
  - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
  - 3. Nominal size, 10 by 14 inches (250 by 360 mm).
- E. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

## 2.5 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
  - 1. Engraved legend with [black letters on white face] <Insert colors>.
  - 2. Punched or drilled for mechanical fasteners.
  - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

## 2.6 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.
- C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).
- D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).
- E. Stenciled Legend: In nonfading, waterproof, [black] <Insert color> ink or paint. Minimum letter height shall be [1 inch (25 mm)] <Insert dimension>.

## 2.7 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch (5 mm).
  - 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
  - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
  - 4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch (5 mm).
  - 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
  - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
  - 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
  - 1. Minimum Width: 3/16 inch (5 mm).
  - 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
  - 3. UL 94 Flame Rating: 94V-0.
  - 4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
  - 5. Color: Black.

## 2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Secure plastic name plates to equipment fronts using screws or rivets. Use of adhesive shall be per owner's approval only.
- E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.
- G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches (400 mm) overall.

#### 3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than A, and [120] V to ground: Identify with self-adhesive vinyl tape applied in bands. Install labels at 10-foot (3-m) [30-foot (10-m) maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. Emergency Power – White letters on Red background.
  - 2. Normal Power – White letters on Black background.
  - 3. UPS – White letters on Orange background.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
  - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
  - b. Colors for 208/120-V Circuits:
    - 1) Phase A: Black.
    - 2) Phase B: Red.
    - 3) Phase C: Blue.
    - 4) Neutral: White.
  - c. Colors for 480/277-V Circuits:
    - 1) Phase A: Brown.
    - 2) Phase B: Orange. (Purple)
    - 3) Phase C: Yellow.
    - 4) Neutral: Gray.
  - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
  1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
  1. Limit use of underground-line warning tape to direct-buried cables.
  2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- G. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
  1. Comply with 29 CFR 1910.145.
  2. Identify system voltage with black letters on an orange background.
  3. Apply to exterior of door, cover, or other access.
  4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.

- b. Controls with external control power connections.
- I. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.
- K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
  - 1. Labeling Instructions:
    - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
    - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
    - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  - 2. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Switchgear.
    - e. Switchboards.
    - f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - g. Emergency system boxes and enclosures.
    - h. Motor-control centers.
    - i. Enclosed switches.
    - j. Enclosed circuit breakers.
    - k. Enclosed controllers.
    - l. Variable-speed controllers.
    - m. Push-button stations.
    - n. Power transfer equipment.
    - o. Contactors.
    - p. Remote-controlled switches, dimmer modules, and control devices.
    - q. Battery-inverter units.

- r. Battery racks.
- s. Power-generating units.
- t. Monitoring and control equipment.
- u. UPS equipment.
- 3. Nameplate Detail:
  - a. For circuit breakers, panelboards, switchboards, disconnect switches, motor starters, and contactors: ¼-inch letters, identify source to and device load serves, including location.
- 4. Enclosure Color Coding:
  - a. The following systems shall have each junction and pull box cover completely painted per the following:

System	Color of Box Cover
Ethernet Backbone	Blue
Telecommunications	Brown
FCMS	Green
Emergency Power	Red
Security**	White
Fire Alarm	Yellow
Clock	Fluorescent Violet
U.P.S.	Fluorescent Pink

- b. \*\*
- c. Security shall include, but not be limited to, the following systems:
  - Card Access
  - Duress Alarms
  - Perimeter Door Alarms
  - CCTV

END OF SECTION 26 05 53



## SECTION 26 05 73.16 - COORDINATION STUDIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

##### B. Related Requirements:

1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 26 00 11 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 26 05 73.13 "Short-Circuit Studies" for fault-current studies.
4. Section 26 05 73.19 "Arc-Flash Hazard Analysis" for arc-flash studies.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data:

1. For power system analysis software to be used for studies.

##### B. Coordination Study Report:

1. Submit the following after approval of system protective devices submittals. Submittals must be in digital form.
  - a. Coordination-study input data, including completed computer program input data sheets.
  - b. Study and equipment evaluation reports.
  - c. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
  - d. Revised one-line diagram, reflecting field investigation results and results of coordination study.

### 1.3 INFORMATIONAL SUBMITTALS

### 1.4 QUALITY ASSURANCE

- A. Studies must be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms must comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.

### 1.5 REGULATORY AGENCY APPROVALS

- A. Submittals for coordination study requiring approval by authorities having jurisdiction must be signed and sealed by qualified electrical professional engineer responsible for their preparation.

## PART 2 - PRODUCTS

### 2.1 POWER SYSTEM ANALYSIS SOFTWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. SKM Systems Analysis, Inc.
- B. Comply with IEEE 242 and IEEE 399.
- C. Analytical features of device coordination study computer software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program must be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program must report device settings and ratings of overcurrent protective devices and must demonstrate selective coordination by computer-generated, time-current coordination plots.

### 2.2 COORDINATION STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:

1. Protective device designations and ampere ratings.
  2. Conductor types, sizes, and lengths.
  3. Transformer kVA and voltage ratings.
  4. Switchgear, switchboard, motor-control center, and panelboard designations.
  5. Revisions to electrical equipment required by study.
  6. Study Input Data: As described in "Power System Data" Article.
    - a. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 26 05 73.13 "Short-Circuit Studies."
- D. Protective Device Coordination Study:
1. Report recommended settings of protective devices, ready to be applied in field. Use manufacturer's data sheets for recording recommended setting of overcurrent protective devices when available.
    - a. Circuit Breakers:
      - 1) Adjustable pickups and time delays (long time, short time, and ground).
      - 2) Adjustable time-current characteristic.
      - 3) Adjustable instantaneous pickup.
      - 4) Recommendations on improved trip systems, if applicable.
    - b. Fuses: Show current rating, voltage, and class.
- E. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for switching schemes and for emergency periods where power source is local generation. Show the following information:
1. Device tag and title, one-line diagram with legend identifying portion of system covered.
  2. Terminate device characteristic curves at point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
  3. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
  4. Plot the following listed characteristic curves, as applicable:
    - a. Power utility's overcurrent protective device.
    - b. Medium-voltage equipment overcurrent relays.
    - c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
    - d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
    - e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
    - f. Cables and conductors damage curves.
    - g. Ground-fault protective devices.
    - h. Motor-starting characteristics and motor damage points.
    - i. Generator short-circuit decrement curve and generator damage point.
    - j. Largest feeder circuit breaker in each motor-control center and panelboard.
  5. Maintain selectivity for tripping currents caused by overloads.

6. Provide adequate time margins between device characteristics such that selective operation is achieved.
7. Comments and recommendations for system improvements.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.
  1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

#### 3.2 POWER SYSTEM DATA

- A. Obtain data necessary for conduct of overcurrent protective device study.
  1. Verify completeness of data supplied in one-line diagram on Drawings. Call discrepancies to Architect's attention.
  2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
- B. Gather and tabulate required input data to support coordination study. List below is guide. Comply with recommendations in IEEE 551 for amount of detail required to be acquired in field. Field data gathering must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:

#### 3.3 COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.
- B. Comply with IEEE 399 for general study procedures.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system to be studied is indicated on Drawings.
- E. Begin analysis at service, extending down to system overcurrent protective devices as follows:
  1. To normal system low-voltage load buses where fault current is 5 kA or less.

- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Transformer Primary Overcurrent Protective Devices:
  - 1. Device must not operate in response to the following:
    - a. Inrush current when first energized.
    - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
    - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
  - 2. Device settings must protect transformers according to IEEE C57.12.00, for fault currents.
- H. Motor Protection:
  - 1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
  - 2. Select protection for motors served at voltages more than 600 V according to IEEE 620.
- I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands maximum short-circuit current for time equivalent to tripping time of primary relay protection or total clearing time of fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- J. Generator Protection: Select protection according to manufacturer's instructions and to IEEE 242.
- K. Include ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.
- L. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at each equipment indicated on one-line diagram.
  - 1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.
- M. Protective Device Evaluation:
  - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
  - 2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
  - 3. Include in report identification of protective device applied outside its capacity.

### 3.4 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to recommended settings provided by coordination study. Field adjustments must be completed by engineering service division of equipment manufacturer under "Startup and Acceptance Testing" contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.
- C. Testing and adjusting must be by qualified medium-voltage and low-voltage electrical testing and inspecting agency.
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for adjustable overcurrent protective devices.

END OF SECTION 26 05 73.16

## SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Fabricate and test low voltage dry-type distribution transformers as described in this specification and on the Drawings.

#### 1.2 SUMMARY

- A. Transformers on this project significantly exceed basic DOE 2016 requirements being optimized to provide 33% energy savings on average compared to a comparable DOE 2016 transformer when feeding predominately electronic equipment in the 0-25% loading range.
- B. General Purpose Transformers do NOT meet this specification as they do not carry a UL Listing for this application.
- C. Other highlights of requirements of this specification include:
  - a. Copper wound
  - b. K-7 rated
  - c. No load loss limits
  - d. Efficiency under nonlinear loading to ensure real world performance
  - e. 105% continuous duty overload capacity
  - f. Performance Validation Reports for each unit shipped on project signed by professional engineer
  - g. Lockable Hinged Door to reduce arc flash risk when accessing for maintenance & thermal scans
- D. Information to be submitted with bid:
  - a. Line-by-line compliance, deviation, exception for this specification
  - b. Performance Guarantee by Manufacturer that ALL transformers on this project will meet specified performance
  - c. Failure to provide this information will result in a non-compliant proposal.

#### 1.3 REFERENCES

- A. US Department of Energy, 10 CFR Part 431 – Energy Efficiency Program for Certain Commercial and Industrial Equipment, Subpart K – Distribution Transformers
- B. US Department of Energy, 10 CFR Part 429 – Certification, Compliance, and Enforcement for Consumer Products and Commercial and Industrial Equipment
- C. ANSI/NEMA ST 20 - 2014 - Dry Type Transformers for General Applications.
- D. Metering Standards:
  - a. Computational algorithms per IEEE Std 1459-2000

- b. UL 916, UL 61010C-1 CAT III
- E. IEEE C57.110-2008 – IEEE Recommended Practice for establishing liquid-filled and dry-type power distribution transformer capability when feeding nonsinusoidal load currents
- F. IEEE Std C57.12.91-1995 Standard Test Code for Dry-Type Transformers
- G. IEEE-1100 – Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
- H. ISO 9001:2008 – International Standards Organization - Quality Management System
- I. ISO 14001:2004 – International Standards Organization - Environmental Management System
- J. ISO 17025 – International Standards Organization - General requirements for the competence of testing and calibration laboratories

#### 1.4 BID PROPOSAL

- A. Compliance Review:
  - a. Submit a complete copy of these specifications with each subparagraph marked either "compliance", "deviation", or "exception". Fully describe all deviations and exceptions taken to this specification.
    - i. "Compliance": Comply with no exceptions.
    - ii. "Deviation": Comply with deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
    - iii. "Exception": Exception, do not comply. For each and every exception, provide a numbered footnote with reasons and possible alternatives.
  - b. Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the Bidder is in complete compliance with this Specification. Deviations or exceptions taken in cover letters, subsidiary documents, by omission or by contradiction do not release the Bidder from being in complete compliance, unless the exception or deviation has been specifically noted in the Compliance Review. Bidders may submit the latest state-of-the-art components and their standard control components in lieu of the specified items. All deviations from the Specifications must be approved by the Architect/Engineer.
  - c. Failure to provide this information will result in a non-compliant proposal.

#### 1.5 SUBMITTALS

Submit product data including the following:

- A. Manufacturer documentation guaranteeing that ALL units on the project will comply with the performance requirements of this specification.
- B. Where one or more of the integrated transformer options is selected for this project, provide associated documentation.



- C. Insulation system impregnant data sheet as published by supplier.
- D. Construction details including enclosure dimensions, kVA rating, primary & secondary nominal voltages, voltage taps, BIL, unit weight
- E. Basic Performance characteristics including insulation class, temperature rise, core and coil materials, impedances & audible noise level, unit weight
- F. Manufacturer documentation that sizing primary protection at 125% of nominal full load amps will not result in nuisance tripping on transformer inrush
- G. Documentation of UL listing of 2" clearance from ventilated surface
- H. Inrush Current (typical 3 cycle recovery)
- I. Short Circuit Current data: Primary & Secondary
- J. Efficiency, Loss & Heat output Data
- K. No load and full load losses per NEMA ST20
- L. Linear load data @ 1/6 load
- M. Linear load data @ 1/4, 1/2, 3/4 & full load
- N. Linear Load efficiency @ 35% loading tested per NEMA TP-2.
- O. Efficiency under K7 load profile at 16.7%, 25%, 50%, 75%, 100% of nameplate rating.
- P. Factory ISO 9001 procedure describing nonlinear load test program
  - a. Meter and CT details including model, accuracy, serial numbers and calibration information.
- Q. 25 year Product Warranty Certificate
- R. Manufacturer's ISO 14001:2004 Certification
- S. Manufacturer's ISO 9001:2008 Certification
- T. ISO 17025 Certificate - Efficiency Test Lab where transformers are tested
- U. Documentation that materials used for shipment packaging meet the environmental requirements of this specification.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Comprehensive Operations and Maintenance Manual
- B. Applicable wiring diagrams, including any modifications made
- C. Copies of completed factory and site testing reports.

#### 1.7 NONLINEAR LOAD TEST PROGRAM

- A. Efficiency shall be determined by actual measurements using a nonlinear load bank. Calculations based on software modeling is not acceptable.

- B. Nonlinear Load Testing shall be carried out by an ISO 17025 Certified Efficiency Test Lab, and follow a defined protocol, independently audited within the manufacturer's certified ISO system.
- C. Follow IEEE Std C57.12.91-1995 Standard Test Code for Dry-Type Transformers to determine efficiency. Proprietary or non-standard methodology is not acceptable.
- D. The nonlinear load bank shall consist of phase-neutral loads, representative of a mix of electronic equipment.
- E. Efficiency: Measurements shall be taken at multiple load levels and plotted to show compliance with specification and correlation to the designed efficiency curve.
- F. Harmonic data including current and Voltage THD at the different load levels shall be included with the test report.

#### 1.8 PACKAGING FOR SHIPMENT

- A. Transformers shall be packaged for shipment using materials that reduce environmental impact:
  - 1. Transformer Wrapping
    - a. Transformers shall be wrapped for shipment in material that is recyclable or compostable at the destination
  - 2. Transformer Shipping Base
    - a. Transformers shall be shipped on a base that uses at least 50% less wood than traditional pallets.
    - b. Wood used in the shipping base shall be Forestry Stewardship Council (FSC) certified as having been sustainably harvested.
  - 3. Shall minimize labor, risk of injury and equipment damage, while handling from initial transportation through to final placement of the transformer.

#### 1.9 DELIVERY, STORAGE AND HANDLING

- A. Store and protect products
- B. Store in a warm, dry location with uniform temperature. Cover ventilation openings to keep out dust, water and other foreign material.
- C. Handle transformers using lifting eyes and/or brackets provided for that purpose. Protect against unfavorable external environment such as rain and snow, during handling.

#### 1.10 WARRANTY

- A. Transformer shall carry a 25-year pro-rated warranty, which shall be standard for the product line.
- B. Guaranteed Performance: Manufacturer warranty shall explicitly state that every transformer is guaranteed to meet published performance data.
- C. Manufacturer warranty shall remain in effect through a qualified seismic event

### 1.11 COMMERCIAL PRODUCT

- A. Transformer shall be a standard item in the manufacturer's catalog.

### 1.12 PERFORMANCE VALIDATION REPORTS

- A. A Performance Validation Report shall be provided for EACH transformer shipped on this project as follows:
  - a. Documentation shall be certified and signed by a (factory) professional engineer (PE), and identify each product by model and serial number
  - b. Transformers shall be tested in an ISO 17025 Certified Test Lab.
  - c. Validation Report shall contain two components:
    - i. Test Report per DOE Test Method for Measuring the Energy Consumption of Distribution Transformers under Appendix A to Subpart K of 10 CFR part 431, identifying no load losses, and efficiency at 35% loading.
    - ii. Routine Test Report per NEMA ST20 including audible noise test for each unit.

### 1.13 INTERNATIONAL STANDARDS ORGANIZATION REGISTRATION

- A. Registration of the manufacturer to current versions of the following ISO standards is required.
  - a. ISO 9001:2008 – Quality Management System
  - b. ISO 14001:2004 – Environmental Management System

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS/PRODUCT

- A. Basis of Design: E-Saver-33L by Powersmiths International Corp. and or as specified on plans.
- B. Manufacturers wishing to have products evaluated for acceptability and conformance with the performance requirements of this specification, shall provide detailed compliance and/or exception statements, along with the documentation required in the submittal section, including test documentation, signed by an engineer, that confirms that the transformer(s) meets the specified performance.
- C. Failure to provide the required documentation no less than 7 days prior to the bid date will disqualify products from consideration for this project.

### 2.2 TRANSFORMER SPECIFICATION

- A. Compatibility: This product must facilitate the ability of the electrical system to supply a sinusoidal voltage in order to improve the long-term compatibility of the electrical system with both linear and nonlinear loads.
- B. 3-phase, common core, ventilated, dry-type, isolation transformer built to UL1561, NEMA ST20 and other relevant NEMA, UL and IEEE standards; 200% rated neutral; 60Hz rated; Transformers shall be UL or cUL Listed, and/or CSA Approved. All terminals, including those

for changing taps, must be readily accessible by removing a front cover plate. Windings shall be continuous with terminations brazed or welded. 10kV BIL.

- C. Lugs are not provided by the transformer manufacturer.
- D. Winding Material: Copper
- E. K-Rating: K-7 (per IEEE-C57.110)
- F. Impedance: 4.0% or greater (unless otherwise noted) in order to manage downstream fault and arc flash levels, and required downstream component fault interrupting (kAIC) ratings.
- G. Inrush: Inrush currents are managed in order to avoid nuisance tripping of the primary breaker and to enable the use of standard 125% rated primary protection, thereby avoiding expensive design changes that otherwise may be needed.
- H. Operating Temperature Rise: 130 degree C in a 40 degree C maximum ambient
- I. Continuous Duty Overload Capacity: 105% of nominal kVA Rating
- J. Voltage Taps: For transformers 15kVA-750kVA, provide two 2-1/2% full capacity taps above and four 2-1/2% taps below nominal primary voltage.
- K. Audible Noise levels:
  - a. Every unit to meet required noise level. Production Test every unit. Data to be available upon request.
  - b. Must meet 3 dB quieter than NEMA ST-20 as follows:
    - i. up to 50kVA: 42dB, 51-150kVA: 47dB, 151-300kVA: 52dB, 301-500kVA: 57dB, 501-700kVA: 59dB, 701-1000kVA: 61dB
- L. Enclosure type: Ventilated NEMA 1 enclosure with Lockable Hinged Doors
  - i. Provide lockable hinged doors on the transformer to facilitate access in support of NFPA 70E/CSA-Z462 Arc Flash Standard to minimize arc flash risk when opening the enclosure of live equipment
- M. Rear Clearance: UL Listed for 2" clearance from the wall rather than standard 6". This capability shall be explicitly described on the nameplate of each unit.
- N. Exceed minimum efficiency requirements of US Department of Energy, 10 CFR Part 431 (DOE 2016), by complying with the table of Maximum No Load Losses, efficiency requirements at 1/6 load, efficiency at 35% load, and efficiency at 25% load under a K-7 load profile. Testing backed by ISO 17025 efficiency test lab.

kVA	Max. No load losses (Watts)	Efficiency @ 1/6 load (%)	Efficiency @ 35% load (%)	Efficiency at 25% load under K-7 nonlinear load
15	34	98.17	98.24	98.18
20	42	98.27	98.34	98.28
25	50	98.37	98.44	98.38
30	57	98.47	98.54	98.48
45	80	98.61	98.71	98.62

50	86	98.64	98.73	98.65
63	101	98.71	98.79	98.72
75	114	98.78	98.84	98.78
100	145	98.85	98.93	98.85
112.5	160	98.88	98.97	98.88
125	175	98.90	98.99	98.88
150	204	98.93	99.03	98.88
175	229	98.96	99.06	98.95
200	255	99.00	99.10	99.01
225	281	99.03	99.13	99.08
250	304	99.05	99.15	99.08
300	352	99.09	99.20	99.08

O. Maximum Allowable Footprint:

kVA	Standard Case Size (in)	Alternate Smaller Case Size (in)*
15	17.5W x 17D x 27.5H	17.5W x 14.5D x 25H
20	25.5W x 18D x 30H	23W x 15.5D x 27.5H
25	25.5W x 18D x 30H	23W x 15.5D x 27.5H
30	25.5W x 18D x 30H	23W x 15.5D x 27.5H
45	25.5W x 18D x 30H	25.5W x 16D x 29H
50	25.5W x 18D x 30H	No Alternate
63	31.5W x 21.5D x 40H	26.5H x 20D x 33H
75	31.5W x 21.5D x 40H	26.5H x 20D x 33H
100	31.5W x 21.5D x 40H	30.5H x 20D x 35H
112	31.5W x 21.5D x 40H	30.5H x 20D x 35H
125	37.5W x 26.5D x 48H	33W x 23D x 38H
150	37.5W x 26.5D x 48H	33W x 23D x 38H
175	37.5W x 26.5D x 48H	34.5W x 26.5D x 42H
200	37.5W x 26.5D x 48H	34.5W x 26.5D x 42H
225	37.5W x 31.5D x 52H	34.5W x 26.5D x 42H
250	37.5W x 31.5D x 52H	37.5W x 26.5D x 48H
300	37.5W x 31.5D x 52H	37.5W x 26.5D x 48H

P. Insulation System:

- a. Shall be NOMEX-based with an Epoxy Co-polymer impregnant for lowest environmental impact, long term reliability and long life expectancy
- b. Class: 220 degrees C
- c. Impregnant Properties for low emissions during manufacturing, highest reliability and life expectancy
- d. Epoxy co-polymer

- e. VOC: less than 1.65 lbs/gal (low emissions during manufacturing)
- f. Water absorption (24hrs @25C): less than 0.05% (superior insulation, longer life)
- g. Chemical Resistance: Must have documented excellent performance rating by supplier
- h. Dielectric Strength: minimum of 3200 volts/mil dry (for superior stress, overvoltage tolerance)
- i. Dissipation Factor: max. 0.02 @25C to reduce aging of insulation, extending useful life

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Follow all national, state and local codes with respect to transformer installation.
- B. Where sound level may be of concern, utilize the services of a recognized and established Acoustical Consultant to provide the proper installation environment to minimize noise and vibration.
- C. Check for damage and loose connections.
- D. Set the transformer plumb and level.
- E. Mount transformer on vibration isolation pads suitable for isolating the transformer.
- F. Provide Seismic restraints where required.
- G. Coordinate all work in this Section with that in other sections.
- H. Verify all dimensions in the field.
- I. Adjust transformer secondary voltages to provide the required voltage at the loads.
- J. Upon completion of the installation, an infrared scan shall be provided for all bolted connections. Correct any deficiencies. Repeat thermal scan 3 months after installation and prepare a report for the customer
- K. FIELD QUALITY CONTROL
  - a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and review test results.
  - b. Tests and Inspections:
    - a. Perform each visual and mechanical inspection and electrical test stated in
    - b. Follow NETA Acceptance Testing Specification.
    - c. Certify compliance with tests
- L. PERFORMANCE VALIDATION: To insure that the products shipped to the job site meet this specification, provide on-site revenue class accurate efficiency and harmonic measurements of transformers once installed and operating at customer's site. Data shall be collected from primary and secondary sides of the transformer simultaneously on a synchronized cycle by cycle basis. The use of two discrete meters that are not synchronized is not acceptable. Sampling shall be of 10% of transformers on the project once installed and op-

erating, as selected by customer. Submit a detailed report to the project engineer.

- M. Where integrated metering has been specified to be connected to an external network, contractor to provide the required connection and commissioning to customer's specified system.
- N. Identify non-compliant products to the engineer and replace at no cost to the customer.

END OF SECTION 26 22 00

## 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.
  - 3. Electronic-grade panelboards.

##### 1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor.

##### 1.4 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,
  - B. performance, electrical characteristics, ratings, and finishes.
- C. 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 NRTL listing for series rating of installed devices.
  - 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 graft paper; include selectable ranges for each type of overcurrent protective device.

#### 1.5 INFORMATIONAL SUBMITTALS

#### 1.6

- A. 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.
- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

#### 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 Division 01 Section 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:  
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.
  3. 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. 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 panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.

#### 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 NEMA PB 1.

#### 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 23 deg F (minus 5 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 Owner no fewer than two days in advance of proposed interruption of electric service.
  2. 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 in Division 03.

#### 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. 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. KitchenWash-Down Areas: NEMA 250
    - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. 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. Panel front shall be fabricated so that the panel may be opened to access the breakers and also to allow access to breaker wiring without removal of the front.
  4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
  5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
  6. Finishes:
    - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel.
  7. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- B. Incoming Mains Location: As required.
- C. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
  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.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
  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.
  5. Subfeed (Double) Lugs: [Compression] [Mechanical] type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
  6. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.
- H. 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:
  - 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. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. 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.
  - 2. Door or doors shall allow access to breakers dead front and also to the breaker wiring without removal of front.
- D. Mains: As indicated.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in or Bolt-on circuit breakers.
- F. 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.
- G. Branch Overcurrent Protective Devices: Fused switches.

## 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- 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. 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: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Door shall be available to open over breaker lugs.

#### 2.4 LOAD CENTERS

- 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.
- B. Mains: As indicated.
- C. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- D. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

#### 2.5 ELECTRONIC-GRADE PANELBOARDS

- 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. Panelboards: NEMA PB 1; with factory-installed, integral TVSS; labeled by an NRTL for compliance with UL 67 after installing TVSS.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

- D. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- E. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- F. Buses:
  - 1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
  - 2. Copper equipment and isolated ground buses.
- G. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, bolt-on, solid-state, parallel-connected, type, with sine-wave tracking suppression and filtering modules, short-circuit current rating complying with UL 1449, second edition, and matching or exceeding the panelboard short-circuit rating, redundant suppression circuits, with individually fused metal-oxide varistors.
  - 1. Accessories:
    - a. Fuses rated at 200-kA interrupting capacity.
    - b. Fabrication using bolted compression lugs for internal wiring.
    - c. Integral disconnect switch.
    - d. Redundant suppression circuits.
    - e. Redundant replaceable modules.
    - f. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
    - g. LED indicator lights for power and protection status.
    - h. Audible alarm, with silencing switch, to indicate when protection has failed.
    - i. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
    - j. Four digit, transient-event counter set to totalize transient surges.
  - 2. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase.
  - 3. Minimum single-impulse current ratings, using 8-by-20-mic.sec. waveform described in IEEE C62.41.2.
    - a. Line to Neutral: 70,000 A.
    - b. Line to Ground: 70,000 A.
    - c. Neutral to Ground: 50,000 A.
  - 4. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
  - 5. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277 208Y/120 - V, three-phase, four-wire circuits shall be as follows:
    - a. Line to Neutral: 800 V for 480Y/277 400 V for 208Y/120.
    - b. Line to Ground: 800 V for 480Y/277 400 V for 208Y/120.
    - c. Neutral to Ground: 800 V for 480Y/277 400 V for 208Y/120.

6. Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:
  - a. Line to Line: 2000 V for 480 V 1000 V for 240 V.
  - b. Line to Ground: 1500 V for 480 V 800 V for 240 V.

## 2.6 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- 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. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
  1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable 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.
  4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
  6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
  7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
  8. 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. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
- e. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

## 2.7 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] [NEMA PB 1.1].
- 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 NEMA PB 1.1.
- B. Equipment Mounting: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03:
  - 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. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- E. 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.
- F. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
- G. Install filler plates in unused spaces.
- H. 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.
- I. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- J. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. 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 Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: For distribution panels label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "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 Division 26 Section "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 25 00 - ENCLOSED BUS ASSEMBLIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Enclosed bus assemblies.
2. Plug-in devices.

##### B. Related Requirements:

1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 26 00 11 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

#### 1.2 ACTION SUBMITTALS

##### A. Shop Drawings: For each type of product.

1. Show fabrication and installation details for enclosed bus assemblies. Include plans, elevations, and sections of components. Designate components and accessories, including clamps, brackets, hanger rods, connectors, straight lengths, and fittings.
2. Show fittings, materials, fabrication, and installation methods for .
3. Indicate required clearances, method of field assembly, and location and size of each field connection.
4. Detail connections to switchgear, switchboards, transformers, and panelboards.
5. Cable and conductor terminal sizes for bus and plug-in device terminations.
6. Wiring Diagrams: Power wiring.

#### 1.3 INFORMATIONAL SUBMITTALS

##### A. Field quality-control reports.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- ##### A. Deliver, store, and handle enclosed bus assemblies according to NEMA BU 1.1, "General Instructions for Handling, Installation, Operation, and Maintenance of Busway Rated 600 Volts or Less."

## PART 2 - PRODUCTS

### 2.1 ASSEMBLY DESCRIPTIONS

- A. Source Limitations: Obtain enclosed bus assemblies and plug-in devices 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 UL 857.

### 2.2 PERFORMANCE REQUIREMENTS

### 2.3 ENCLOSED BUS ASSEMBLIES

- A. Feeder-Bus Assemblies: Low-impedance bus assemblies in totally enclosed, nonventilated housing; single-bolt joints; ratings as indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ABB, Electrification Business.
    - b. Eaton.
    - c. Siemens Industry, Inc., Energy Management Division.
    - d. Square D; Schneider Electric USA.
  - 2. Seismic Fabrication Requirements: Fabricate mounting provisions and attachments for feeder-bus assemblies with reinforcement strong enough to withstand seismic forces defined in Section 26 05 48.16 "Seismic Controls for Electrical Systems" when mounting provisions and attachments are anchored to building structure.
  - 3. Electrical Characteristics:
    - a. Voltage: 120/208 277/480 V.
    - b. Phase: Three; 4 wire.
    - c. Percent of Neutral Capacity: 100 .
  - 4. Short-Circuit Interrupting Rating:
    - a. For Bus Amperage of 800: 85 symmetrical kAIC.
    - b. For Bus Amperage of 1200: 100 symmetrical kAIC.
    - c. For Bus Amperage of 1600: 125 symmetrical kAIC.
    - d. For Bus Amperage of 2500: 150 symmetrical kAIC.
    - e. For Bus Amperage of 5000: 200 symmetrical kAIC.
  - 5. Temperature Rise: 55 deg C above 40 deg C ambient maximum for continuous rated current.
  - 6. Bus Materials: Current-carrying copper conductors, fully insulated with Class 130C insulation except at joints; plated surface at joints.
  - 7. Voltage Drop:
    - a. Measure voltage drop at 30 deg C ambient with bus thermally stabilized at full rated load.

- b. Three-phase, line-to-line voltage drop less than 3.1 V per 100 ft. at 40 percent power factor.
  8. Ground: 50 percent capacity, isolated, internal bus bar of material matching bus material.
  9. Enclosure: Steel , with manufacturer's standard finish. Weatherproof, sealed seams, drains, and removable closures.
  10. Fittings and Accessories: Manufacturer's standard.
  11. Firestop: Comply with UL 1479 firestop system, listed and labeled by an NRTL acceptable to authorities having jurisdiction for penetrations of fire-rated walls, ceilings, and floors.
  12. Mounting: Arranged flat, edgewise, or vertically without derating. Rated for hanger spacing of up to 10 ft. for horizontally mounted runs and up to 16 ft. for vertically mounted runs.
  13. Expansion Section: Manufacturer's standard expansion fitting for the provided busway with expansion capability to accommodate thermal expansion of bus and enclosure, and to accommodate movement across building expansion joints.
- B. Plug-in Bus Assemblies: Low-impedance bus assemblies in totally enclosed, nonventilated housing; single-bolt joints; ratings as indicated.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. ABB, Electrification Business.
    - b. Eaton.
    - c. Siemens Industry, Inc., Energy Management Division.
    - d. Square D; Schneider Electric USA.
  2. Electrical Characteristics:
    - a. Voltage: 120/208 277/480 V.
    - b. Phase: Three; 4 wire.
    - c. Percent of Neutral Capacity: 100 .
  3. Short-Circuit Interrupting Rating:
    - a. For Bus Amperage of 800: 85 symmetrical kAIC.
    - b. For Bus Amperage of 1200: 100 symmetrical kAIC.
    - c. For Bus Amperage of 1600: 125 symmetrical kAIC.
    - d. For Bus Amperage of 2500: 150 symmetrical kAIC.
    - e. For Bus Amperage of 5000: 200 symmetrical kAIC.
  4. Temperature Rise: 55 deg C above 40 deg C ambient maximum for continuous rated current.
  5. Bus Materials: Current-carrying copper conductors, fully insulated with Class 130C insulation except at stabs and joints; plated surface at stabs and joints.
  6. Ground: 50 percent capacity, isolated, internal bus bar of material matching bus material.
  7. Enclosure: Steel , with manufacturer's standard finish.
  8. Plug-in Openings: 24 inch on center on each side of bus, and hinged covers over unused openings. Plug-in openings must be finger-safe with covers open or closed.
  9. Fittings and Accessories: Manufacturer's standard.
  10. Firestop: Comply with UL 1479 firestop system, listed and labeled by an NRTL acceptable to authorities having jurisdiction for penetrations of fire-rated walls, ceilings, and floors.

11. Mounting: Arranged flat, edgewise, or vertically without derating. Rated for hanger spacing of up to 10 ft. for horizontally mounted runs and up to 16 ft. for vertically mounted runs.
12. Expansion Section: Manufacturer's standard expansion fitting for the provided busway with expansion capability to accommodate thermal expansion of bus and enclosure, and to accommodate movement across building expansion joints.

C. Joints:

1. Busway joints must use one high-strength steel bolt with Belleville washers.
2. Bolts must be torque indicating type and at ground potential.
3. Bolts must be two-headed design to indicate when proper torque has been applied and require only a standard long handle wrench to be properly activated.
4. Access must be required to only one side of the busway for tightening joint bolts.
5. Joint connection assemblies must be removable without disturbing adjacent busway lengths.
6. Joint connection assemblies that rely on the joint cover to provide ground continuity are unacceptable.

## 2.4 PLUG-IN DEVICES

- A. Molded-Case Circuit Breakers: UL 489; hookstick-operated handle, lockable with two padlocks, and interlocked with cover in closed position. Interlocked to prevent plug-in device insertion into or removal from bus with switch in closed position.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ABB, Electrification Business.
    - b. Eaton.
    - c. NOARK Electric North America.
    - d. Siemens Industry, Inc., Energy Management Division.
    - e. Square D; Schneider Electric USA.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Coordinate layout and installation of enclosed bus assemblies and suspension system with other construction that penetrates ceilings or floors or is supported by them, including luminaires, HVAC equipment, fire-suppression system, and partition assemblies.
- B. Support bus assemblies independent of supports for other elements such as equipment enclosures at connections to panelboards and switchboards, pipes, conduits, ceilings, and ducts.



1. Design each fastener and support to carry load indicated by seismic requirements and to comply with seismic-restraint details according to Section 26 05 48.16 "Seismic Controls for Electrical Systems."
  2. Design each fastener and support to carry 200 lb or 4 times the weight of bus assembly, whichever is greater.
  3. Support bus assembly to prevent twisting from eccentric loading.
  4. Support bus assembly with not less than 3/8 inch <Insert dimension> steel rods. Install side bracing to prevent swaying or movement of bus assembly. Modify supports after completion to eliminate strains and stresses on bus bars and housings.
  5. Fasten supports securely to building structure according to Section 26 05 29 "Hangers and Supports for Electrical Systems."
  6. Bolts and nuts that are loosened for any reason after tightening to manufacturer's recommended torque setting must be discarded and replaced with new bolts and nuts.
- C. Coordinate bus-assembly terminations to equipment enclosures to ensure proper phasing, connection, and closure.
- D. Tighten bus-assembly joints with torque wrench or similar tool recommended by bus-assembly manufacturer. Tighten joints again after bus assemblies have been energized for 30 days.
- E. Install bus-assembly, plug-in units. Support connecting conduit independent of plug-in unit.

### 3.2 CONNECTIONS

- A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- C. Terminate to transformer enclosures with matching bus assemblies according to Section 26 22 00 "Low-Voltage Transformers."
- D. Terminate to switchgear enclosures with matching bus assemblies according to Section 26 23 00 "Low-Voltage Switchgear."
- E. Terminate to switchboard enclosures with matching bus assemblies according to Section 26 24 13 "Switchboards."
- F. Terminate to panelboard enclosures with matching bus assemblies according to Section 26 24 16 "Panelboards."
- G. Terminate to motor-control centers enclosures with matching bus assemblies according to Section 26 24 19 "Motor-Control Centers."

### 3.3 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by <Insert names or titles of witnesses>.
- B. Tests and Inspections:
  - 1. After installing equipment test, for compliance with requirements according to NETA ATS.
  - 2. Visual and Mechanical Inspection:
    - a. Compare equipment nameplate data with Drawings and Specifications.
    - b. Inspect physical and mechanical condition.
    - c. Inspect anchorage, alignment, and grounding.
    - d. Verify correct connection according to single-line diagram.
    - e. Inspect bolted electrical connections for high resistance using one or more of the following methods:
      - 1) Use of low-resistance ohmmeter.
      - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
      - 3) Perform thermographic survey.
  - 3. Electrical Tests:
    - a. Perform insulation resistance measurements through bolted connections and bus joints with low-resistance ohmmeter.
    - b. Perform insulation resistance tests of each busway, phase to phase, and phase to ground.
    - c. Perform a dielectric withstand voltage test on each busway, phase to ground with phases not under test grounded for one minute.
    - d. Measure resistance of assembled busway sections on insulated busway and compare values with adjacent phases.
    - e. Perform phasing test on each busway tie section energized by separate sources.
    - f. Verify operation of busway space heaters.
- C. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
  - 1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
  - 3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.
- E. Nonconforming Work:

1. Enclosed bus assemblies will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 26 25 00

## SECTION 26 27 26

### WIRING DEVICES

#### PART 1 - GENERAL

#### 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. Receptacles, receptacles with integral GFCI, and associated device plates.
  2. Twist-locking receptacles.
  3. Wall-box motion sensors.
  4. Isolated-ground receptacles.
  5. Hospital-grade receptacles.
  6. Snap switches and wall-box dimmers.
  7. Solid-state fan speed controls.
  8. Wall-switch and exterior occupancy sensors.
  9. Communications outlets.
  10. Pendant cord-connector devices.
  11. Cord and plug sets.
  12. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

##### 1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.

- F. UTP: Unshielded twisted pair.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Field quality-control test reports. Submitted prior to final punch list.
- D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.
- E. Submit on digital wiring analyzer to be used to test voltage drop on receptacles.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- 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.
- C. Comply with NFPA 70.

#### 1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  - 1. Cord and Plug Sets: Match equipment requirements.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  - 1. Arrow Hart/Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
  - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  - 3. Leviton Mfg. Company Inc. (Leviton).
  - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

5. Hubbell Building Automation Systems.

## 2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
  1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 5351 (single), 5352 (duplex).
    - b. Hubbell; HBL5351 (single), CR5352 (duplex).
    - c. Leviton; 5891 (single), 5352 (duplex).
    - d. Pass & Seymour; 5381 (single), 5352 (duplex).
- B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
  1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Hubbell; CR 5253IG.
    - b. Leviton; 5362-IG.
    - c. Pass & Seymour; IG6300.
  3. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
- C. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; TR8300.
    - b. Hubbell; HBL8300SG.
    - c. Leviton; 8300-SGG.
    - d. Pass & Seymour; 63H.
  2. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

## 2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; GF20.
  - b. Pass & Seymour; 2084.

## 2.4 TVSS RECEPTACLES

### A. Isolated-Ground, Duplex Convenience Receptacles:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; IG5362BLS.
  - b. Hubbell; IG5362SA.
  - c. Leviton; 5380-IG.
3. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

### B. Isolated-Ground, Hospital-Grade, Duplex Convenience Receptacles:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; IG8300HGBLS.
  - b. Hubbell; IG8362SA.
  - c. Leviton; 8380-IG.
3. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R. Comply with UL 498 Supplement SD. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

## 2.5 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

### A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

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 Crouse-Hinds.
  - b. EGS/Appleton Electric.
  - c. Killark; a division of Hubbell Inc.

## 2.6 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; L520R.
    - b. Hubbell; HBL2310.
    - c. Leviton; 2310.
    - d. Pass & Seymour; L520-R.
  
- B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Hubbell; IG2310.
    - b. Leviton; 2310-IG.
  - 3. Description: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

## 2.7 PENDANT CORD-CONNECTOR DEVICES

- A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.
  - 1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
  - 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

## 2.8 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
  - 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
  - 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.



## 2.9 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
    - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
    - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
    - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
- C. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 1995L.
    - b. Hubbell; HBL1557L.
    - c. Leviton; 1257L.
    - d. Pass & Seymour; 1251L.

## 2.10 WALL-BOX DIMMERS (REFER TO PLANS FOR REQUIREMENTS)

## 2.11 OCCUPANCY SENSORS (REFER TO PLANS FOR REQUIREMENTS)

## 2.12 COMMUNICATIONS OUTLETS

- A. Telephone Outlet:
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 3560-6.
    - b. Leviton; 40649.
  - 3. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.
- B. Combination TV and Telephone Outlet:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; 3562.
  - b. Leviton; 40595.
3. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one Type F coaxial cable connector.

#### 2.13 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
  1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: Smooth, satin-finished stainless steel 0.04-inch- (1-mm-) thick
  3. Material for Unfinished Spaces: Galvanized steel.
  4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant , die-cast aluminum with lockable cover.

#### 2.14 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Rectangular, solid brass with satin finish.
- D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 Category 5e or Category 6 jacks for UTP cable. Verify exact jack requirements with telecommunication specifications.

#### 2.15 POKE-THROUGH ASSEMBLIES

- 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. Hubbell Incorporated; Wiring Device-Kellems.
  2. Pass & Seymour/Legrand; Wiring Devices & Accessories.
  3. Square D/ Schneider Electric.

4. Thomas & Betts Corporation.
  5. Wiremold Company (The).
- C. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
1. Service Outlet Assembly: Pedestal type with services indicated.
  2. Size: Selected to fit nominal 3-inch (75-mm) or 4-inch (100-mm)] cored holes in floor and matched to floor thickness.
  3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
  4. Closure Plug: Arranged to close unused 3-inch (75-mm) or 4-inch (100-mm)] cored openings and reestablish fire rating of floor.
  5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of [four], 4-pair, Category 3, Category 5e or Category 6 voice and data communication cables. Verify with owner and telecommunication specifications.

#### 2.16 MULTIOUTLET ASSEMBLIES

- 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. Hubbell Incorporated; Wiring Device-Kellems.
  2. Wiremold Company (The).
- C. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- D. Raceway Material: Metal, with manufacturer's standard finish.
- E. Wire: No. 12 AWG.

#### 2.17 SERVICE POLES

- A. Description: Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.
1. Poles: Nominal 2.5-inch- (65-mm-) square cross section, with height adequate to extend from floor to at least 6 inches (150 mm) above ceiling, and with separate channels for power wiring and voice and data communication cabling.
  2. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
  3. Finishes: Manufacturer's standard painted finish and trim combination.

4. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, 4-pair, Category 6 or 5 voice and data communication cables.
5. Power Receptacles: Two duplex, 20-A, heavy-duty, NEMA WD 6 configuration 5-20R units or as indicated on plans.
6. Voice and Data Communication Outlets: As shown on plans.

## 2.18 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
  1. Wiring Devices Connected to Normal Power System As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
  2. Wiring Devices Connected to Emergency Power System: Red.
  3. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
  1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
  2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
  1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
  2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
  4. Existing Conductors:
    - a. Cut back and pigtail, or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pigtailling existing conductors is permitted provided the outlet box is large enough.

- D. Device Installation:
1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
  2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
  4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
  5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
  6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
  7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
  8. Tighten unused terminal screws on the device.
  9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings. Verify with Architect and Owner that all floor outlets and service poles are coordinated with furniture to be installed.

### 3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

### 3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
1. Test Instruments: Use instruments that comply with UL 1436.

2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
  2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable. Report voltage drop on receptacle circuit as follows: Receptacle circuit L-1 (Typical) Voltage measured = 119V. All receptacle circuits shall be reported. Final close out of project will not be attained without report.
  3. Ground Impedance: Values of up to 2 ohms are acceptable.
  4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  5. Using the test plug, verify that the device and its outlet box are securely mounted.
  6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Test straight blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).

END OF SECTION 26 27 26

## SECTION 26 27 26.43 - SPECIAL-PURPOSE POWER OUTLET ASSEMBLIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Fabricated power outlet cord management assemblies.
2. Spring-driven commercial/industrial-use cord reels.

B. Related Requirements:

1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 26 00 11 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 01 31 00 "Project Management and Coordination" for preinstallation conference procedures.
4. Section 26 27 26.51 "Connectors, Cords, and Plugs" for connectors, cords, and strain-relief cord grips.

#### 1.2 PREINSTALLATION MEETINGS

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

#### 1.3 ACTION SUBMITTALS

A. Product Data:

1. Spring-driven commercial/industrial-use cord reels.
2. Cord reels for use in hazardous locations.

B. Field Quality-Control Submittals:

1. Field quality-control reports.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturers' Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:

1. Spring-driven commercial/industrial-use cord reels.
2. Cord reels for use in hazardous locations.

B. Sample warranties.

#### 1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

#### 1.6 WARRANTY

A. Special Installer Extended Warranty: Installer warrants that fabricated and installed cord-reel power outlet assemblies perform in accordance with specified requirements and agrees to repair or replace assemblies that fail to perform as specified within extended warranty period.

1. Extended Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.

### PART 2 - PRODUCTS

#### 2.1 FABRICATED POWER OUTLET CORD MANAGEMENT ASSEMBLIES

A. Description: Power outlet cord management assemblies that are custom fabricated by manufacturer or Installer.

B. Source Limitations: Obtain all components for each power outlet cord management assembly from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements: Components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

D. Ceiling-Mounted Wall-Mounted Power Outlet Cord Management Assembly :

1. General Characteristics: Provide the following specified products with fabricated power outlet cord management assembly:

a. Cord Management System:

- 1) Spring-driven commercial/industrial-use cord reel, #10AWG conductors .
- 2) Motor-driven, indoor, general-use cord reel; #10AWG conductors .
- 3) DC motor-driven cable management system .

b. Termination Fitting:

- 1) Owner-furnished fitting.



- 2) Indoor-use, dry-location cord connector; specified in Section 26 27 26.51 "Connectors, Cords, and Plugs."
  - 3) Indoor-use, sealed cord connector; Electrical Equipment Connection Schedules specified in Section 26 27 26.51 "Connectors, Cords, and Plugs."
  - 4) Indoor-use, compression-grip, sealed cord connector; specified in Section 26 27 26.51 "Connectors, Cords, and Plugs."
  - 5) Outdoor-use, watertight, sealed cord connector; specified in Section 26 27 26.51 "Connectors, Cords, and Plugs."
  - 6) Antimicrobial, watertight, sealed cord connector; specified in Section 26 27 26.51 "Connectors, Cords, and Plugs."
- c. Cord or Cable:
- 1) Oil-resistant, extra-hard-usage, jacketed, flexible cord for indoor damp locations; , , and specified in Section 26 27 26.51 "Connectors, Cords, and Plugs."
- d. Strain-relief cord grips specified in Section 26 27 26.51 "Connectors, Cords, and Plugs."

## 2.2 SPRING-DRIVEN COMMERCIAL/INDUSTRIAL-USE CORD REELS

- A. Description: Reel equipped with, or intended for use with, length of flexible cord, providing means for cord to be unwound by user as desired, providing spring take-up mechanism to rewind cord on reel, and providing latch to restrain action of spring take-up mechanism while cord reel is in use.
- B. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  2. General Characteristics:
    - a. Reference Standards: UL CCN SBCV and UL 355.
    - b. Spring take-up retraction mechanism.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for cord reel mounting and power connections to verify actual locations of mounts and power connections before cord reel installation.
- B. Examine walls, floors, and ceilings for suitable conditions where cord reel will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's instructions.
- B. Interfaces with Other Work:
  - 1. Coordinate installation of new products for with existing conditions.
  - 2. Coordinate with light fixtures and mechanical for .
- C. Adjust spring mechanisms and moving parts of cord reels and fittings to function smoothly, and lubricate as recommended in writing by manufacturer.
- D. After installation, protect cord reels and fittings from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 26 27 26.43

## 26 27 33 Power Distribution Unit (PDU)

### 1 General

#### 1.1 Summary

- A. This specification describes the electrical and general requirements for an ultra-efficient Power Distribution Unit (PDU) in the power range of 50 to 1350 kVA. Particular specified characteristics include a true front only access capability without access or installation limitations, significant efficiency performance beyond DOE 2016 (in Canada Ontario O. Reg. 404/12: ENERGY AND WATER EFFICIENCY - APPLIANCES AND PRODUCTS under Green Energy Act, 2009, S.O. 2009, c. 12, Sched. A, Last amendment: 448/17) coupled with application specific efficiency optimization to further minimize losses and associated costs at operating conditions, comprehensive serviceability enhancements including Safe Maintainability or “Cold Tap” capability while in the powered state and effective thermographic preventative maintenance aids and extensive monitoring plus Seismic qualification requirements.
- B. Extensive Testing and Proof of Performance is required in order to meet this specification
- C. Transformers used in the PDU on this project significantly exceed the legal requirements of DOE 2016 (in Canada Ontario O. Reg. 404/12: ENERGY AND WATER EFFICIENCY - APPLIANCES AND PRODUCTS under Green Energy Act, 2009, S.O. 2009, c. 12, Sched. A, Last amendment: 448/17) and are optimized to provide up to 35% reduction in energy loss beyond a comparable legally compliant transformer in a similar application.
- D. Other highlights of requirements of this specification include:
  - 1. Performance Type Validation and Production Reports for each unit shipped on project.
  - 2. A minimum of 115% or up to 150% continuous duty overload capacity dependent on the transformer model selected preempting additional derating.
- E. Information to be submitted with bid:
  - 1. Line-by-line compliance, deviation or exception for this specification
  - 2. Performance Guarantee by Manufacturer that ALL units in this project will meet specified performance
  - 3. Failure to provide this information will result in a non-compliant proposal.

#### 1.2 REFERENCES

- A. US Department of Energy, 10 CFR Part 431 – Energy Efficiency Program for Certain Commercial and Industrial Equipment, Subpart K – Distribution Transformers
- B. In Canada Ontario O. Reg. 404/12: ENERGY AND WATER EFFICIENCY - APPLIANCES AND PRODUCTS under Green Energy Act, 2009, S.O. 2009, c. 12, Sched. A, Last amendment: 448/17
- C. US Department of Energy, 10 CFR Part 429 – Certification, Compliance, and Enforcement for Consumer Products and Commercial and Industrial Equipment
- D. ANSI/NEMA ST 20 - 2014 - Dry Type Transformers for General Applications.
- E. Metering Standards:
- F. Computational algorithms per IEEE Std 1459-2000

- G. Certification and Safety UL 916, UL 61010C-1 CAT III, CSA-C22.2 No. 61010-1, CSA-C22.2 No. 61010-2-030
- H. IEEE Std C57.12.91-2001/2011 Standard Test Code for Dry-Type Transformers
- I. IEEE-1100 – Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
- J. LEED – Leadership in Energy and Environmental Design, U.S. Green Building Council.
- K. Seismic Qualification References: International Building Code, 2006/2009 Edition, California Building Code, 2007/2010 Edition, ASCE Standard 7, 2005 Edition to OSHPD CAN 2-1708A.5, Rev. , ICC-ES AC 156, Effective 01/01/2007, OSHPD
- L. ISO 9001:2008 – International Standards Organization - Quality Management System
- M. ISO 14001:2004 – International Standards Organization - Environmental Management System
- N. ISO 17025 – International Standards Organization - General requirements for the competence of testing and calibration laboratories
- O. UL 1062: Unit Substation and CAN/CSA-C22.2 – 29/31
- P. NEMA AB1: Molded Case Circuit Breakers
- Q. NEMA PB1: Panelboards
- R. ANSI/NFPA 70 - National Electric Code and CSA 22.1 Canadian Electric Code

### 1.3 *BID PROPOSAL*

Perform a compliance review: and submit a complete copy of these specifications with each subparagraph marked either "Compliance", "Deviation", or "Exception". Fully describe all deviations and exceptions taken to this specification as follows:

- "Compliance": Comply with no exceptions.
- "Deviation": Comply with deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
- "Exception": Exception, do not comply. For each and every exception, provide a numbered footnote with reasons and possible alternatives.

Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the Bidder is in complete compliance with this Specification. Deviations or exceptions taken in cover letters, subsidiary documents, by omission or by contradiction do not release the Bidder from being in complete compliance, unless the exception or deviation has been specifically noted in the Compliance Review. Bidders may submit the latest state-of-the-art components and their standard control components in lieu of the specified items. All deviations from the Specifications must be approved by the Architect/Engineer.

Failure to provide this information will result in a non-compliant proposal.

### 1.4 *SUBMITTALS*

The submittal shall include as a minimum the following in the submittal package:

- A. Manufacturer documentation guaranteeing that ALL units on the project will comply with the performance requirements of this specification.

- B. Manufacturer documentation that sizing primary protection at 125% of nominal full load amps with  $I_r$  set at  $8 \times I_n$ , will not result in nuisance tripping on transformer inrush at energization.
- C. Where one or more of the integrated options is selected for this project, provide associated documentation.
- D. Comprehensive Construction details including enclosure dimensions, kVA rating, primary & secondary nominal voltages, voltage tap, BIL, unit weight, breaker details, etc.
- E. 32 year Transformer Warranty Certificate
- F. Manufacturer's ISO 14001:2004 Certification
- G. Manufacturer's ISO 9001:2008 Certification
- H. ISO 17025 Certificate - Efficiency Test Lab where transformers are tested
- I. Documentation that materials used for shipment packaging meeting the environmental requirements of this specification.
- J. For LEED projects, provide the following additional submittal information: Optimize Energy Performance: Provide savings calculations vs. DOE 2016 baseline reference
- K. PDU User/Operator Manual which includes Operation, Setup and Maintenance
- L. PDU Installation and Start-up Manual
- M. PDU Electrical Schematics / Wiring Diagrams
- N. Model specific PDU Data sheet including the following (a general data sheet is not acceptable):
  - 1. Distribution details
  - 2. Monitoring system
  - 3. kVA rating, Input / Output voltages
  - 4. Service access and ventilation clearances
  - 5. Electrical Characteristics including:
    - a. Impedance Data
    - b. Short Circuit Currents
    - c. Inrush Currents for 0% (absolute max.), 1 ½% and 3% upstream impedances
    - d. Guaranteed losses at 0% (no load), 25%, 50%, 75% and 100% Loading
    - e. 35% Efficiency per DOE 10CFR431 Appendix A Subpart K
- O. Transformer characteristics including efficiency and load performance, insulation class, temperature rise, coil materials, audible noise level, voltage taps, BIL etc.
- P. Particular unit characteristics including Front Only Access requiring zero side or rear clearance, comprehensive IR Scan ports, IR scan grills over all breakers, Safe

POWER DISTRIBUTION UNIT (PDU)

Maintainability characteristics, Conduit pull-box for ease of connection installation, Full Input and Output Monitoring details including losses and efficiency and Transformer temperatures, etc.

- Q. Unit weight and dimensions
- R. Outline drawing(s) illustrating operator controls
- S. Accessories and options included in the unit
- T. Product Warranty Certificate

#### 1.5 *CLOSEOUT SUBMITTALS*

- A. Comprehensive Operations and Maintenance Manual which includes:
  - 6. A User/Operator manual which includes Operation, Setup and Maintenance
  - 7. Installation and start-up manual
  - 8. Outline Drawings and Electrical Schematics / Wiring Diagrams
- B. Test Certificate with all factory settings (see quality assurance below)
- C. Recommended spare parts list when requested
- D. Efficiency Test Certificate for each unit per DOE 10CFR431, Subpart K
- E. Provide a certified type test certificate of the transformer efficiency per DOE 10CFR431, Subpart K
- F. Provide a certified type test certificate of the transformer temperature rise in the PDU at full rated linear load for each unit type on the project.
- G. Provide a certified type test certificate of the transformer losses at 50%, 75% & 100% loading at operating temperature.
- H. Supply copies of completed factory and site testing reports.

#### 1.6 *PACKAGING FOR SHIPMENT*

- A. PDU shall be packaged for shipment using materials that reduce environmental impact.
- B. PDUs shall be shipped on a base that uses at least 70% less wood than traditional pallets. Wood used in the shipping base shall be Forestry Stewardship Council (FSC) certified as having been sustainably harvested.
- C. PDUs shall be packaged to minimize labor, risk of injury and equipment damage, while handling from initial transportation through to final placement.

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

- A. Store and protect products

POWER DISTRIBUTION UNIT (PDU)

- B. Protect from environmental extremes in a dry location with uniform temperature. Cover ventilation openings to keep out dust, water and other foreign material.
- C. Handle PDU using a pallet truck or Forklift for lifting from the base or lifting eyes and/or brackets provided for that purpose. Protect against unfavorable external environment such as rain and snow, during handling.

#### 1.8 *WARRANTY*

- A. The manufacturer shall provide a limited warranty for the PDU against defects in workmanship or material of not less than 1 year from the shipping date or 18 months from factory startup except that the transformer component shall carry a 32-year pro-rated warranty, which shall be standard for the product line.
- B. Guaranteed Performance: Manufacturer warranty shall explicitly state that the transformer component of the PDU is guaranteed to meet published performance data.
- C. Manufacturer warranty shall remain in effect through a qualified seismic event

#### 1.9 *COMMERCIAL PRODUCT*

PDU shall be a standard item in the manufacturer's catalog.

#### 1.10 *REQUIRED TESTING & PERFORMANCE VALIDATION REPORTS*

Test & Performance Validation Reports shall be provided for EACH PDU shipped on this project as follows:

- A. Documentation shall be certified and signed and identify each product by model and serial number
- B. Transformer efficiency shall be measured in an ISO 17025 Certified Test Lab.
- C. Efficiency Test Report per DOE Test Method for Measuring the Energy Consumption of Distribution Transformers under Appendix A to Subpart K of 10 CFR part 431, identifying no load losses, and efficiency at 35% loading.
- D. Routine Test Report per NEMA ST20 including audible noise test for each unit.
- E. Full Rated Load Temperature Rise Test Report for one of each model configuration (type test)
- F. Efficiency Load Type Test Report at 50%, 75% and 100% load after operating temperature stabilization for the respective loading level for each model configuration

#### 1.11 *FACTORY WITNESS TESTING*

- A. A factory witness test is required on a representative sample for review and defined type and performance tests and to check for compliance with accepted submittal.

- B. A factory witness test is required for the production batch where the units will be subjected to quality checks and functional production tests to assure quality of units.

1.12 *INTERNATIONAL STANDARDS ORGANIZATION REGISTRATION*

Registration of the manufacturer to current versions of the following ISO standards is required.

- ISO 9001– Quality Management System
- ISO 14001 – Environmental Management System
- ISO 17025 – Certified Efficiency Test Lab



## **PART 2 PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS/PRODUCT**

- A. Basis of Design: Energy Station PDU, Model ES by Powersmiths International Corp.
- B. Manufacturers wishing to have products evaluated for acceptability and conformance with the performance requirements of this specification, shall provide detailed compliance and/or exception statements, along with the documentation required in the submittal section, including test documentation, signed by an engineer that confirms that the unit meets the specified performance.
- C. Failure to provide the required documentation no less than 7 days prior to the bid date will disqualify products from consideration for this project.

#### **1.13 *Main Electrical Characteristics***

Power Rating (kVA): 50, 75, 100, 112.5, 125, 150, 200, 225, 250, 300, 375, 400, 500, 600, 750, 800, 1,000, 1,200 or 1,350 kVA

#### **1.14 *Operating Environmental Conditions***

Ambient temperature range: 0°C to 40°C or -25°C to 40°C (for outdoor applications)

Cooling: Convection only (no forced air flow requirement)

Relative humidity range: 0% to 95%, non-condensing

Altitude range: 0 – 6,600 feet (0 – 2,000 meters) above sea level without derating

Environment: Type 1; 2; 3R

#### **1.15 *Quality Assurance***

The PDU shall pass complete functional tests before shipping and all required routine safety tests with a test report provided with each shipped unit. A software settings file shall be saved at the manufactures' facility for future reference or field support and to be provided on request.

## 2 Product Specification

### 2.1 General Design and Construction

#### A. Installation & Operation

The PDU shall be capable of being installed with zero clearance at rear and sides and shall be accessible for maintenance or operation from the front aisle only. Access panels shall be a minimum of 18" wide opening permitting internal access to connections and any necessary service adjustments within the unit including transformer tap adjustments.

Cabling space and bending radius shall meet the minimum requirements per National Electric Codes (NEC/CEC) for all input and output connections.

The unit shall have lockable hinged doors which should be easily removable to aid installation operation or service.

Exception to Front only access: This requirement is excepted when the unit is configured with both front and rear distribution to increase density with a zero side clearance requirement or by specific exemption for an application specific requirement.

#### B. Construction

The PDU shall be designed and constructed with good workmanship practices to ensure safe and reliable operation and specifically as follows.

Wiring shall be grouped, bundled and braced to mechanical supports. All components, including CTs shall be mechanically attached and supported to a chassis other than to just cabling.

Top ventilation openings shall be designed to provide a measure of protection to falling debris entering the unit to prevent inadvertent failures due to the ingress of foreign material which precludes exposed horizontal vent slots on the top of the unit without a barrier.

The unit shall be capable of being handled by using a pallet truck, fork-lift or by overhead crane with the installation of lifting eyes.

Expansion cabinets, if supplied, shall utilize bus bars for interconnection of power distribution connections supplied for the purpose. Control wiring interconnections shall utilize pluggable connectors to facilitate error free installation.

#### C. Safe Maintainability & Serviceability

1. **Compartmentalization:** Input breakers, output distribution including breakers and/or fused disconnects and controls shall be mounted in individual compartments with associated removable dead fronts.
2. **Panelboards:** Panelboards, when supplied, shall be mounted in a separate compartment with a maximum of two panelboards per compartment. The panelboard breaker terminals shall be shrouded to prevent inadvertent contact when the panelboard dead-front is removed.
3. **SPD (TVSS):** SPDs, when specified, shall be serviceable and accessible without requiring access to the main power compartment. The SPD circuit shall additionally include a disconnect breaker to facilitate replacement with the unit is in the powered state.
4. **Metering and Controls:** Metering and controls and associated overcurrent protection

shall be mounted in a separate compartment and accessible for service without exposure to the high voltage/energy power.

5. The unit shall be designed and constructed to facilitate fast, effective and safe preventative maintenance procedures using thermographic IR scanning methods of the main power compartments, Input and Output Breaker terminals and Panelboards including main and load circuit breakers, without exposing the technician to high voltage/energy components. IR scanning grills provided in support of this requirement shall incorporate hinged or easily removable covers opened only for IR scanning procedures. IR Scan mechanisms for the main power compartment shall facilitate 360° viewing including transformer and terminals.
6. Fixed Mount Distribution Breakers: Distribution breakers shall be individually mounted in a separate compartment accessible by removal of its dead-front cover without exposure to adjacent circuits. Dead-front covers shall include means to facilitate IR scans of the load terminals without exposure to the live connections and any grills provided for the purpose shall be covered for normal operation.
7. Pluggable Distribution Breakers: Distribution breakers shall be mounted on a touch-safe pluggable base to which load circuit cabling is connected to facilitate removal for service with the unit in a powered state. The breaker assembly shall be individually mounted in a separate compartment accessible by removal of its dead-front cover without exposure to adjacent circuits. Dead-front covers shall include means to facilitate IR scans of the load terminals without exposure to the live connections and any grills provided for the purpose shall be covered for normal operation.
8. Rack-out Distribution Breakers: Distribution breakers shall be mounted on a touch-safe pluggable base to which load circuit cabling is connected to facilitate removal for service with the unit in a powered state and additionally incorporate a rack-out mechanism to allow the operator to be at a greater distance from the unit to reduce potential ARC flash incident energy. The breaker assembly shall be individually mounted in a separate compartment accessible by removal of its dead-front cover without exposure to adjacent circuits. Dead-front covers shall include means to facilitate IR scans of the load terminals without exposure to the live connections and any grills provided for the purpose shall be covered for normal operation.
9. Conduit Pull-box: Due to the multiplicity of output distribution sub-feed circuits, the unit shall incorporate a conduit pull-box to facilitate ease of contractor installation and service of the cabling.

D. Cooling, Losses and Heat Load

The PDU unit shall be natural-convection cooled with no internal fans or blowers and not require forced air from the room ventilation system. The transformer in the PDU shall be specifically optimized for the application loading to minimize losses and heat load and maximize efficiency. Continuous full load operation of the PDU at full rated kVA with rated K-Factor shall not exceed the insulation limit of 150°C rise.

E. Internal Connections

All internal cable connections shall be terminated with UL Recognized compression lugs. Mechanical connectors shall not be permitted except at Breakers, Panelboards or Customer Input connections. Fine stranded cables (e.g. DLO) shall utilize a ferule or wrapped with a 10-15 mil copper foil prior to termination in mechanical lugs to prevent damage to the fine wire

strands and to ensure reliable operation. All internal connections inaccessible by normal maintenance shall be welded to make them maintenance-free.

F. Wiring Access

The unit shall be capable of being wired from the top or bottom of the unit for both Input and load wiring unless specifically specified for top or bottom wiring access. Removable gland plates shall be provided for the main input and for each sub-feed breaker and where panelboards are employed, a sufficient electrical knock-outs (EKO's) shall be provided for panelboard load circuits.

G. Components

All electrical components used in the construction of this product shall be rated with regards voltage, current or power and appropriately de-rated following good application specific engineering practice and shall be Listed, Certified or Recognized for the application by a recognized certifying authority (e.g. UL, ETL, CSA, etc.).

H. Finish

All exterior metal surfaces shall be painted with medium-textured semi-gloss powder coat in IBM White or Black finish specified at time of order. All interior unpainted metal panels shall be zinc coated/plated or painted for corrosion resistance.

I. Handling and Installation

The unit shall be designed for pad or raised floor installation and shall be equipped with heavy-duty easy rolling swivel casters for ease of installation. Leveling jacks shall be provided for final installation leveling. The unit shall have provision for directly moving by Pallet or Forklift truck without a skid and have provision for lifting eyes for overhead crane handling.

J. Shipping Splits

When specified, the PDU shall be shipped with defined shipping split widths as individual components provided with integral interconnections and appropriate tagging for error free field assembly.

2.2 *Comprehensive Power Monitoring and Control (PMC)*

A. General requirements

The PDU shall be equipped with a comprehensive power monitoring and control system (PMC) capable of measuring with high accuracy all the main electrical parameters related to voltage, current, power, energy, distortion, power factor at both the input and total output(s) of the unit, real time transformer losses and efficiency and transformer coil temperatures. It shall also provide oscillographs of voltages and currents and harmonic bar graphs. All data is also to be available over the user's network using only a WEB Browser.

The monitor system should also serve to simultaneously measure and monitor addition multi-voltage outputs such as 208, 415V or 480V when so equipped.

The PMC shall have the capability to record user selected and programmed events with time/date stamps plus a deviation record and provide a visual, audible and/or remote signal alert.

The PMC shall be powered ahead of the main PDU input breaker for checking power conditions prior to energizing and shall be equipped with internal fused disconnects and shunting CT terminal blocks to facilitate safe servicing with the PDU energized.

The PMC shall be operable down to 50% nominal voltage on any two phases and provide hold-up for a minimum of 200ms after power failure to ensure reliable capture and recording of fault conditions even under transitory or poor power quality conditions to ensure reliable monitoring.

**B. Human Interface (HMI)**

Operator information/data display shall be provided by a color touch screen with minimum size of 5.7". Operator input shall be by means of context sensitive menu driven 'soft-keys' to facilitate easy navigation to measured data and setup screens. Access to the setup/configuration data should be password protected. All measured data, including event logs, oscillographs of voltages and currents and harmonics bar graphs, shall be available over an Ethernet connection using a common Internet Browser without the use of specialized software.

**C. Measurement Parameters & Accuracy**

The PDU metering system shall provide the following parameter measurements with minimum operating characteristics as detailed in the table below:

<b>Table of Measurement Parameters with minimum accuracy requirements</b>			
<b>Item</b>	<b>Accuracy</b>	<b>Input</b>	<b>Output(s)</b>
Line and phase voltages – $V_{ab}, V_{bc}, V_{ca}, V_{an}, V_{bn}, V_{cn}$	±0.3%	√	√
Currents - $I_a, I_b, I_c, I_n$	±0.3%	√	√
Power (per phase and total) - kW, kVA, kVAR	±0.5%	√	√
Energy – kWh, kVAh, kVARh	±0.5%	√	√
Efficiency	±0.2%	√	√
Frequency	±0.1%	√	√
Power factor (total and per phase for Wye connection)	±1%	√	√
Line and Phase voltage THD– $V_{ab}, V_{bc}, V_{ca}, V_a, V_b, V_c$	±1%	√	√
Current THD - $I_a, I_b, I_c, I_n$	±1%	√	√
Current harmonic spectrum - $I_a, I_b, I_c, I_n$ (to 31harmonic)	±5%	√	√
Voltage harmonic spectrum up to 31 harmonic	±5%	√	√
K- factor	±5%	√	√
Transformer coil temperatures - $T_a, T_b, T_c$	±2 deg.	-	-
Ambient Temperature	±2 deg.	-	-
Digital Inputs (4 min) for Breaker or SPD Status (see Alarm/events)	-	-	-

**D. Events and Alarms**

The PDU shall provide audible and visual alarms for abnormal events or states and be user programmable for magnitudes, delays, logging and output actions. The audible alarm shall sound until the operator intervenes to operate the silencing provision.

An event log should be digitally recorded with time/date stamp of the occurrence with the magnitude of deviation and duration of the anomaly from nominal for user selected conditions and be able to store a minimum of 1,000 events. Events shall include all conditions listed in the table below including Sag and Swell detection set and measured in ½ cycle increments for root cause determination of voltage anomalies.

The required recordable events shall be as listed in the table following:

<b>Table of Configurable User Events/Alarms requirements</b>						
<b>Parameter</b>	<b>Threshold Setpoint</b>	<b>Hysteresis</b>	<b>Delays On/Off</b>	<b>Input</b>	<b>Output (s)</b>	<b>Event Logs</b>
<b>Over-voltage</b>	% > Nominal	% < Setpoint	√	√	√	√
<b>Under-voltage</b>	% < Nominal	% > Setpoint	√	√	√	√
<b>Voltage Imbalance</b>	% >/< average	% </> Setpoint	√	√	√	√
<b>Phase Loss</b>	% >/< Nominal	% </> Setpoint	√	√	√	√
<b>Frequency</b>	% >/< Nominal	% </> Setpoint	√	√	√	√
<b>Over Current</b>	% > Nominal	% < Setpoint	√	√	√	√
<b>Overload</b>	% > Nominal	% < Setpoint	√	√	√	√
<b>Neutral Over Current</b>	% > Nominal	% < Setpoint	√	-	√	√
<b>Swells (½ cycle response)</b>	% > Nominal	% < Setpoint	√	√	√	√
<b>Sags (½ cycle response)</b>	% < Nominal	% > Setpoint	√	√	√	√
<b>Voltage THD</b>	% > Nominal	% < Setpoint	√	√	√	√
<b>Phase Rotation</b>	-	-	√	√	-	√
<b>Transformer (3) Coils Over-temperature</b>	% > Set value	% < Setpoint	√	-	-	√
<b>Ambient Over-temperature</b>	% > Set value	% < Setpoint	√	-	-	√
<b>SPD (TVSS) defective</b>	Digital Status	-	√	-	-	√
<b>SPD (TVSS) Breaker tripped</b>	Digital Status	-	√	-	-	√
<b>EPO Operation</b>	Digital Status	-	√	-	-	√
<b>User Digital Input (User Defined)</b>	Digital Status	-	√	-	-	√

The PMC shall be equipped with a minimum of two (2) output relays rated 5 Amps at 240VAC minimum and wired and available as follows:

- a. One (1) set externally wired for user connection
- b. One (1) set internally connected to the input Breaker shunt trip coil (if so equipped) to facilitate tripping off the PDU for user specified alarm conditions (for example transformer over-temperature). This function shall have a physical hardware jumper override when this function is not required (default setting to be in disabled mode).

#### E. Communication & Protocols

The unit shall be equipped with an Ethernet port supporting Modbus TCP, BACnet/IP (Smart Sensor Protocol) or SNMP V2 specified at time of order. It shall include DHCP support for automatic IP addressing and be provided with no cost software tools for setup and configuration available from the manufacturer's WEB site.

The Ethernet Port shall also support direct user access to all data including waveforms and event logs using only a common WEB Browser without the use of specialized software.

Exception: RS485 if specified as the sole communications port, shall support Modbus RTU and be isolated (floating) to prevent ground loops.

#### F. Data Trend Logging

1. Trend Logs: The Ethernet communication device shall provide data trend logging for user selected parameters in settable time increments.
2. Commission Data Logging: The data trend logging function shall be field configurable for data acquisition to record critical system electrical and temperature parameters during commissioning and validation without requiring the use of external data acquisition equipment to confirm system performance without requiring the use of external data acquisition equipment.

### 2.3 *Main Input Circuit Breaker(s)*

Main input circuit breaker(s) shall be a molded case electronic trip breaker supporting LSI settings, 80% rated and sized at 125% of full load current such that adequate overload protection it is maintained; for breaker frame sizes at 250A or smaller, a thermal-magnetic trip type breaker may be employed when approved by the engineer. The input breaker(s) shall be UL Listed and should have symmetrical fault interrupting capacity of at least 35kA at 480V or 18kA at 600V. Higher interrupting capacity breakers (65kAIC at 480V) shall be available when specified at time of order.

Input breaker (s) shall be mounted within a compartment separated from other distribution and shall be equipped with a shunt trip coil to interface with the local EPO or remote EPO circuits as well as with the shutdown sequence generated by the PMC unit.

### 2.4 *EPO Function*

The PDU shall be equipped with an Emergency Power Off (EPO) function configured to trip out the main input breaker(s). The EPO pushbutton switch shall be a red color with the letters "EPO" logo engraved and backlit by a LED for long reliable operation and covered with a transparent hinged plastic lid top prevent accidental operation. Additionally a minimum of four (4) pairs of external EPO terminals shall be provided for user connection to external remote dry contact circuits.

Operation of the EPO function shall be recorded by the monitor as an EPO event. The EPO circuit shall include an internal manual override disabling function to facilitate service of the unit without tripping the unit.

## 2.5 *Grounding*

The PDU shall be equipped with the an electrical equipment cabinet ground and a field selectable isolated ground for central isolated distribution ground or local ground.

## 2.6 *Distribution*

The unit shall be equipped as specified at time of order with Panelboards, Sub-feed Breakers, Sub-feed Fused Disconnects or multi-combinations. Panelboards or sub-feeds shall be fitted behind a dead-front panel and operator accessible behind lockable hinged doors.

## 2.7 *Panelboards*

The PDU shall be equipped with the type and number of Panelboards as specified at time of order. Panelboards shall be mounted within separate compartments separate from other distribution with a maximum of two (2) panelboards per compartment. Each Panelboard shall be individually protected by a thermal-magnetic breaker and accept bolt-on circuit breakers with single, double and three poles with Neutrals and associated Ground connections. The interrupt capacity (kAIC) of the Panelboard shall be coordinated with the available short-circuit current of the internal transformer.

### A. Panelboard Types

The number and types of the required Panelboards are to be indicated on the individual unit data sheet. The types require are to be specified at time of order from the following list:

1. 42, 72 or 84 circuit
2. 225 Amp or 400 Amp rating
3. Single or double column
4. Voltage rating specific to PDU output

### B. Panelboard Distribution Breakers

The Panelboards shall be loaded with distribution breakers per schedule specified at time of order noting the short circuit coordination requirement previously listed in this section.

## 2.8 *Sub-Feed Breakers (Individual and Panelboard Mounted)*

Sub-feed circuits may be supplied by individually mounted 100% rated Sub-feed breakers or group mounted in a main distribution panel. The interrupt capacity (kAIC) of the Sub-feed Breakers shall be coordinated with the available short-circuit current of the internal transformer.

### A. Individual Sub-feed Breakers

The number of sub-feed circuits and current ratings are to be specified at time of order. Each output shall also have a double rated neutral and an associated Ground connection.



B. Sub-feed Distribution in Panelboards

Sub-feed distribution panels when employed, shall have ratings of 400 Amps, 800 Amps or 1,200 Amps as specified at time of order, and support the number and size of 100% rated sub-feed breakers specified at time of order. Sub-feed panels shall be individually protected by a suitably rated main breaker.

C. LSIG Sub-feed Breakers

When specified at time of order, sub-feed breakers shall be equipped with ground sensing current relays.

D. Sub-Feed Fused Disconnects

Fused Disconnects, specified at time of order, shall be equipped with the specified fuses. The Fused disconnects shall be capable of breaking full load current without damage and coordinated with the available short-circuit current of the internal transformer. Each output shall also have a double rated neutral and an associated Ground connection.

2.9 *PDU Transformer Characteristics*

A. General Requirements

The transformer in the PDU shall as a minimum comply with the following general requirements:

1. Temperature rise < 115°C at full linear load for lower load losses, inherent derating, safety margin, overload capability and long term reliability
2. UL 1561 Listing/Recognition rated for K-Factor/harmonic loading.
3. Class 220 Insulation System with Epoxy co-polymer impregnant and rated to 10kV BIL.
4. Minimum Positive/Negative Sequence Impedance of > 4.0%
5. Six full capacity 2-1/2% voltage taps; 2 above nominal and 4 below
6. Two Electrostatic shields providing > 90 dB common mode attenuation at < 10 kHz
7. Audible noise limits per NEMA ST-20 less 3dB for K-9 rated units or 6dB less for K-13 rated units, individually compliance tested prior to shipment.
8. The inrush current to the transformer shall not exceed 7 x FLA with 1 ½% system upstream impedance

B. Specific Requirements < 50% Loading

The transformer in the PDU shall as a minimum comply with the following general requirements:

1. Basis of design Powersmiths E-Saver-25H (Copper/Aluminum hybrid)
2. Temperature rise < 105°C at full linear load for lower load losses, overload capability and long term reliability
3. Efficiency optimized for application loading between 32 -75%.
4. Inrush not to exceed 7 Times nominal input full load amps with 1 1/2% upstream impedance
5. Comply with the performance data in the following table:

kVA	No load losses (Watts)	Efficiency @ 35% load (%)	Efficiency at 50% load
15	41	98.37	98.19
20	53	98.44	98.28
25	64	98.51	98.37
30	75	98.58	98.46
45	110	98.66	98.57
50	119	98.69	98.60
63	141	98.76	98.68
75	162	98.83	98.75
100	184	98.90	98.82
112.5	195	98.93	98.85
125	221	98.95	98.88
150	274	99.00	98.94
175	306	99.04	98.98
200	337	99.07	99.01
225	369	99.11	99.05
250	399	99.13	99.08
300	458	99.18	99.13
400	567	99.22	99.15
450	621	99.24	99.20
500	675	99.26	99.22
600	787	99.28	99.24
750	955	99.32	99.28
800	960	99.33	99.30
1,000	1,250	99.36	99.32
1,350	1,462	99.42	99.40

C. Specific Requirements > 50% Loading

The transformer in the PDU shall as a minimum comply with the following general requirements:

1. Basis of design Powersmiths E-Saver-35H (Copper/Aluminum hybrid)
2. Temperature rise < 80°C at full linear load for lower load losses, overload capability and long term reliability
3. Efficiency optimized for application loading of 50 - 100%.
4. Inrush not to exceed 7 Times nominal input full load amps with 1 1/2% upstream impedance
5. Comply with the performance data in the following table

kVA	No load losses (Watts)	Efficiency @ 35% load (%)	Efficiency @100% Load
15	47	98.39	97.38
20	59	98.45	97.47
25	71	98.51	97.56
30	83	98.57	97.65
45	122	98.70	97.97
50	130	98.73	98.01
63	151	98.81	98.11
75	170	98.88	98.21
100	215	98.95	98.36
112.5	237	98.98	98.43
125	257	98.99	98.45
150	298	99.02	98.49
175	325	99.06	98.53
200	353	99.11	98.56
225	380	99.15	98.60
250	421	99.16	98.65
300	502	99.19	98.74
400	603	99.25	98.82
450	653	99.27	98.85
500	703	99.30	98.89
600	834	99.32	98.93
750	1030	99.34	99.00
850	1050	99.35	99.00

D. Specific Requirements with High Loading and High Harmonic Content

The transformer shall as a minimum comply with the following general requirements:

1. Basis of design Powersmiths T1000-30H (Copper wound)
2. Temperature rise < 105°C at full linear load for lower load losses, overload capability and long term reliability
3. Inrush not to exceed 7 Times nominal input full load amps with 1 1/2% upstream impedance
4. Rated for powering K-Factor loads to K-20
5. Zero sequence impedance/reactance: Less than 0.95% and 0.3% respectively for 75kVA and higher)
6. Treat 3<sup>rd</sup>, 9<sup>th</sup> & 15<sup>th</sup> (triplen) harmonics in the secondary of the transformer by flux cancellation by employing balanced zig-zag secondary with only the residual difference harmonics currents coupled to the primary
7. Treat 5th and 7th harmonics at the point of common coupling through pairing of zero (0) degree and thirty (30) degree phase-shifted units
8. Shall reduce the phase current imbalance on the primary side of the transformer

9. Comply with the performance data in the following table

kVA	No load losses (Watts)	Efficiency @ 35% Linear load (%)	Efficiency @ 50% Linear load (%)	Efficiency at 50% load under K-13 nonlinear load
15	50	98.16	98.02	97.68
20	60	98.28	98.14	97.81
25	69	98.39	98.25	97.95
30	78	98.51	98.37	98.08
45	106	98.63	98.51	98.28
50	114	98.66	98.54	98.30
63	134	98.72	98.60	98.34
75	153	98.78	98.66	98.38
100	196	98.86	98.76	98.51
112.5	218	98.90	98.81	98.58
125	231	98.93	98.84	98.61
150	257	98.99	98.90	98.68
175	293	99.02	98.93	98.71
200	328	99.04	98.96	98.75
225	364	99.07	98.99	98.78
250	391	99.09	99.01	98.81
300	444	99.14	99.06	98.88
400	521	99.19	99.11	98.88
450	560	99.22	99.14	98.88
500	598	99.24	99.16	98.88
600	703	99.27	99.20	98.96
750	860	99.31	99.26	99.08

2.10 Additional PDU Components and Accessories

The PDU shall include the selected components and accessories listed in the following tables where indicated or specified at time of order with specifications per the referenced section:

- A. Rotatable IR Ports for Preventative Maintenance by Thermography
- B. The PDU shall include a Rotatable IR viewing port to enable an operator to thermographically examine the transformer and its main internal connections and all areas within the enclosure by rotating the window to the required angle for an effective preventative maintenance program. Basis of design is the Powersmiths IRP family of Rotatable IR Ports.
- C. Extra Low Inrush Current

The inrush current to the transformer shall not exceed five (5) times full load amps (FLA) with an upstream source impedance of 1 ½ %.

D. Impedance Options (for downstream kAIC limits)

The transformer shall be designed for an impedance value or for a maximum specified short-circuit kAIC rating specified at time of order; this parameter has a tolerance of +/- 10% per UL:1561.

E. Triple Electrostatic Shields

The transformer shall be equipped with three electrostatic shields for enhanced common mode noise reduction, connected as follows:

1. Shield No. 1 & 2 connected to the equipment Isolated Ground Bus
2. Shield No. 3 connected to the equipment Ground
- 1.

F. Field Changeable Output Voltage

The PDU shall be designed with internal dual voltage fully rated outputs of 120/208 and 240/415 (or 220/380) volts. The selection of the output voltage shall be field selectable by a serviceman changing over the output distribution wires to the required voltages. The monitoring system shall be prewired to support the changeover without monitor system rewiring for ease of this operation.

G. Input Junction Box

When specified at time of order, a NEMA 12 rated input junction box shall be provided with the PDU with 10 foot flexible conduit and shall include a three-pole barrier- type terminal block plus a ground terminal block. Cabling shall be sufficient length to allow for connection between the flexible conduit and the PDU, be suitably terminated to be compatible with the PDU input terminals and shall be right sized for the PDU current per the relevant National Electric Code (e.g. NEC).

H. Windowed Doors

When specified at time of order, the PDU shall be equipped with transparent windowed doors to permit visual inspection of the position of the breakers (Off, On or Tripped).

END OF SPECIFICATION SECTION 26 27 66

## 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. Molded-case circuit breakers (MCCBs).
  - 4. Enclosures.

##### 1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

##### 1.4 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. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
  - 5. 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.

- C. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 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.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

#### 1.6 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 (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
  - 2. Altitude: Not exceeding 6600 feet (2010 m).

#### 1.7 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.

#### 1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. 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.

## PART 2 - PRODUCTS

### 2.1 FUSIBLE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide or product 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.
  5. Bussmann (Elevator Switch).
- B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
  1. Equipment Ground Kit: Internally mounted and labeled for copper 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] [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 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.
- C. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Accessories:



1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
3. For isolated grounded systems 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. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  2. Siemens Energy & Automation, Inc.
  3. 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. 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.

### 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. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
  4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
  5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

## 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. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in fusible devices.
- D. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "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. 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.
- B. 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.
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 26 28 16

## SECTION 26 43 13

### SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

##### 1.3 DEFINITIONS

- A. Inominal: Nominal discharge current.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SPD: Surge protective device.
- H. VPR: Voltage protection rating.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - a. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - b. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, nominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

- c. From an independent nationally recognized testing laboratory (NRTL), verification that equipment has been tested and conforms to both UL 1283 and 1449 standards
  - d. Noise rejection test results at 100kHz.
- B. Contract Closeout Submittals
- a. Operations and Maintenance
    - i. Include data per Division 1 Copy of warranty statement clearly establishing the terms and conditions to the building/facility owner/operator.
  - b. Field Verification Test Report
    - i. Include the report for field verification of the injection startup test results and the factory benchmark testing results for confirmation of proper suppression filter system function as required from this specification in Section 3.3 & 3.4.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For manufacturer's special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

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

#### 1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Service Entrance Twenty (15) years from date of Substantial Completion.
  - 2. Warranty Period: Panel Suppressors Fifteen (15) years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 GENERAL SPD REQUIREMENTS

- A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Comply with UL 1449.

- D. MCOV of the SPD shall be the nominal system voltage. MCOV shall be a tested value per section 37.7.3 of UL1449 4<sup>th</sup> Edition.

## 2.2 SERVICE ENTRANCE AND TRANSFER SWITCH SUPPRESSOR

- A. Basis of Design: Subject to compliance with requirements. Provide product to the following:
  - 1. ACT Communications 471 Series.
  - 2. Current Technology "TG3" Series.
- B. Other manufacturers wishing to have specific products evaluated for equivalence shall provide detailed compliance or exception statements, along with supporting test documentation, to all provisions of this specification, no less than 10 days prior to the bid date.
  - 1. Failure to provide the required documentation no less than 10 days prior to the bid date will disqualify products from consideration for this project.
- C. SPDs: Listed as Type 1 SPD per UL1449 5<sup>th</sup> Edition
  - 1. SPDs with the following features and accessories:
    - a. Mounted external to electrical equipment.
    - b. Advanced RFI/EMI Filter rated for -55dB
    - c. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
    - d. SPD monitoring shall include:
      - 1.) Indicator lights which display protection status.
      - 2.) Audible alarm with silence switch.
      - 3.) Form C contacts rated at 5 A and 250 V, one normally open and one normally closed for remote monitoring of protection status.
        - a.) Continuous and resettable dual surge counters.
    - e. Information from monitoring shall be available through the facility network.
      - 1.) Via ModBus.
      - 2.) Via Ethernet.
- D. Comply with UL 1283 with a maximum attenuation of 54dB based on 50ohm insertion loss test per MIL-STD-220B
- E. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per mode shall not be less than 125 kA. The peak surge current rating shall NOT be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- F. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277V or 208Y/120V, three-phase, four-wire circuits shall not exceed the following:
  - 1. Line to Neutral: [1000 V for 480Y/277 V] [700 V for 208Y/120 V].
  - 2. Line to Ground: [1000 V for 480Y/277 V] [700 V for 208Y/120 V].

- 3. Line to Line: [1800 V for 480Y/277 V] [1000 V for 208Y/120 V].
- G. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:
  - 1. Line to Neutral: 700 V.
  - 2. Line to Ground: [700 V] [1000 V].
  - 3. Line to Line: 1000 V.
- H. SCCR: Equal or exceed 200 kA.
- I. Inominal Rating: 20 kA and compliance to all UL96A requirements for ac surge protection.
- J. Repetitive Surge: SPD shall survive a minimum of 20,000 repetitive category C3 (20kV/10kA) surges with no more than 10% deterioration. Calculated repetitive surge values will not be accepted. SPD manufacturer shall provide repetitive surge test report.
- K. Temporary Over Voltages: SPD shall be able to prevent common temporary over voltages from damaging the MOVs, increasing longevity and ability of SPD unit to protect the critical load. SPD shall limit the voltage per the following chart.

<b>Overvoltage seen by MOVs as % of Nominal</b>				
	<b>available current</b>			
<b>time</b>	<b>30A</b>	<b>100A</b>	<b>500A</b>	<b>1000A</b>
1 cycle	120%	130%	150%	160%
10 cycles	130%	150%	160%	160%
30 cycles	140%	150%	160%	160%

- L. Temporary Over Voltages: SPD shall be able to withstand a minimum of 100 temporary over voltage events, as defined by: 30A available fault current, 30 cycles of duration, with 10 seconds between events.

2.3 PANEL SUPPRESSORS

- A. Basis of Design: Subject to compliance with requirements. Provide comparable product by the following:
  - 1. ACT Communications 471 Series.
  - 2. Current Technology "TG3" Series.
- B. SPDs: Listed as Type 1 SPD per UL1449 5<sup>th</sup> Edition
  - 1. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
  - 2. SPD monitoring shall include:
    - Indicator lights which display protection status.
    - Audible alarm with silence switch.
    - Form C contacts rated at 5 A and 250 V, one normally open and one normally closed for remote monitoring of protection status.

Resettable surge counters.  
Advanced RFI/EMI Filter rated for -55dB

3. Information from monitoring shall be available through the facility network.  
Via ModBus.  
Via Ethernet.

- C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per mode shall not be less than 50 kA. The peak surge current rating shall NOT be the arithmetic sum of the ratings of the individual MOVs in a given mode. SPD manufacturer shall provide independent 3<sup>rd</sup> party testing validating unit is capable of surviving a single surge at the specified rating.
- D. Comply with UL 1283 with a maximum attenuation of 34dB based on 50ohm insertion loss test per MIL-STD-220B
- E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277V or 208Y/120V, three-phase, four-wire circuits shall not exceed the following:
  1. Line to Neutral: [1000 V for 480Y/277 V] [700 V for 208Y/120 V].
  2. Line to Ground: [1000 V for 480Y/277 V] [700 V for 208Y/120 V].
  3. Line to Line: [1800 V for 480Y/277 V] [1000 V for 208Y/120 V].
- F. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:
  1. Line to Neutral: 700 V.
  2. Line to Ground: [700 V] [1000 V].
  3. Line to Line: 1000 V.
- G. SCCR: Equal or exceed 200 kA.
- H. Inominal Rating: 20 kA

## 2.4 ENCLOSURES

- A. Indoor Enclosures: NEMA 250, Type 1.
- B. Outdoor Enclosures: NEMA 250, Type 3R.

## 2.5 CONDUCTORS AND CABLES

- A. Power Wiring: SPD shall be equipped with mechanical lugs that can accept up to #2 AWG wire. Conductors between SPD and switchgear shall be "LOW Z" cables with Ultra Low impedance characteristics at 10kHz and above.



- B. Class 2 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.
- C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground. If installed lead length must exceed 10', SPD manufacturer shall provide a low impedance cable that improves the installed performance.
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.
- E. Wiring:
  - 1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
  - 2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

#### 3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
  - 1. Compare equipment nameplate data for compliance with Drawings and Specifications.
  - 2. Inspect anchorage, alignment, grounding, and clearances.
  - 3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. An SPD will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.3 SYSTEM TESTING

- A. Upon completion of installation, provide the start-up and testing services of a factory-authorized and factory-trained local service representative. The tests shall include:
  - 1. Off-line Testing: Impulse injection to verify the system tolerances as well as verification of proper facility neutral-to-ground bond. Compare field test results to factory benchmark test parameters supplied with each individual unit.
  - 2. On-line Testing: Verify that suppression and filtering paths are operating with 100% protection as well as verification of proper facility neutral-to-ground bond by measuring neutral-to-ground current and voltage and by visual inspection.
  - 3. Voltage measurements from Line-to-Ground (L-G), Line-to-Neutral (L-N), Line-to-Line (L-L), and Neutral-to-Ground (N-G), taken at the time of the testing procedure.

### 3.4 DOCUMENTATION AND REPORTING

- A. Record results of field testing and compare to factory benchmark test parameters supplied with each individual surge protective device. Indicate that the integrity of neutral-to-ground bonds were verified through testing and visual inspection, and that grounding bonds were observed to be in place.
- B. Submit to the Owner's representative and to the Architect/Engineer copies of the startup test results and the factory benchmark testing results for confirmation of proper suppression filter system function, as required by this section. Provide the number of copies as required by Division One and the Electrical General Provisions section; and three copies where not otherwise specified.

END OF SECTION 26 43 13

## SECTION 26 51 19 - LED INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Cylinder.
2. Downlight.
3. Lowbay.
4. Recessed, linear.
5. Strip light.
6. Suspended, linear.
7. Materials.
8. Luminaire support.

- B. Related Requirements:

1. Section 26 09 23 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 26 09 26 "Lighting Control Panelboards" for panelboards used for lighting control.
3. Section 26 09 36 "Modular Dimming Controls" for architectural dimming systems and for fluorescent dimming controls with dimming ballasts specified in interior lighting Sections.
4. Section 26 09 43.16 "Addressable-Luminaire Lighting Controls" and Section 26 09 43.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

#### 1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.

- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, and finishes.
  - 3. Include physical description and dimensions of luminaires.
  - 4. Include emergency lighting units, including batteries and chargers.
  - 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
  - 6. Photometric data and adjustment factors based on laboratory tests IES LM-79 .
    - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
    - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- B. Shop Drawings: For nonstandard or custom luminaires.
  - 1. Include plans, elevations, sections, and mounting and attachment details.
  - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include diagrams for power, signal, and control wiring.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Luminaires.
  - 2. Suspended ceiling components.
  - 3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
  - 4. Structural members to which equipment luminaires will be attached.
  - 5. Initial access modules for acoustical tile, including size and locations.
  - 6. Items penetrating finished ceiling, including the following:
    - a. Other luminaires.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Ceiling-mounted projectors.
  - 7. Moldings.
  - 8. Refer to Light Fixture Schedule .
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.

- C. Product Certificates: For each type of luminaire.
- D. Product Test Reports: For each type of luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency .

#### 1.6 CLOSEOUT SUBMITTALS

#### 1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications:
  - 1. Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
  - 2. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

#### 1.9 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year (s) from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Ambient Temperature: 41 to 104 deg F .
  - 1. Relative Humidity: Zero to 95 percent.
- B. Altitude: Sea level to 2900 .

#### 2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter, shape, size, wattage, and coating.
    - c. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.
- D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- F. California Title 24 compliant.

## 2.3 CYLINDER

- A. Lamp:
  - 1. Dimmable from 100 percent to zero percent of maximum light output.
  - 2. Internal driver.
  - 3. User-Replaceable Lamps:
    - a. Bulb shape complying with ANSI C78.79.
    - b. Lamp base complying with ANSI C81.61 .
  - 4. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.
- B. Housings:
  - 1. Extruded-aluminum housing and heat sink.
  - 2. powder-coat finish.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- D. Diffusers and Globes:
  - 1. Refer to Light Fixture Schedules .
  - 2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 3. Glass: Annealed crystal glass unless otherwise indicated.
  - 4. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.
- E. With integral mounting provisions.
- F. Standards:
  - 1. ENERGY STAR certified.
  - 2. RoHS compliant.

3. UL Listing: Listed for damp location.

#### 2.4 DOWNLIGHT .

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. Lithonia Lighting; Acuity Brands Lighting, Inc.
- B. Nominal Operating Voltage: 277 V ac .
- C. Lamp:
  1. Dimmable from 100 percent to zero percent of maximum light output.
  2. Internal driver.
  3. User-Replaceable Lamps:
    - a. Bulb shape complying with ANSI C78.79.
    - b. Lamp base complying with ANSI C81.61 .
  4. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.
- D. 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.
- E. Standards:
  1. ENERGY STAR certified.
  2. RoHS compliant.
  3. UL Listing: Listed for damp location.
  4. Recessed luminaires shall comply with NEMA LE 4.

#### 2.5 HIGHBAY, LINEAR .

- A. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- B. Standards:
  1. ENERGY STAR certified.
  2. RoHS compliant.
  3. UL Listing: Listed for damp location.

#### 2.6 HIGHBAY, NONLINEAR .

- A. Lamp:
  1. Dimmable from 100 percent to zero percent of maximum light output.
  2. Internal driver.
  3. User-Replaceable Lamps:
    - a. Bulb shape complying with ANSI C78.79.
    - b. Lamp base complying with ANSI C81.61 .
  4. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.



- B. Housings:
  - 1. Universal mounting bracket.
  - 2. Integral junction box with conduit fittings.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- D. Standards:
  - 1. ENERGY STAR certified.
  - 2. RoHS compliant.
  - 3. UL Listing: Listed for damp location.

## 2.7 LINEAR INDUSTRIAL .

- A. Lamp:
  - 1. Dimmable from 100 percent to zero percent of maximum light output.
  - 2. Internal driver.
  - 3. User-Replaceable Lamps:
    - a. Bulb shape complying with ANSI C78.79.
    - b. Lamp base complying with ANSI C81.61 .
  - 4. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.
- B. Housing and Heat Sink Rating:
  - 1. Class 1, Division 2 Group(s) A B C and D.
  - 2. NEMA 4X.
  - 3. IP 54.
  - 4. IP 66.
  - 5. Marine and wet locations.
  - 6. CSA C22.2 No 137.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- D. With integral mounting provisions.
- E. Standards:
  - 1. ENERGY STAR certified.
  - 2. RoHS compliant.

## 2.8 LOWBAY

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Lithonia Lighting; Acuity Brands Lighting, Inc.
- B. Nominal Operating Voltage: 277 V ac .

- C. Lamp:
  - 1. Minimum allowable efficacy of 80 lm/W.
  - 2. Dimmable from 100 percent to zero percent of maximum light output.
  - 3. Internal driver.
  - 4. User-Replaceable Lamps:
    - a. Bulb shape complying with ANSI C78.79.
    - b. Lamp base complying with ANSI C81.61 .
  - 5. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.
- D. Housings:
  - 1. Extruded-aluminum housing and heat sink.
  - 2. powder-coat painted finish.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- F. Diffusers and Globes:
  - 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
  - 3. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.
- G. Standards:
  - 1. ENERGY STAR certified.
  - 2. RoHS compliant.
  - 3. UL Listing: Listed for damp location.

## 2.9 RECESSED, LINEAR .

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Lithonia Lighting; Acuity Brands Lighting, Inc.
- B. Nominal Operating Voltage: 277 V ac .
- C. Lamp:
  - 1. Dimmable from 100 percent to zero percent of maximum light output.
  - 2. Internal driver.
  - 3. User-Replaceable Lamps:
    - a. Bulb shape complying with ANSI C78.79.
    - b. Lamp base complying with ANSI C81.61 .
  - 4. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.
- D. Housings:
  - 1. Extruded-aluminum housing and heat sink.
  - 2. Clear powder-coat painted finish.
  - 3. With integral mounting provisions.

- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- F. Diffusers and Globes:
  - 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
  - 3. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.
- G. Standards:
  - 1. ENERGY STAR certified.
  - 2. RoHS compliant.
  - 3. UL Listing: Listed for damp location.
  - 4. NEMA LE 4.

#### 2.10 STRIP LIGHT .

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Lithonia Lighting; Acuity Brands Lighting, Inc.
- B. Nominal Operating Voltage: 277 V ac .
- C. Lamp:
  - 1. Dimmable from 100 percent to zero percent of maximum light output.
  - 2. Internal driver.
  - 3. User-Replaceable Lamps:
    - a. Bulb shape complying with ANSI C78.79.
    - b. Lamp base complying with ANSI C81.61 IEC 60061-1.
  - 4. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.
- D. Housings:
  - 1. Extruded-aluminum housing and heat sink.
  - 2. powder-coat painted finish.
  - 3. With integral mounting provisions.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping of luminaire without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- F. Diffusers and Globes:
  - 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
  - 3. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.
- G. Standards:

1. ENERGY STAR certified.
2. RoHS compliant.
3. UL Listing: Listed for damp location.

#### 2.11 SUSPENDED, LINEAR

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Lithonia Lighting; Acuity Brands Lighting, Inc.
- B. Nominal Operating Voltage: 277 V ac .
- C. Lamp:
1. Dimmable from 100 percent to zero percent of maximum light output.
  2. Internal driver.
  3. User-Replaceable Lamps:
    - a. Bulb shape complying with ANSI C78.79.
    - b. Lamp base complying with ANSI C81.61 .
  4. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.
- D. Housings:
1. Extruded-aluminum housing and heat sink.
  2. powder-coat painted finish.
  3. With integral mounting provisions.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- F. Diffusers and Globes:
1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  2. Glass: Annealed crystal glass unless otherwise indicated.
  3. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.
- G. Standards:
1. ENERGY STAR certified.
  2. RoHS compliant.
  3. UL Listing: Listed for damp location.

#### 2.12 MATERIALS

- A. Metal Parts:
1. Free of burrs and sharp corners and edges.
  2. Sheet metal components shall be steel unless otherwise indicated.
  3. Form and support to prevent warping and sagging.
- B. Steel:
1. ASTM A36/A36M for carbon structural steel.

2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. Manufacturer's standard grade.
2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

#### 2.13 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

#### 2.14 LUMINAIRE SUPPORT

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage .

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

### 3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Provide support for luminaire without causing deflection of ceiling or wall.
  - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaires:
  - 1. Secured to outlet box.
  - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
  - 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaires:
  - 1. Attached to structural members in walls .
  - 2. Do not attach luminaires directly to gypsum board.
- G. Suspended Luminaires:
  - 1. Ceiling Mount:
    - a. 4 5/32-inch- diameter aircraft cable supports adjustable to 10 feet in length .
    - b. Pendant mount Four-point pendant mount with 5/32-inch- diameter aircraft cable supports adjustable to 10 feet in length .
    - c. Hook mount.
  - 2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
  - 4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
  - 5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- H. Ceiling-Grid-Mounted Luminaires:
  - 1. Secure to any required outlet box.
  - 2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
  - 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

- I. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

### 3.6 STARTUP SERVICE

- A. Comply with requirements for startup specified in Section 26 09 43.16 "Addressable-Luminaire Lighting Controls."
- B. Comply with requirements for startup specified in Section 26 09 43.23 "Relay-Based Lighting Controls."

### 3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
  1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
  2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 26 51 19

## SECTION 26 56 19 - LED 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. Luminaire-mounted photoelectric relays.
  - 2. Luminaire types.
  - 3. Materials.
  - 4. Finishes.
  - 5. Luminaire support components.
- B. Related Requirements:
  - 1. Section 26 09 23 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
  - 2. Section 26 09 26 "Lighting Control Panelboards" for panelboard-based lighting control.
  - 3. Section 26 09 36 "Modular Dimming Controls" for architectural dimming systems specified in Section 26 51 00 "Interior Lighting."
  - 4. Section 26 09 43.16 "Addressable-Luminaire Lighting Controls" and Section 26 09 43.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
  - 5. Section 26 56 13 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

#### 1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.



1. Arrange in order of luminaire designation.
  2. Include data on features, accessories, and finishes.
  3. Include physical description and dimensions of luminaire.
  4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
  5. Photometric data and adjustment factors based on laboratory tests, complying with IES LM-80.
    - a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
    - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
  6. Wiring diagrams for power, control, and signal wiring.
  7. Photoelectric relays.
  8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
  2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  3. Include diagrams for power, signal, and control wiring.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.
  2. Structural members to which equipment and luminaires will be attached.
  3. Underground utilities and structures.
  4. Existing underground utilities and structures.
  5. Above-grade utilities and structures.
  6. Existing above-grade utilities and structures.
  7. Building features.
  8. Vertical and horizontal information.
  9. .
- B. Product Certificates: For each type of the following:
1. Luminaire.
  2. Photoelectric relay.
- C. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency a qualified testing agency.
- D. Source quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.
  - 1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
  - 2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

#### 1.7 QUALITY ASSURANCE

- A. Provide luminaires from a single manufacturer for each luminaire type.
- B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

#### 1.9 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

#### 1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures, including luminaire support components.
    - b. Faulty operation of luminaires and accessories.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    - d. .
  - 2. Warranty Period: 5 year(s) from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

#### 2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598 and listed for wet location.
- E. Lamp base complying with ANSI C81.61 .
- F. Bulb shape complying with ANSI C79.1.
- G. CRI of 80 . CCT of 5000 K .
- H. L70 lamp life of 50,000 hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- J. Internal driver.
- K. Nominal Operating Voltage: 277 V ac .
- L. In-line Fusing: Separate in-line fuse for each luminaire.
- M. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.
- N. Source Limitations:
  - 1. Obtain luminaires from single source from a single manufacturer.
  - 2. For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

### 2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. GE Current, a Daintree company; American Industrial Partners (AIP).
  - 2. Lithonia Lighting; Acuity Brands Lighting, Inc.
- B. Comply with UL 773 or UL 773A.

### 2.4 LUMINAIRE TYPES

- A. Area and Site:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. GE Current, a Daintree company; American Industrial Partners (AIP).
    - b. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - 2. Luminaire Shape: Round Square Hexagonal .
  - 3. Diffusers and Globes: **<Insert material>**.

4. Housings:
  - a. <Insert material> housing and heat sink.
  - b. powder-coat finish.
- B. Canopy:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. H.E. Williams.
    - b. Lithonia Lighting; Acuity Brands Lighting, Inc.
  2. Dimensions: 12 inches square .
  3. Housings:
    - a. Extruded-aluminum housing and heat sink.
    - b. powder-coat finish.
- C. Decorative Post Top:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. GE Current, a Daintree company; American Industrial Partners (AIP).
    - b. Lithonia Lighting; Acuity Brands Lighting, Inc.
  2. Housings:
    - a. Extruded-aluminum housing and heat sink.
    - b. powder-coat finish.

## 2.5 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Corrosion-resistant aluminum Stainless steel . Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers and Globes:
  1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  2. Glass: Annealed crystal glass unless otherwise indicated.
  3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
  1. White Surfaces: 85 percent.
  2. Specular Surfaces: 83 percent.
  3. Diffusing Specular Surfaces: 75 percent.

- G. Housings:
  - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
  - 2. Provide filter/breather for enclosed luminaires.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter, shape, size, wattage and coating.
    - c. CCT and CRI for all luminaires.

## 2.6 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
  - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
  - 3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
  - 4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
    - a. Color: Refer to Light Fixture Schedule .
- D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
  - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

- a. Color:
  - 1) Match Architect's sample of manufacturer's standard color.

## 2.7 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, and canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Support luminaires without causing deflection of finished surface.
  - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Wall-Mounted Luminaire Support:
  - 1. Attached to a minimum 1/8 inch backing plate attached to wall structural members .

- G. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.
- I. Coordinate layout and installation of luminaires with other construction.
- J. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- K. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and Section 26 05 33 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

### 3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

- A. Aim as indicated on Drawings.
- B. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 03 30 00 "Cast-in-Place Concrete."

### 3.5 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

### 3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

### 3.7 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Verify operation of photoelectric controls.
- C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
  - a. IES LM-5.
  - b. IES LM-50.
  - c. IES LM-52.
  - d. IES LM-64.
  - e. IES LM-72.
2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

### 3.8 DEMONSTRATION

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

### 3.9 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 26 56 19



**SECTION 27 00 00**  
**STRUCTURED CABLING SYSTEM**

**PART 1– GENERAL**

**1.1 PROJECT SUMMARY/OVERVIEW**

- A. The communication cabling contractor is to provide a complete communications cabling infrastructure system installation including but not limited to: Copper and Fiber backbone/riser system w/secondary protection, horizontal data and voice cabling with attendant terminations, mounting equipment, cable pathway and management systems, testing and other items/materials, as specified in drawings, these specifications, and contract documents.
- B. The items described herein shall not be substituted without the written consent of SIGMA HN ENGINEERS (consultant).
- C. Communications Cabling Contractor shall be herein after referred to as Contractor for the scope of this document.
- D. Contractor shall be responsible for all written specifications and drawings that correspond to this project.
- E. These specifications are intended for bidding purposes only. No part shall be copied or used for any purpose other than bidding on this project.

**1.2 RELATED DOCUMENTS:**

- A. Drawings and general provisions of the Contract, including Uniform General Conditions, Supplementary General Conditions, Architectural Plans and Specifications, requirements of Division 1, electrical, mechanical specifications and plans, and Telecommunications plans apply to the Telecommunications section and shall be considered a part of this section. The contractor shall read all sections in their entirety and apply them as appropriate for work in this section.
- B. In order to accomplish the conditions of this agreement, the contractor shall perform the specific duties listed herein.
- C. Contract Documents: Drawings and specifications are to be used in conjunction with one another and to supplement one another. In general the specifications determine the nature and quality of the materials, and the drawings establish the quantity guidelines, details, and give characteristics of performance that should be adhered to in the installation of the communications system components. If there is an apparent conflict between the drawings and specifications, the items with the greater quantity or quality shall be estimated upon and installed. Clarification with the owner about these items shall be made prior to the ordering and

- installation.
- D. Insurance: Prior to commencing work the Contractor shall procure at their own cost and expense insurance against claims for injuries to persons or damages to property by the Contractor, its agents, officers, employees, or subcontractors that may arise from or in connection with the performance of this Agreement. The policies will be available for review by the owner or consultant at any time during the agreement. These insurance policies shall be maintained and remain in full effect for the entire term of agreement.
  - E. Project and cost payment: Refer to general contractor contract documents and/or master specifications issued by architect.
  - F. Contractor will respect and protect the privacy and confidentiality of Owner, its employees, processes, products, and intellectual property to extent necessary, consistent with the legal responsibilities of the State of Texas and Owner policies.
  - G. Contractors shall sign a non-disclosure agreement and abide by the requirements to keep confidential all information concerning bid documents and this project
  - H. Use of subcontractors: Bidding contractors shall inform owner's contact and General Contractor in writing about the intention to use subcontractors and the scope of work for which they are being hired. Owner must approve the use of subcontractors in writing or owner's designated contact prior to the subcontractor's hiring and start of any work.
  - I. Contractor shall designate their project manager as the single point of contact and shall provide the name phone number and electronic mail information for the designated person. Project manager shall oversee all work performed to ensure compliance with specifications as outlined in bid documents (which includes all specifications and drawings) to insure a quality installation.

### 1.3 SCOPE OF WORK

- A. Contractor to comply with the master specifications documents and following requirements for a complete project installation.
- B. This section establishes a communications infrastructure to be used as signal pathways for voice and high-speed data transmission. Provide a structured cabling system as described hereafter including but not limited to: communications outlets, fiber and voice riser/backbone cable, data and voice copper horizontal cabling, cable connectors, cable protection and terminations, and equipment racks/cabinets for networking hardware and cable termination patch panels.
- C. Furnish all labor, materials, tools, equipment and services for the installation described herein. All requirements and specifications will be enforced. All cable pathways and runs to individual outlets are not shown in their entirety but shall be provided as if shown in their entirety. Where not specifically noted the contractor shall determine exact routing.
- D. Installation procedures for communications cable will be such that the mechanical and electrical

transmission characteristics of the specified cable plant and equipment are maintained.

- E. Work of this Section covers a complete installation of both permanent and channel links for a Data and Voice Communications Network utilizing copper and fiber transmission media that includes, but is not limited to the following:
1. Installation and termination of secondary fused Building Entrance Terminals (BET's) for protection of incoming Service provider or campus inter-building copper pair circuits. Interconnection to Service provider demarc shall be coordinated with communications consultant, switch provider, service provider and client's IT representative on a later date. All copper pairs entering the building from an outside distribution network will be fuse protected. Coordinate with owner/consultant for the specific type of fused protection.
  2. Provide and install Innerduct rated appropriately for the installation location, verify with architect for plenum and riser rated areas.
  3. Provide, install, terminate, test, and document all fiber and copper backbone and riser cable.
  4. Provide, install, terminate, test, and document all fiber and copper voice and data horizontal cable.
  5. Provide and place all termination devices such as but not limited to: Modular patch panels, termination blocks, information outlets, phone jacks, fiber distribution panels and fiber splice modules.
  6. Provide, in quantities specified, interconnect components such as but not limited to: Copper patch cords; cross connect wire, fiber patch cables and data station cables.
  7. Provide and place horizontal and vertical cable support devices such as but not limited to: Cable tray, flex tray, D-rings, J-hooks, Cable saddles, and all required mounting hardware, unless otherwise noted.
  8. Provide and install all equipment mounting racks and cabinets.
  9. Provide and install all rack mounted vertical and horizontal cable management panels
  10. Provide and install approved fire-stopping systems in all communication pass-through spaces, conduit and cable tray wall and floor penetrations. Fire stop systems will be coordinated with General Contractor/Architect.
  11. Grounding and bonding of racks, cable ladder and tray in MC and TR rooms to the grounding bus provided by Telecommunication's Contractor.

12. Provide complete documentation and demonstration of work.
13. Resolution of all punch list deficiencies within 10 working days.
14. Provide organized complete 100% Test Results of all copper and fiber cable and their components.
15. Produce final drawings of record.
16. The Owner may separately purchase and/or provide certain equipment and miscellaneous items that will be installed during the course of trim work. Such items may not be indicated in the Documents. Contractor shall cooperate with the Owner and his Suppliers.
17. The furnishing and installation of computer hardware and related networking software and equipment.
18. The furnishing and installation of multi-port routers, hubs, and UPS in MC, SR and TR's.

1.4 WORKS AND MATERIAL BY OTHERS (NIC) INCLUDE:

- A. The Telecommunications Grounding Buss bars and grounding conductors connecting to main building electrode system ~~to be provided on this project by Division 26-00-00.~~
- B. The dedicated electrical power panels, isolated/non-isolated, emergency circuits and utility outlets ~~to be provided by Division 26-00-00.~~
- C. The furnishing, installation and finishing of plywood backboards to be provided by others. (Div.26 00 00) Plywood installation will be coordinated with the General Contractor/Architect.
- D. Building mechanical ductwork, HVAC system, and environmental control sensors to be provided by others.
- E. The communication pathway devices such as, but not limited to: cable tray, flex tray, conduits, conduit sleeves, and wall and floor penetrations in corridors, office spaces, and open areas ~~to be provided by Division 26-00-00.~~

1.5 STAFFING

- A. Qualification: Submit an up-to-date and valid certification verifying the qualifications of the Contractor and installers to perform the work specified herein at time of bid submission.
- B. Contractor shall have a complete working knowledge of low voltage cabling applications such as, but not limited to: data, voice and video network systems.

- C. Contracting firm shall have installed similar systems in at least (10) other projects in the last five years prior to this bid and be regularly engaged in the business of installation of the types of systems specified in this document. Contractor shall provide information on prior projects including, but no limited to: items such as name and location of project contacts and numbers, total square footage, total number of cables/drops, types of media, etc.
- D. All installer personnel assigned to this project shall be listed in the qualification questionnaire document. Eighty percent (80)% shall have a minimum of 3 years experience in the installation of the types of systems, equipment, and cables specified in this document prior to this bid. Any personnel substitutions shall be noted in writing to SIGMA HN ENGINEERS prior to commencement of work.
- E. Contractor shall submit evidence of compliance with these requirements prior to beginning work on the project.
- F. Cabling installers shall be trained by manufacturer and certified for Telecommunication Cabling installations and maintenance of specified materials.

#### 1.6 ADMINISTRATIVE REQUIREMENTS AND COORDINATION

- A. Project meetings: Contractor shall provide a person (name, contact phone number and e-mail address) for coordination with Telecommunication Consultant and Owner.
- B. Coordinate work of this section with Owner's telephone system specifications, telephone instruments, workstations, equipment suppliers, and installers.
- C. Coordinate installation work with drop ceiling vendors to coordinate cabling installation time frame in relation to drop ceiling installation. Resolve procedures and installation sequence for both installations. The result of this coordination will be to eliminate as much as possible loss or damage to ceiling materials, associated hardware, and delays to the project. Damage by contractor to the ceiling installation will be remedied at the contractor's expense in a timely manner.
- D. Exchange information and agree on details of equipment arrangements and installation interfaces.
- E. Record agreements reached in meetings and distribute record to other participants, Owner and Telecommunication Consultant.
- F. Adjust arrangement and locations of distribution frames, patch panels, and cross-connect blocks in equipment rooms and racks to accommodate and optimize arrangement and space requirements of any service provider equipment, telephone system, and LAN equipment. Tasks shall be coordinated with owner or his representative, and other trades' installations.

- G. Where installed, confirm exact locations and method of mounting outlets in modular furniture. Follow furniture manufacturers written instructions for cable and installing devices in modular partitions. Obtain modular furniture and power pole locations from General Contractor/Architect. Wiring locations noted in plans along walls for modular furniture are approximate and will have to be determined by contractor at time of installation. Field condition adjustments for installation may have to be made.
- H. When requested by owner or owner's representative furnish extra materials that match specified products and that are factory packaged with protective covering for storage and identified with labels describing contents.

#### 1.7 CONTRACT ADMINISTRATION

- A. Change orders shall be submitted to the consultant/client representative or GC complete with price breakdown and description. No work related to any change order will commence until approved.
- B. The Contractor will attend all scheduled progress meetings with Owner representative, Architect, Telecommunication Consultant and General Contractor. It is possible that all parties may not be represented at every meeting.

#### 1.8 PERMITS AND LICENSE

- A. Contractor shall supply all State, City and County Telecommunication Cabling Permits required by appropriate governing agency.
- B. The Owner or their representative will verify the above and determine any additional requirements.

#### 1.9 ALTERNATES, SUBSTITUTIONS AND CHANGE ORDERS

- A. If the Contractor proposes an alternate material that is equal to or exceeds specified requirements, Contractor shall provide manufacturers specifications in writing to owner/consultant for approval prior to bid.
- B. Contractor shall provide a complete cabling infrastructure according to these written specifications and drawings. If the Owner changes the scope of work to be performed by the Contractor, it shall be in writing. Contractor shall respond to these changes with a complete material list, labor, and taxes in writing presented to the Owner for approval within ten (10) working days. Contractor shall not proceed with additional scope of work without a signed approval by the Owner.
- C. Owner will not pay for any additional work performed by the Contractor without signed approval of these changes. Submit a copy of signed change order upon billing.

- D. A complete price breakdown itemizing all additional material and labor costs shall be submitted to the owner/consultant with the change order.

1.10 CODES AND STANDARDS (REFERENCES):

- A. Codes: Comply with applicable sections of the following for interior and exterior installations. Ensure you are using the latest and most current standards and regulations applicable.

Uniform Building Code (UBC)

International Building Code (IBC)

National Electrical Code (NEC/NFPA 70, 2008)

National Electrical Safety Code (NES IEEE C2-1997)

IEEE Std. 1100-1999 Recommended Practice for Powering and Grounding Sensitive Electronic equipment.

Local Codes, amendments, and ordinances.

- B. Standards: Comply with the most recently published applicable sections of the following for installation and testing of communication cabling and connectors:

ANSI/TIA/EIA-568-B.1-2001: Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.

ANSI/TIA/EIA-568-B.2-1-2002: Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.

ANSI/TIA/EIA-568-B.3-2001 Part 3: Optical Fiber Cabling Components Standard.

ANSI/TIA/EIA-455-A-1991: Standard Test Procedures for Fiber Optic Cables.

ANSI/CEA S83-596-1994: Fiber Optic Premises Distribution Cable.

ANSI/TIA/EIA-526-7-1998: Optical Power Loss Measurements of Installed Single Mode Fiber Cable Plant-OFSTP-7.

ANSI/TIA/EIA-526-14-A-1998: Optical Power Loss Measurements of Installed Multi Mode Fiber Cable Plant-OFSTP-14A.

ANSI/TIA/EIA-569-A-1998: Commercial Building Standards for Telecommunications Pathways and Spaces.

ANSI/TIA/EIA-606-1993: The Administration Standard for the Telecommunications infrastructure of Commercial Building.

ANSI/TIA/EIA-607-1994: Commercial Building Grounding and Bonding Requirements for Telecommunications.

TIA/EIA 758-April 1999: Customer-Outside Plant Telecommunications Cabling Standard.

C. Supervisors and lead installers shall have read the above documents and shall be familiar with the requirements that pertain to this installation. Installers shall be familiar with and have practical working knowledge of the requirements that pertain to this installation. The documents may be obtained from:

1. Global Engineering Documents, 15 Inverness Way East, Englewood, CO, 80112-5776, 800-854-7179, fax: 303-397-2740, <http://global.his.com/>

IEEE-Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY, 10017-2394, 800-678-IEEE, fax: 732-981-9667, <http://standards.ieee.org/>

2. NFPA: 1-800-344-3555- 11 Tracy Drive, Avon, MA 02322-9908

#### 1.11 COMMUNICATIONS ABBREVIATIONS

BICSI: Building Industry Consulting Service International

C/W: Complete With.

CBC: Coupled Bonding Conductor

Div.1: Division 1 General Specifications

~~Div.23: Division 23 Mechanical Specifications-~~

Div.26: Division 26 Electrical Specifications

EMI: Electromagnetic Interference.

GC: General Contractor

HC: Horizontal Cross-Connect.

IC: Intermediate Cross-Connect.

IDC: Insulation Displacement Connector.



I/O: Information Outlet.

LAN: Local Area Network.

MC: Main Cross-Connect.

MDF: Main Cross-Connect (MC).

N/A: Not Applicable.

NIC: Not In Contract.

OTDR: Optical Time Domain Reflectometer

RCDD: Registered Communications Distribution Designer

RFI: Radio Frequency Interference.

SR: Server Room

TBB: Telecommunications Bonding Backbone.

TBBIBC: Telecommunications Bonding Backbone Interconnecting Bonding Conductor

TBC: Telecommunications Bonding Conductor.

TBD: To Be Determined

TGB: Telecommunications Ground Bus Bar.

TMBC: Telecommunications Main Bonding Conductor.

TMGB: Telecommunications Main Grounding Bus Bar.

TR: Telecommunications Room.

UTP: Unshielded Twisted Pair.

#### 1.12 SUBMITTALS:

- A. Product Data: Include Manufacturer's data on features, ratings and performance for each component specified for approval prior to purchase and installation.
- B. Drawings of Record: Shall be in AutoCAD format same version used by Architect/Consultant. Upon completion, submit facility floor plan drawings to consultant and/or owner upon request.

Dimensions and scale of the drawing sheets submitted shall match the size of the drawing used for the contract documents, and shall include the following:

- C. Dimensioned plan and elevation views of networking components including, but not limited to: outlet and raceway location, roughing-in diagrams and instructions for installation. Show access and workspace requirements.
  - 1. One-line diagram of equipment/device interconnecting cabling for the data and voice systems.
  - 2. Standard or typical installation details of installations unique to Owner's requirements.
  - 3. Cable pathways, I/O's, rack numbering, equipment layout and numbering.
  - 4. Submit one soft and one hard copy with project deliverables within 30 days of substantial completion.
- D. Graphic symbols and component identification on detail drawing shall conform to the latest EIA/TIA 568-B, 606 and 607 conventions.
- E. System labeling schedules, including electronic copies of labeling schedules, as specified below, in software and format selected/approved by Owner.
- F. Samples: For workstation outlet connectors, jack assemblies, housing and faceplates for color selection and evaluation of technical specifications and requirements. Confirm with architect/interior designer/Owner representative for color before purchasing materials.
- G. Product Certificates: Signed by manufacturer of cables, connectors, and terminal equipment certifying that products furnished comply with requirements.
- H. Qualification Data: For firms and persons specified in "Quality Assurance" article. Provide evidence of applicable registration or certification.
- I. Field Test Reports: Upon completion and testing of the installed system, test reports shall be submitted in booklet form and electronic media showing all field tests performed on, and adjustments to each/any component and all field tests performed to prove compliance with the specified performance criteria. Indicate and interpret test results in written form and verbally to Owner for compliance with performance requirements.
- J. Contractor will provide maintenance data and manuals for: all products.
- K. Warranty: Deliver manufacturer's sample of 15-year warranty of installed cabling system to include all components that comprise the complete cabling system.

#### 1.13 RESUBMITTING

- A. Contractor must clearly identify any resubmitted drawing sheets, documents or cut sheets either by using a color to highlight or cloud around resubmitted information. Maintain drawing numbering or page/sheet scheme consistency as per previously issued drawings/documents.

1.14 RECORDING AND COPYING TO DRAWINGS OF RECORD (AS-BUILT DRAWINGS)

- A. The build-as drawings shall be developed from AutoCAD (version 2012) drawing files of Communications Design drawings to be supplied by SIGMA HN ENGINEERS or the Architect.
- B. As-built drawing submittals by the Contractor shall be in the same version AutoCAD format, as used by architect and consultant. Unless otherwise specified. This requirement currently is AutoCAD 2011.
- C. The As-built drawings shall incorporate all changes made to the building identified in, but not limited to: Addendum, contemplated change notices, Site Instructions or deviations resulting from site conditions. Utilize normal recognized drafting procedures that match the AutoCAD standards, architect, and consultant guidelines and methodology. The Contractors as-built submittals shall include but not be limited to:
  - D. All communications data/voice outlet locations complete with outlet/cable labeling.
  - E. Cable routing paths of communications cables to identified infrastructure pathways.
  - F. All rack and cabinet locations and labeling there of.
  - G. All plan or elevation view changes to the room layouts.
  - H. Wall Field and patch panel layouts and cable assignments.

1.15 PRE-INSTALLATION CONFERENCE:

- A. Contractor will attend and/or arrange a scheduled pre installation conference prior to beginning any work of this section (Data and Voice cabling).
- B. Requests For Information (RFI): Contractor will submit questions in writing related to work to be performed, scheduling, coordination, etc. with consultant and/or project manager/owner representative.
- C. Attendance: Contractors project manager/supervisor shall attend all meetings arranged by General Contractor, Owner's representatives, and other parties affected by work ~~of this division~~ 26-00-00.
- D. All individuals who will be in an on-site supervisory capacity of installation personnel; project managers, supervisors and lead installers shall be required to attend the pre-installation

conference. Individuals who do not attend the conference will not be permitted to supervise the installation of, or install, terminate, or test communications cables on the project.

1.16 DELIVERY/STORAGE AND HANDLING

- A. Delivery, Loss, Storage, and Protection: All materials and equipment delivered and placed in storage shall be stored with protection from the weather, humidity, and temperature variation, dirt, dust, or other contaminants.
- B. Coordinate deliveries and submittals with the Prime Contractor to ensure an organized timely installation.
- C. Contractor shall be responsible for all handling and control of equipment. Contractor is liable for any material loss due to delivery and storage problems.
- D. No equipment materials shall be delivered to the job site more than three weeks prior to the commencement of its installation. Coordinate with Prime Contractor on location for storage of materials.

1.17 VEHICULAR ACCESS, PARKING AND DELIVERY

- A. Owner shall supply a designated parking location for Contractor to park their vehicles.
- B. Contractor to provide orange safety cones at front and back of vehicles parked in owner assigned space. Vehicles shall be properly identified (labeled) with company logo and registered with general contractor/owner on site.
- C. Owner is not responsible for any material, tools and/or company assets damaged due to theft/pilfering by others.
- D. Provide a clean work area, which includes parking lot free from cable spools, boxes, trash/rubbish etc. Work areas will be cleaned daily.
- E. Coordination with Delivery Company, driver, site address, and contact person will be the responsibility of the Contractor.
- F. Contractor is responsible for prompt material deliveries to meet contracted completion date.

1.18 PRODUCT STORAGE REQUIREMENTS AND SITE ACCESS

- A. Owner/General Contractor will assign a location or room to store telecommunication materials.
- B. Contractor is ultimately/exclusively responsible for loss and/or damage to materials.
- C. Contractor will have access to this site between the hours of 7am to 5pm. Monday thru Friday.

- D. Extended work hours: If the Contractor desires to work after hours or weekends, Contractor shall provide a work schedule complete with dates, times, and individuals names to the Owner/General Contractor for approval.
- E. Contractor will comply with provisions of Owner/General Contractor supplied list of job site security requirements.

#### 1.19 PROJECT/SITE CONDITIONS

- A. For all environmental recommendations, Refer to Master Architectural section.
- B. For all security recommendations, Refer to Owner/General Contractor.
- C. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.
- D. Contractor shall provide a clean work environment, free from trash/rubbish accumulated during and after cabling installation. Work area will be cleaned daily.
- E. Contractor shall keep all liquids (drinks, Sodas, etc.) off finished floors, carpets, and tiles. If any liquid damages finished surfaces, Contractor shall provide professional service to clean or repair scratched/soiled finishes at their own expense.

#### 1.20 EMERGENCY FACILITIES AND SAFETY

- A. Contractor shall provide a minimum of two persons trained and certified in CPR and present during the cabling installation project. Provide CPR certification to Owner upon request.
- B. Contractor shall conduct regular scheduled safety meetings within their team and/or coordinate same with GC on site. Contractor shall comply with all safety standards set by the GC.
- C. All of the Contractor's vehicles on site shall be equipped with fire-retardant canister and first aid kit.
- D. Contractor shall provide a minimum of one person equipped with a cell phone for emergency 911 calls and/or communications to local/main/central office safety staff. Designated person shall be on site at all times when work is being performed.
- E. Communications contractor to coordinate other safety procedures with General Contractor and/or owner representative on site.

#### 1.22 SCHEDULING

- A. Construction schedule will be determined on a later date by General Contractor/Architect/Owner and/or communication consultant. Refer to master Architectural specifications.

#### 1.23 ACCEPTANCE

- A. Once all work has been completed, test documentation has been submitted, and Owner is satisfied that all work is in accordance with contract documents, the Owner shall notify contractor in writing of formal acceptance of the system.
- B. Contractor must warrant in writing that 100% of the installation meets the requirements specified herein (Standards Compliance & Test Requirements).
- C. Notification of the likelihood of a cable exceeding standardized lengths must be made prior to installation of the cable. Designer/consultants and Owners may agree to allow certain cabling runs to exceed standardized performance criteria (e.g. length). If it is decided to allow the designated cable to exceed standardized lengths, such runs shall be explicitly identified and excluded from requirements to pass standardized tests. Tests for wire mapping, open, shorts, and grounds shall be made if other tests are waived.
- D. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation soft and hard copies as described herein.

#### PART 2– PRODUCTS

##### 2.1 WARRANTY AND CONDITIONS:

- A. Contractor shall provide a minimum one (1) year warranty on installation and workmanship.
- B. All materials are to be new and unused.
- C. Pre-installation inspection:
  - 1. Visually inspect all cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport. Visibly damaged goods are to be returned to the supplier and replaced at no additional cost to the Owner.
- D. All Contractors must be Manufacturer Certified and employ installers capable of an installation that falls under Manufacturer's guidelines necessary to obtain a minimum 15-year Manufacturer's Warranty.

2.2 ACCEPTABLE MANUFACTURERS:

A. Only manufactures offering certified partnered system solutions for structured cabling, that carry a full manufacturer warrantee will be accepted.

B. Products:

1. Campus Copper Backbone (indoor/outdoor rated PE rated 22AWG):

a. PANDUIT

2. Copper Riser Cable, Plenum rated:

a. PANDUIT

3. Horizontal Category 6 UTP, Plenum Rated, Blue in Color (Data)

a. PANDUIT

4. Horizontal Category 6 UTP, Plenum Rated, White in Color (Voice)

a. PANDUIT

5. Caterogy 6 Patch Panels (Recessed Rack Mountable - Data):

a. PANDUIT

6. Caterogy 6 Patch Panels (Recessed Rack Mountable - Voice):

a. PANDUIT

7. Category 6 UTP Patch Cords (Data 5-foot Telecommunication Rooms white for voice and blue for data)

a. PANDUIT

8. Category 6 UTP Patch Cords (7-foot Workstations white for voice and blue for data)

a. PANDUIT

9. Cross-Connect wire

a. PANDUIT

10. Racks with vertical and horizontal cable management.

a. PANDUIT

11. Horizontal and vertical cable runway

a. PANDUIT

12. Above Ceiling Cable Supporting Hardware.

- a. PANDUIT
13. Labeling:
- a. Horizontal cabling: PANDUIT
  - b. UTP Patch panels: PANDUIT
  - c. Riser Cabling: PANDUIT
  - d. Conduits/Trays: Caddy-ERICO International
14. Corridors and other areas as indicated on drawings. (No more than twenty-four-4 pair UTP Category 6 cables shall be installed in each J-hook).
- a. PANDUIT
15. Fire Stop systems (All Wall Sleeves)
- a. Specified Technologies Inc. (SPI-Easy Path Products)
16. Grounding bus bars:
- a. Harger BICSI Pattern Telecommunications Ground Bar Kits
  - b. Chatsworth BICSI & ANSI/EIA/TIA Grounding Bus-bars
17. Building Entrance Protection Terminators (BET): 110 in/out w/ five pin protection modules for all in-coming pairs
- a. Circa Enterprises Inc.
  - b. Porta Systems Corp.
- 2.3 IDENTIFICATION PRODUCTS:
- A. Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.
  - B. Provide transparent plastic label holders and 4-pair marked colored labels.
  - C. Install colored labels according to the type of field as per TIA/EIA color code designations.
  - D. Use TIA/EIA designation strip color-code guidelines for voice, data, cross-connect, riser, and backbone fields.
- 2.4 FIRE STOP PROCEDURES:
- A. Provide fire resistant intumescent materials to restore fire ratings to all wall, floor or ceiling penetrations used in the distribution and installation for this communications cabling system.
  - B. Seal all penetrations through fire-rated barriers created by or made for or on behalf of the contractor to prevent the passage of smoke, fire, toxic gas, sound or water through the penetrations either, before, during or after a fire.



- C. Fire stop materials shall be installed per manufacturer's instructions, be UL listed for intended use, and meet current NEC and local codes for fire stop measures.
- D. The fire stop material chosen shall be distinctively colored to be clearly distinguishable from other materials, adhere to itself, and remain resilient and pliable to allow for the removal and/or addition of cable without the necessity of drilling holes in the material.
- E. Provide and install removable, intumescent, fire-stop pillows in an approved fashion in all openings greater than 4 inches.
- F. Provide and install manufacturer-approved methods for securing pillows.
- G. Coordinate fire stop material, methods of installation, installation schedule, color, etc. with general contractor and electrical contractor on site.
- H. Fire Stop Labeling: The contractor shall label each fire-stopped penetration with the following typical label;

!! WARNING!!  
\_\_\_\_\_ Hour Rating  
FIRE STOP SEAL  
DO NOT DISTURB

NAME OF CONTRATORS COMPANY: PHONE# - \_\_\_\_\_

INSTALLER - \_\_\_\_\_ DATE - \_\_\_\_\_

SUPERVISOR - \_\_\_\_\_ DATE - \_\_\_\_\_

TESTING

2.5 ACCESSORIES

- A. The Contractor shall mount one hard copy, in color, 36" w x 24" h of a floor plan, clear plastic laminated, serving each communication room. Install the One-line drawings within a protective Plexiglas encasement on the wall of the mechanical room 113. The Plexiglas encasement shall be in either flip-down format or file folder format for ease accessibility.

2.6 TEST RESULTS AND AS-BUILTS:

- A. Contractor shall provide test results in soft copy for each cable with the date and time of testing shown. Copies shall be provided on CD. Copies shall be in MsOffice 2007 spreadsheets.
- B. Provide a minimum of two (2) hard copies of the above mentioned test results.

- C. Contractor shall submit the approved and complete master "As-Built" drawing package in both hard and soft copies to the Owner and SIGMA HN ENGINEERS. The copies shall be in the same release of AutoCAD as provided by consultant and shall comply with drawing symbols, text styles, layering standards, drawing practices, etc. as set forth in consultant supplied files.
- D. Provide a minimum of two (2) hard and soft copies of the as-builts.

## 2.7 QUALITY CONTROL

- A. Materials: All materials shall be UL and/or ETL approved and labeled in accordance with NEC for all products where labeling service normally applies.
- B. Materials and equipment requiring UL 94, 149 or 1863 listing shall be so labeled. Modification of products that nullifies UL labels is not permitted.
- C. All material and equipment as provided should be the standard Commercial-Off-The-Shelf (COTS) products of a manufacturer engaged in the manufacturing of such products. All shall be typical commercial designs that comply with the requirements specified. All material and equipment shall be readily available through manufacturers and/or distributors.
- D. All equipment shall be standard catalogued items of the manufacturer and shall be supplied complete with any optional items required for proper installation.
- E. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections of optimum future performance and backward compatibility.
- F. Expansion Capability: Unless otherwise indicated, provide spare conductor pairs in cables, positions in patch panels, cross connects, and terminal strips, and space in cable pathways and backboard layouts to accommodate 20 percent future increase in campus distribution and active workstations.
- G. Backward Compatibility: The provided solution shall be backward compatible with lower category ratings such that if higher category components are used with lower category components, the basic link and channel measures shall meet or exceed the lower channel's specified parameters.
- H. Component Compliance: The provided solution's components shall each meet the minimum transmission specifications listed herein such that no individual component will be less than specifications for permanent link and channel, regardless of the fact that tests for link and channel ultimately meet required specifications.
- I. In the event of a breach of the representations and warranties contained herein, the Contractor, at their own expense, shall take all measures necessary to correct and make the cabling system work in compliance with the applicable manufacturer written technical recommendations and standards.

## PART 3– EXECUTION

### 3.1 OBJECTIVE

A. The objective of this agreement is to provide a complete communications system cabling infrastructure installation for backbone, riser, cable protection, and horizontal data and voice wiring with attendant terminations, mounting equipment, materials, testing and other items as specified in drawings, these specifications, and contract documents.

### B. COORDINATION AND COMPLIANCE

1. Contractor shall coordinate data/voice outlets, locations of cable tray, racks, etc. with the Architect, electrical, mechanical consultant drawings/documents before installation.
2. Contractor shall call for any inspections required by public agencies having jurisdiction in the area. Final payment of this contract will not be made until final inspections have been completed and all deficient items noted have been corrected.
3. The Contractor shall be responsible for complying with all local, state and federal laws or regulations applicable to the work to be performed, although said law; rule or regulation is not identified herein.
4. The contractor is responsible for any remaining construction materials; refuse within the area of work, and daily cleaning of the work area.
5. The Contractor will cooperate and coordinate with General Contractor and owner's representative to ensure the timely progress of all work.
6. Coordinate items or equipment components related to this project provided by the owner. Refer to section "Work and Material by Others" Items furnished by owner, installed by contractor: Communications contractor shall request of owner at the start of rough in any equipment not listed in this RFP to be installed by contractor.
7. Contractor shall be responsible for coordination with all trades, to include required scheduling of materials and/or equipment with Owner or general contractor for delivery and protection of equipment as required.
8. Refer to manufacturer's installation specifications and procedures for work to be accomplished by Contractor. The installation of cable, equipment, and materials will conform to manufacturer's specification to insure manufacturer's full warranty is in effect.
9. Contractor shall be responsible for review of all drawings of record to verify service requirements for proper installation of items.

10. The Contractor shall assume custody and responsibility for the items upon delivery and for determining that the contents are complete and in satisfactory condition for installation.
11. Salvage: Unless indicated otherwise, all items that must be removed due to interference with work of this contract remain the property of the Owner, and are to be salvaged at the Owner's discretion.
12. Remove all redundant (other) items from site at Contractor's expense.
13. Report percentage of work completed on a weekly basis.

### 3.2 EXAMINATION

- A. Examination of building and site shall be the responsibility of the Contractor: Contractors shall examine site and building as required prior to quoting to determine any conditions affecting the work. Contact Owner for arrangements.

### 3.3 CABLE PLANT OVERVIEW

- A. Contractor shall provide all labor and material for a complete Telecommunications Cabling Infrastructure (Fiber and Copper Cabling, Termination Hardware, Information Outlet, Testing, Labeling, and Warranty).
- B. Horizontal: Copper – Blue sheath four (4) pair Category 6 cable for data and White sheath four (4) pair Category 6 cable for the second voice/data. Terminate all (blue and white) horizontal work area as indicated on plans. The 12 port patch panels shall have 110 IDC terminations on the back and modular 8-pin/8-position RJ type jacks on the front. Terminate the horizontal cabling using the T-568B wiring scheme. See communications construction drawing for typical detail.
- C. Workstation I/O: See construction drawings for detail.

### 3.4 COMMUNICATIONS EQUIPMENT

- A. Provide a minimum of two (1) freestanding heavy-duty APC Rack as shown on plans.
- B. Brace and secure top of racks with appropriate hardware per manufacturer specifications. Racks will be secured to floor with a minimum of four ½" hex screws, flat washers, lock washers and anchors.
- C. Attach grounding lugs to each rack, cable raceway, conduit, etc. in the work room.

### 3.5 VOICE TERMINATION BLOCKS

- A. Provide Category 6/110 termination blocks for rack-mounted voice riser cable termination, complete with labeling strips, bracket kit, distribution rings, etc.

### 3.6 CABLE LADDER RACK

- A. Refer to Communications drawings for location and size of each runway. Securely attach to wall studs (and racks if applicable) with support brackets, complete hardware components in accordance with manufacturers written instructions.
- B. Cable runway radius Bend: Per manufacturers/NEMA specifications.
- C. Use cable runway E-Bend 12" or equivalent where required: Refer to drawings.
- D. Contractor shall provide all connection, supporting and grounding hardware for a complete overhead cable runway system.

### 3.7 CABLE SUPPORT STRAPS, POWER STRIPS AND RACK MOUNT UPS

- A. Provide hook and eye type (Velcro) cable management straps for horizontal (voice/data) cables: Provide sufficient quantities to wrap all cable at minimum 6 foot intervals.
- B. Use proper methods for routing and securing backbone, and riser cables in a neat, secure manner. Securely retain the cable bundle with Tak-Tape cable ties.
- C. If provided mount one 6-outlet horizontal power protection strip for each rack c/w surge protection. Refer to communication drawings rack details.
- D. Furnish and install rack mounted Un-interruptible Power System, (UPS) in each Rack (Minimum of 3 Kw) coordinate location, type, and rating of receptacle with Div-16. Refer to communication drawings rack detail.

### 3.8 COPPER PATCH CORDS

- A. Copper: Provide equal amounts of blue 5 foot Category 6 patch cables for 75% of the terminated horizontal data cables in the telecommunications rooms. Patch cables shall be from the same manufacturer as the structured cabling system. Coordinate with owner/consultant prior to procurement.
- B. Provide equal amounts of blue 7 foot Category 6 patch cables for 75% of the terminated horizontal cables at the work areas. Patch cables shall be from the same manufacturer as the structured cabling system. Coordinate with owner/consultant prior to procurement,

### 3.9 GROUNDING

- A. Provide compression type ground lugs for each 19" rack or cabinet. Rack shall be grounded to wall mounted ground bus bar using #6 AWG stranded, insulated copper conductor. Furnish all required bonding material and hardware; follow NEC / ANSI/TIA/EIA -607 manuals for bonding procedures and specifications.
- B. Ground all Telecommunication hardware inside all communication rooms and wall mounted cabinet areas like, but not limited to: cable ladder, conduit, equipment racks, protection units and shielded cabling with #6AWG stranded insulated cable.
- C. Ground all Building Entrance Terminal equipment per manufactures specifications.

### 3.10 PLYWOOD BACKBOARDS

- A. Provided by General Contractor ~~and/or Division 26-00-00~~, 8'H x 4'W x ¾"T vertically hung, grade AC, plywood in MC/TR rooms as indicated on plans. Paint plywood backboards with two coats of fire retardant white or light gray paint. Coordinate with Architect, Prime Contractor, ~~Division 26-00-00~~ and Owner for installation of backboard. Refer to drawings for proposed location and details.

### 3.11 MAIN DISTRIBUTION FRAMES AND SERVICE ENTRANCES

- A. Entrance: Protection related hardware. Contractor shall coordinate location/placement of hardware to be mounted on plywood backboards with Owner and service provider before mounting hardware to insure proper layout and requirements. Coordinate with owner's representative and service provider prior to purchase and installation to verify need.
- B. Provide secondary protection modules (110-in/out type) for all incoming pairs at both termination points, complete with solid-state 5 pin protector modules. Securely attach protector housing to wall mounted plywood backboard. Refer to communications drawings for proposed location.
- C. Provide 12 pair cable whips between protector unit and termination block for voice cross-connection. Coordinate with service provider.
- D. Ground Protection unit to ground bar with #6AWG stranded insulated wire.
- E. Ground Duct Rated Cable with a B-Bond clamp and #6AWG stranded insulated cable to ground bus bar within 50 feet of entering the building.

### 3.12 INTERIOR COMMUNICATION PATHWAYS

- A. Cables shall be neatly bundled along common paths. Maximum number of cables per bundle shall be determined by supporting hardware manufacturer recommendations.
- B. Use only pathway and spaces designed for telecommunications.
- C. Provide a minimum of 20% spare capacity in all vertical/horizontal chases.
- D. Mechanical and power separation. Install communications cabling:
  - 1. Minimum of 3 feet from electrical panel boards, photocopier.
  - 2. Minimum of 6 inches from fluorescent fixtures
  - 3. Minimum of 6 feet from electrical motors.

### 3.13 CONDUITS

- A. All information outlets shall have a minimum of one 1" conduit provided from the recessed deep box to the nearest "Zone" pull box or to within 18 inches of the closest cable tray. (By Div.16)
- B. There shall be a maximum of two (2) 90° degree bends per conduit run, between any two adjacent pull boxes.
- C. No conduit run shall exceed 100 feet between pull boxes.
- D. ~~Division 26-00-00 shall p~~rovide conduit path (sleeves) where cabling passes through fire rated walls\deck\slab. Seal penetration with intumescent fire-stop material that matches the rating of the surface penetrated. Coordinate fire stopping with ~~Division 26-00-00 and~~ general contractor on site.
- E. ~~Division 26-00-00 shall s~~ecure conduit sleeves with minimum 12" long "Uni-strut" or equivalent (support) channel at both sides of wall. Complete installation with "Uni-strut" or equivalent conduit retaining straps sized for the conduit being installed.
- F. ~~Division 26-00-00 in e~~Coordination with architect and general contractor shall provide accessible entry and exit points in all vertical and horizontal cable chases so as to provide working space to install and maintain cable infrastructure.
- G. Do not install communication cables in conduits until all bushings/couplers are installed on the ends of the conduits.
- H. Contractor shall ground all incoming communication conduit/tray into the MC and TR rooms with minimum #6 AWG green insulated jacket, copper conductor.

3.14 SURFACE MOUNT RACEWAY, TELECOMMUNICATION, AND PACK POLES

- A. If used system furniture vendor shall supply vertical telecommunication and power pack (power pole) between modular furniture and drop ceiling. This will ensure capacity, color matching and installation continuity for modular furniture.
- B. Contractors to confirm exact locations and methods of mounting outlets in modular system furniture.

3.15 CABLE SUPPORT HANGERS AND FIBER SUPPORT HANGERS

- A. Cable Saddles and J-hooks: Cable Saddles or "J"-Hook cable support systems for horizontal cabling shall be installed. Refer to drawings for requirements.

All horizontal cabling shall extending from the offices to the corridors shall be in continuous conduit complete with bushings and connecting hardware from the I/O to within 18 inches of the cable runway system (Div 26 00 00).

- B. Provide threaded rod and/or # 8AWG wire for supporting hangers when hanging conduits/trays, etc. from floor deck or deck members. Refer to manufacturers' recommendation for proper installation, sizing, and loading of hangers.
- C. Minimum 1/2" diameter threaded rod or equivalent and "Uni-strut" or equivalent channel shall be used for hanging cable runway from floor deck or deck members. Follow manufacturer recommendations and standards. Refer to communications drawings for details.
- D. Cables shall be neatly bundled using hook and eye (Velcro) type cable straps along common paths. Maximum number of cables per bundle shall not exceed twenty-four 4 pair UTP.
- E. Layout cable runs in advance to determine quantities of cable to be installed along pathways, and to insure non-interference from other trade installations.
- F. Maximum-stacked height of cable installed in cable runway shall not exceed 2-1/2". Increase width of runway or provide additional runs of cable runway where required to fulfill requirements.
- G. Do not support cables from or lay on ceiling suspension system. Do not use electrical, plumbing, or other pipes for support. Cable supports shall be permanently anchored to building structure or substrates. Provide attachment hardware and anchors designed for the structure to which attached, and that are suitably sized to carry the weight of the cables to be supported. Confirm with Architect and/or Prime Contractor on installation procedures for Cable Support System prior to implementation. No exceptions.
- H. Secure and support exposed horizontal cable at intervals not exceeding 4ft and not more than 18 inches from cabinets, pack poles, boxes, fittings, outlets, racks, frames, and terminals. The



exception is in a vertical drop into a pack pole above a drop ceiling where the distance between supports shall not exceed 4ft.

- I. Support vertical fiber optical cable with Basket weave wire/cable grips – Hubbell #022-29-X or equivalent. Support fiber riser with single weave support grip with a single offset eye. Mount/attach pulling eye to a wall or ceiling deck secured hook to support and provide strain relief to riser cable. Provide a minimum 36” loop of fiber prior to entering fire stopped floor sleeve.
- J. Where pull is required coil up slack fiber cable into pull box and secure with single weave support grip. Refer to communications drawings.

### 3.16 CABLE CLEANER AND CABLE PULLING LUBRICANTS

- A. Cable cleaners and/or lubricants shall be materials designed and manufactured for telecommunication cabling use.

### 3.17 HORIZONTAL CABLING REQUIREMENTS

- A. Provide all necessary installation materials, hardware, tools and equipment to perform insulation displacement type terminations at all data outlets, patch panels, and voice termination materials. Furnish quantities required to terminate all UTP horizontal cables plus percentage.
- B. Cabling Method: Provide cabling in acceptable spaces, cable tray, (surface and/or enclosed raceway), or conduit, cable support system. Within consoles, racks, cabinets, desks, and counters, in accessible ceilings spaces and in gypsum board partitions where open cable method may be used. Use UL or ETL listed plenum rated cable in all spaces. Conceal raceway and cabling except in unfinished spaces.
- C. Utilize conduits/cable runway as indicated on the drawings. All data and voice cables will be routed in a neat and orderly fashion. No cable ties or wraps shall be used to secure the cables in the runway outside of the MC and TR's.
- D. Examine pathway elements intended for cable. Check raceways and other elements for compliance with space allocations, installation tolerances, debris, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Horizontal cabling when exiting runway and/or conduit shall thereafter be supported with

approved materials and space supporting hardware to maintain performance characteristics.

- F. Install cable using techniques, practices, and methods that are consistent with specified data cabling and the installed components and that insure specified performance levels of completed and linked signal paths, end to end.
- G. Cable bundles brought into the MC/TR shall be routed and dressed in such a manner that prior to termination the cables are not subject to damage and misuse such as installers walking on the bundles that are lying on the floor.
- H. Cable Pulling shall not exceed 25lbs of pulling tension typical.
- I. Install Cables in continuous lengths from communications outlet to specified patch panels for data and termination blocks for voice.
- J. Pull cables in smooth and regular motions using methods that prevent cable kinking.
- K. Keep all items protected before and after installation with dust and moisture proof barrier materials/envelopes. If wiring is terminated on patch panels, data, voice jacks prior to painting, carpet installation, and general finish clean up, these jacks shall be placed in a protective envelope to insure dust, debris, moisture, and other foreign material do not settle onto jacks' contacts. Envelope will be removed on final trim out after other trades have finished their finish work. It shall be the contractor's responsibility to ensure the integrity of these protective measures throughout the life/installation of the project.
- L. Do not bind cables tightly together with tie or other wraps. Wraps shall slip loosely around cables. Use Velcro wraps instead of cables ties for all cable bundling in the MC and TR's.
- M. Pull cables without exceeding cable manufacturer's recommended pulling tensions
- N. Pull cables simultaneously if more than one is being installed in the same raceway/pathway.
- O. Use pulling compound or lubricant if necessary. Use compounds approved for lubricating telecommunications cabling that will not damage conductor or insulation.
- P. Use pulling means; including fish tape, cable, rope, and basket weave wire/cable grips that will not damage media or raceway.
- Q. Install open cabling parallel and perpendicular to surfaces or structural members following surface contours where possible. Cables shall be run above other ducts, pipes, and other installations. Provide surface mount raceway to protect all exposed cabling from damage, confirm with owner for color and manufacture style. No exception for exposed cabling runs.
- R. Use no flat or under carpet communications cabling (UTC) without prior written permission of owner or communications consultant.

- S. Separation of Wires: Comply with EIA/TIA-568-A rules for separating unshielded copper communication and data-processing equipment cables from potential EMI sources, including electrical power lines and equipment.
- T. Maintain a minimum spacing of 18" from electrical feeders and/or branch circuit wiring.
- U. Maintain a minimum spacing of 12" from auxiliary systems cabling.
- V. Maintain a 1" separation where UTP cables must pass perpendicularly to electrical, plumbing, or other wiring, conduit, or piping systems. Use non-conduit bushings, if necessary to maintain separation, which allow for the addition of a reasonable number of cables in the future.
- W. Maintain communications pathways away from electrical apparatus such as motor driven equipment and transformers, minimum separation distance of 10'-0" is recommended.
- X. Terminate horizontal cables in consistent consecutive order. Arrangement of cables on patch panels and voice termination hardware shall be in ascending order of room numbers and outlet numbers within rooms. Numbering shall start at the left of the main door to the room and continue in a clockwise direction around the room. That is, start the wire termination on patch panels and blocks with the cables that are the lowest room number, and place them in the first patch panel and port number. In any building for example, a room 100 would be terminated first; room 101 would be terminated second, etc. The cables within the room will be terminated starting with the cables located to the left of the main door to the room and continue around the room in a clockwise direction.
- Y. Provide 6" service loop for horizontal cables at I/O's. Locate service loop neatly with in outlet box. (Typical)
- Z. Maintain twists in cable pairs to within ½" of termination.
- AA. Group all specialty cables such as the pay phone cables, which do not have their own termination hardware, in one group, clearly labeled as to cable number and function, in the last positions on the horizontal cabling blocks in each MC/TR.
- BB. Limit cable-bending radius to 20 times the cable diameter during installation, and 15 times the cable diameter after installation.
- CC. Use cable acceptable for installation as "Open cabling" in spaces used for environmental air handling (plenum) when installed in accordance with NEC Article 300-22.
- DD. All Data and Voice wiring shall be terminated in TIA/EIA wiring configuration T-568-B unless Owner/Consultant indicates another termination scheme.
- EE. All horizontal cables shall have an installed length less than 90 meters (295 ft.).

FF. Communications Outlet Assemblies:

1. Provide quantity to support locations specified on drawings.
2. Verify color with General Contractor/Owner prior to purchase.
3. Acceptable Manufactures: refer to approved manufacturer list.
4. Wall Information Outlet Jacks: refer to approved manufacturer list.
5. Data: Blue Category 6 T-568-B wire scheme 8-pin 8 pos modular jack.
6. Voice (second data): White 6A T-568-B wire scheme 8-pin 8 pos modular jack.
7. Lighting Control (nLight Lighting Control System): Yellow 6A T-568-B wire scheme 8-pin 8 pos modular jack.
8. Lighting Control : Furnish and install Face Plates-Single Gang 2 port faceplates at each power pack. (unless otherwise indicated in the construction documents). - Provide Blank inserts as needed.
9. Face Plates-Single Gang 2 port faceplates (unless otherwise indicated in the construction documents). - Provide Blank inserts as needed.
10. Floor Information Outlets Jacks: refer to approved manufacturer list.

GG. The cable manufacturer shall test, and provide with each 1000ft. spool/box of horizontal cabling, a factory certified test report guaranteeing each spool/box complies with the electrical performance of the specified Category cable.

HH. Modular System Furniture: Contractor shall supply voice and data termination in Modular System Furniture and/or Custom Built Furniture complete with mounting bracket. Refer to architectural drawings for locations and details if applicable.

3.18 HORIZONTAL COPPER DATA TERMINATION

- A. Provide Horizontal UTP, Category 6, 4-pair, #24 AWG, 350MHz, Plenum Rated Cable: Use one manufacturer only to maintain cable/components. Warranty-shall meet or exceed latest EIA/TIA specifications.
- B. Provide rack mounted Termination Patch Panel (data); Category 6 Patch Panels. They shall be RJ-45 modular jack to 110-type printed circuit board style patch panels, 48 ports as needed. Furnish units that adhere to the performance requirements of ANSI/TIA/EIA-568-B standards, utilizing the wiring termination scheme T-568-B.

- C. Provide rack mounted Termination Patch Panel (nLight lighting Control); Category 6 Patch Panels. They shall be RJ-45 modular jack to 110-type printed circuit board style patch panels, 48 ports as needed. Furnish units that adhere to the performance requirements of ANSI/TIA/EIA-568-B standards, utilizing the wiring termination scheme T-568-B.
- D. Horizontal Cable: The cable jacket shall be printed with a minimum of the following information: Category specified performance marking, Manufacturer, Manufacturer's part number, cable type, listing file number, number of pairs, listing type (i.e., CMP), and sequential footage markings.
1. Cable shall be UL or ETL listed type CMP, TIA/EIA Category 6 with blue outer jacket for the first work area termination (left most jack) and white for the second cable (right most jack) to the same work area termination. Work areas that have terminations in excess of two cables the contractor shall alternate the cables colors accordingly. Refer to drawings for additional detail.
  2. Conductors shall be UTP of a gauge that complies with the Category 6 standard, and have 4 Pairs of solid copper conductors.
  3. All Internal conductors insulation composition shall be of Dupont® Teflon FEP Fluoropolymer resin.
  4. Color-coding shall match TIA/EIA 568-B standards.
  5. Cable shall be listed in the UL or ETL Verified LAN Cable Products Directory. Cable shall meet all tests for current Category 6 specifications.

### 3.19 HORIZONTAL COPPER VOICE TERMINATION

- A. Horizontal Cables for Voice Service: Use Plenum rated UTP cables complying with Category 6 of EIA/TIA-568-B for runs between mechanical room and work room and I/O's.
1. Cable shall be UL or ETL listed type CMP, TIA/EIA Category 6 with white (second cable, right most jacks) outer jacket.
  2. Conductors shall be UTP of a gauge that complies with the Category 6 standard and have 4 Pairs of solid copper conductors.
  3. All Internal conductors insulation composition shall be of Dupont® Teflon FEP Fluoropolymer resin.
  4. Color-coding shall match TIA/EIA 568-B standards
  5. Cable shall be listed in the UL or ETL Verified LAN Cable Products Directory. Cable shall

meet all tests for current Category 6 specifications.

- B. Terminate horizontal voice cables into rack mounted 48 port Category 6 patch panels using the T-568B wiring scheme without damaging twisted pairs or jacket.
- C. Wall Mounted Telephone Faceplates: Provide Stainless Steel faceplate with integral 8-pin, 8-position voice jack wired in accordance with the T-568-B wiring designation for the termination of Voice UTP cables specified herein.
- D. Provide one voice cable to elevator'(s) voice cabling terminal(s) in this building. Coordinate with elevator installer, and client representative. Consult with General Contractor on location of terminus point and length of cable. Clearly, identify elevator-wiring locations on voice termination hardware in MC/TR's, and on documentation of record. Terminate cable in the last position on the horizontal blocks.
- E. An additional 4 pair UTP Category 6 horizontal copper cable may be required for 911 emergency connectivity. Coordinate exact requirements with General Contractor and security consultant/contractor and termination location on site.
- F. Contractor shall install one Voice 4-pair Category 6 UTP copper cable for each pay phone (public phone) location. Confirm exact requirements with client and network consultant on a later date. Phone, shelf, booth and furniture provided by others.

### 3.20 DATA PATCH CORDS

- A. Copper: Provide Category 6 data patch cords in lengths and quantities as specified by Owner/consultant. Verify prior to purchase. Category 6 patch cords will be of the same manufacturer as the Category 6 horizontal data cable.

### 3.21 VOICE PATCH CORDS

- A. Patch cords at workstations: Provided by others.
- B. Others shall provide voice cross-connection at the work and mechanical rooms.

### 3.22 ADMINISTRATION, TESTING, AND IDENTIFICATIONS

- A. These specifications will be strictly enforced. The contractor must verify that the requirements of the specifications are fully met through testing, active data throughput, and documentation as specified below. This includes confirmation of requirements by demonstration, testing and inspection. Demonstration shall be provided in final walk-through and in soft and printed test data. If part or all pairs of cable do not meet specifications contained in this document, the cable shall be replaced at contractor's cost.

- B. Test Plan: provide a complete and detailed test plan for the cabling system specified herein including a complete list of test equipment for UTP and light guide components and accessories. Include procedures for certification, validation, and testing. Furnish factory reel tests for all cable. Owner will require that the Telecommunications Cabling System installed by the contractor be fully certified to meet all necessary requirements to be compliant with referenced IEEE and EIA/TIA specifications.
- C. Testing Agency: Contractor will engage a qualified testing agency to perform field quality control testing. This 'agency' may be Contractor's personnel if the manufacturer of the testing equipment certifies them to conduct the required tests.
- D. Correct malfunctioning units at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.
- E. Contractor will complete all work and documentation according to manufacturer guidelines to insure manufacturer's warranty remains in effect. Contractor shall obtain certificates from manufacturer attesting to warranty being in effect and include certificates with other deliverables due at the completion of the project.
- F. Owner reserves the right to be present during any or all of testing.
- G. Standards Compliance & Test Requirements: Cabling must meet the indicated performance specifications: TIA/EIA 568-A and TIA/EIA TSB-67 Category 3, TIA 568-A Category 6 or latest.

### 3.23 DATA AND VOICE TESTING (COPPER)

- A. Testers shall be calibrated by factory at factory recommended intervals. Produce documentation to validate compliance.
- B. Testers shall be a minimum of a class 2 (level IIe), bi-directional, and Category 6 tester.
- C. Testers shall be capable of reporting data at all measured points and uploading the data to a printer PC/Printer.
- D. Serial number of tester shall be included with the test results.
- E. Test cords shall be new factory manufactured leads.
- F. No test leads shall be used for greater than 1,000 tests, or the maximum number of tests recommended by manufacturer. Follow manufacturer's recommendations. Produce documentation on manufacturer's testing procedures and recommendation. Provide documentation on conformance with manufacturer testing procedures.
- G. Use test leads/patch cord factory made that are "tuned" to test the particular manufacturer's

cabling system used for permanent link tests.

- H. Certify that tester's software has been updated within the last 30 days prior to testing
- I. Testers shall be capable of testing at a minimum to the following levels at 100 MHz and comparable measures at 250, 350 and 500 MHz:
- J. Use only approved UTP/Fiber test equipment: Microtest Omni Scanner, Fluke DSP 400, or Agilent/HP Wirescope 350 OR (LATEST MODEL).
- K. Tester Parameters: Comply with the following table:
  - A. Testing on all horizontal/riser and inter-building copper cabling shall be of the Permanent Link type. However, Contractor shall warrant performance based on Channel performance and if required provide patch cords that meet channel performance criteria.
  - B. The permanent link consists of up to 90 m (295 ft) of horizontal cabling and one connection at each end and may also include an optional/consolidation point connection (CP).
  - C. All cabling not tested strictly in accordance with these procedures shall be re-tested at no additional cost to the Owner.
  - D. 100% of the installed cabling must be tested. All tests must pass acceptance criteria defined in applicable EIA/TIA 568-C.2 Category 6 standard.
  - E. Test equipment shall be fully charged prior to each days testing.

### 3.24 COPPER VOICE TESTING

- A. Copper Cable Procedures: Inspect all cabling for physical damage and test each conductor signal path for continuity, shorts to ground, wire mapping, line loss, and shorts. Test for faulty connector splices, and terminations. Voice cabling rated at Category 6 and Category 6 shall be tested as per data testing specifications.
- B. Each pair of Riser copper cable shall be tested for standard wire mapping, continuity, opens, shorts, and grounded pairs. Record and deliver all tests in paper and electronic media.
- C. Correct malfunctioning units at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest. Any subsequent failures noted in the retesting of all cable plant shall be corrected as noted above
- D. Contractor will complete all work and documentation according to manufacturer guidelines to insure manufacturer's warranty remains in effect. Contractor shall obtain certificates from manufacturer attesting to warranty being in effect and include certificates with other deliverables due at the completion of the project.



### 3.25 PATCH CORD TESTING

- A. Provided patch cords shall be new, tested to manufacturer specifications listed and come with full manufacturer factory warranty.

### 3.26 LABELING

- A. System: use a unique, four syllable alphanumeric designation for each cable, and label cable, jacks, connectors, and terminals to which it connects with the same designation. The following is an example of such a labeling system:

1. First syllable identifies and locates wiring closet or equipment room and floor where cable originates.
2. Second syllable identifies and locates cross-connect block-column or rack number in which the cable terminates.
3. Third syllable identifies the block or patch panel number.
4. Fourth syllable designates the position occupied by the cable pairs in the field. For example, the patch panel, WIC port number, or BIX termination clock connectors. Refer to drawings for this detail.

- B. Label each horizontal cable at four points:

1. General: Label each cable within 4 inches of each termination where it is accessible and readable in a cabinet, junction/splice case, or outlet box, and elsewhere as indicated.
2. Distribution Racks, blocks and other terminating equipment: Label each unit and field within that unit within 4 inches from the block or patch panel termination.
3. Within Connector Fields, in Wiring Closets and Equipment Rooms: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both communication and data-processing equipment, use a different color for jacks and plugs of each service.
4. Cable Schedule: Post in prominent location in each wiring closet and equipment room. List incoming and outgoing cables and their designations, origins, and destinations.

- E. Workstation: Label cables within outlet boxes between 8 and 12 inches from I/O termination.

- F. Labeling of exposed cables and cables in cable runways/conduits: Three (3) feet after exiting

work and mechanical room wall; and three (3) feet prior to entering wall of room that cable I/O is located in.

- G. Communications room Grounding will be marked conspicuously with permanent plastic labels at each end and location stating "Caution: telecommunication Ground- DO NOT REMOVE". Indicate the room number of the opposite end of the wire.
- H. All copies (printed and electronic) of floor plans shall show outlet locations identified by their unique identifier. Place one copy of all floor plans with I/O's in mechanical and work room. Coordinate with owner if they require specific requirements, like: lamination and mounting height, etc.

### 3.27 DOCUMENTATION

- A. Test reports must be submitted in hardcopy and electronic format. Hand-written test reports are not acceptable.
  - 1. Hardcopy reports are to be submitted in labeled 3 ring binders with an attached affidavit verifying passing execution of all tests. For large installations, electronic reports with hardcopy summaries are preferred. Hardcopy summary reports shall contain the following information on each row of the report: circuit ID, test specification used, length of cable, date of test, and pass/fail result.
  - 2. Electronic reports are to be submitted in USB storage Drive or CD-ROM format. If proprietary software is used, disk or CD shall contain any necessary software required to view test results. If the results are delivered in a standard format like Excel, Access, CSV files, etc. then software to read these files are not provided. Electronic reports must be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate must reference traceable circuit numbers that match the electronic record.
- B. Test reports shall include the following information for each cabling element tested:
  - 1. Wiremap results that indicate the cabling has no shorts, opens, miss-wires, split, reversed, or crossed pairs, and end-to-end connectivity is achieved.
  - 2. For Category 6 cabling: Attenuation, NEXT, PSNEXT, ACR, Power Sum ACR, Return Loss, ELFEXT, PSELFEXT, Propagation Delay, and Delay Skew data that indicate the worst case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1 MHz to 500 MHz or highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards. Any individual test that fails the relevant performance specification shall be marked as a FAIL.

3. Length (in meters), propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
  4. Cable manufacturer, cable model number/type, and NVP
  5. Tester manufacturer, model, serial number, hardware version, and software version.
  6. Circuit ID number and project name.
  7. Auto test specification used
  8. Overall pass/fail indication
  9. Date and time of test.
- C. Test reports shall be submitted before substantial completion of the project.

### 3.28 TEST EQUIPMENT

- A. Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years experience in producing field test equipment. Manufacturers must be ISO 9001 certified.
- B. All test tools of a given type shall be from the same manufacturer, and have compatible electronic results output.
- C. The manufacturer of the test equipment must approve test adapter cables. Adapters from other sources are not acceptable.
- D. Baseline accuracy of the test equipment must exceed TIA Level IIe (class2), as indicated by independent laboratory testing.
- E. Test equipment must be capable of certifying Category 6, and 6 links/channels.
- F. Test equipment must have a dynamic range of at least 100 dB to minimize measurement uncertainty.
- G. Test equipment must be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.
- H. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.
- I. Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.

- J. Test equipment must include a library of cable types, sorted by major manufacturer.
- K. Test equipment must store at least 1000 Category 6 auto tests in internal memory.
- L. Test equipment must be able to internally group auto tests and cables in project folders for good records management.
- M. Test equipment must include DSP technology for support of advanced measurements.
- N. Test equipment must make swept frequency measurements in compliance with TIA standards.
- O. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.

### 3.29 SUBSTANTIAL COMPLETION

- A. Date for substantial completion: Coordinate with Construction schedule and client's representative at least 3 months in advance for expected communications infrastructure completion date.

### 3.30 SUPPORT AND WARRANTY

- A. Minimum 15-year manufacturer's certified warranty for this specific project shall be submitted in writing with system documentation. Perform installation of cabling system and hardware to insure covering application assurance (workmanship). Contractor shall provide an installation that meets or exceeds the manufacturer requirements and standards for a complete cabling infrastructure.
- B. Should the cabling system fail to perform its expected operation within this warranty period due to inferior or faulty material and/or workmanship, the contractor shall promptly make all required corrections without cost to the owner.

### 3.31 INTERFACES WITH OTHER WORK

- A. Weekly Meetings and Progress Reports:
  - 1. Contractor shall have a minimum of one representative attending all weekly-scheduled Construction meetings.
  - 2. Contractor is responsible to present a written documentation of weekly progress and/or delays related to this project to the General contractor and consultant.

### 3.32 REPAIR/RESTORATION

- A. Contractor is responsible for the protection of existing facilities, finishes, and equipment.
- B. Contractor is responsible for the patching and repair of facilities, finishes, and equipment as related to the communications installation.
- C. Any damage to building or site caused by this contractor, including grass, paving, curbs etc., shall be restored at Contractor's expense to match condition that day or day of quote opening.
- D. Provide all supplementary or miscellaneous items, accessories and devices incidental to or necessary for a sound, secure and complete installation, whether or not specifically indicated in the Contract Documents.
- E. Contractor shall note and record any other trades related delays to their scope of work and/or safety issues associated to this project.

### 3.33 LAN EQUIPMENT

- A. All active electronic equipment, like Switches, PBX, etc. are supplied and installed as specified on plans.

### 3.34 VOICE SYSTEMS

- A. All active voice equipment, are supplied and installed as specified on plans.

### 3.35 VIDEO AND AUDIO SYSTEMS

- A. Furnish and install category 6 cabling systems as indicated in specification section AUDIOVISUAL SYSTEMS : Refer to drawings for details.

### 3.36 WAN EQUIPMENT AND TELCO SERVICES

- A. Furnish and installed as specified on plans.

### 3.37 SECURITY ACCESS AND SURVEILLANCE SYSTEMS

- A. All Video and Audio equipment, like IP Cameras, Recording equipment etc. are supplied and installed as specified on plans. Refer to documents/drawings for details.

### 3.38 LIGHTING CONTROL DEVICES (CRESTROM Lighting Controls)

- A. Lighting Control cabling: Refer to drawings for details. Furnish and install category 6 cabling systems as indicated in drawings.

END OF SECTION 27 00 00

## SECTION 27 51 23

### eSERIES END POINT INTERCOM, PAGING, AND EMERGENCY MESSAGING SYSTEM

#### 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. The system specified is based on the Telecor eSeries Supervised Network based Communications System providing at least the features and functions outlined below. The System shall be installed and programmed by a local authorized and certified Telecor dealer.
- B. Supply and install a complete supervised network-based intercom system. Field wiring shall be CAT 5E or CAT 6 cable, control wiring for power distributions and very long runs, and utilize an optional fiber backbone (when distances exceed normal Ethernet limitations). All station equipment shall utilize standard RJ-45 modular connections. All remote devices utilizing standard structured cabling shall be capable of PoE (Power over Ethernet) or power supplied within the CAT 5E or CAT 6 cable jacket. Wiring shall be capable of either being installed in conduit or cable trays, where shown on the plans.
- C. The system shall be capable of interconnecting with the building LAN (Local Area Network). This connection shall be minimal and utilize only one Ethernet 100 Mbps (or optionally 1 Gb) connection per station to accomplish all intercom operations. Ethernet ports and associated network switches that are required to connect any intercom devices will be provided by the OWNER.
- D. Provide a separate circuit for each room and administrative office so each room, speaker, amplifier, and emergency messaging display/clock can be individually addressed.
- E. Overall intercom communications network shall utilize Ethernet or VoIP communications between all major components: administrative consoles, intercom stations, amplifiers and individual paging speakers, and network switches. Systems not utilizing Ethernet or VoIP communications protocol to each end-point device will not be acceptable. Systems not capable of supervising all networked devices including network amplifiers, network speakers, notification switches, and emergency messaging display/clocks will not be acceptable.

- F. The network shall support a VLAN configuration to separate activity in the intercom system from other in building LAN traffic. In locations where the supervised network communications system will be considered as part of the facilities life safety systems, a dedicated and isolated network shall be required.
- G. The system shall interface to the facility's IP-PBX via SIP trunk connectivity.
- H. The Communications System shall include master clock support and synchronization of digital secondary clocks, event scheduling, and messaging software allowing the facility to configure multiple schedules per school, multi zone time tone signaling for class changes, and message notification.
- I. The Communication System shall include alarm features, including a comprehensive command center and alarm-focused emergency management capabilities. In the event of an alarm condition, all nonessential system operations shall be automatically suspended. Control of the system shall be transferred to a command center console operated by the incident commander. All call-ins placed from room stations shall be re-routed automatically to the command center console.
- J. The Communications System shall include software for the management of communications during an alarm condition in the facility using a GUI located at the command center. This includes activating, clearing and providing status of all alarms in the facility, including comprehensive management of lockdown and acknowledge status of each classroom designated as a Shelter-in-Place location.

### 1.3 DEFINITION OF TERMS

- A. Installer(s): Shall refer to the person, persons, or company who or which contracts to perform the work specified herein.

### 1.4 SUBMITTALS

- A. Submit the shop drawings, product data, and quality control submittals specified below at the same time as a package.
- B. Shop Drawings: Composite wiring and/or schematic diagrams of the complete system as proposed to be installed. Drawing shall include relative position of all major components, typical connections, field components, accessories, and cable types.
- C. Product Data: Include catalogue data sheets, manufacturer's default specifications, user operation guides, and bill of materials.
- D. Quality control shall include the following:
  - 1. Name, address, and telephone number of the nearest fully equipped service organization.



2. Submit a certificate of completion of installation and service training from the system manufacturer.
  3. Submit a list of comparable completed projects. Furnish the name, address, telephone number, and contact name of end user.
- E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Include record of final matching transformer-tap settings and signal ground-resistance measurement certified by Installer.
- F. Maintenance Data: For equipment to be included in maintenance manuals specified in Division 1.
  - a. Record of Owners equipment-programming option decisions.
  - b. All instructions necessary for proper operation and manufacturer's instructions.
  - c. "Proof of Performance" information.
  - d. Manufacturer's maintenance information.
  - e. Copies of non-proprietary computer programs and system set up disks documenting all programmable features of the installed system.
- G. Record Drawings: Prior to final
- H. acceptance, provide three (3) complete sets of drawings indicating all cable numbers and construction details in accordance with the actual system installation. Revise all shop drawings to represent actual installation conditions. These Record Drawings will be used during "Final Acceptance Testing".
- I. System Training: Submit the following information describing the training programs and system trainers as outlined in paragraph 1.6 of this specification and in accordance with Division 1 specifications.
  - a. Include with the submittal a preliminary staff development training program in outline form for review and approval by the owner's representative.
  - b. Include with the submittal a current copy of the trainer's certification from the manufacturer that certifies and identifies the trainer(s) who are eligible to provide training and support for the project.
  - c. Include with the submittal a current copy of trainer's needs assessment form which will be reviewed with the owner's designated representative for the system's preliminary system programming and configuration.
  - d. Include with the submittal copies of all documentation used to identify for the owner those participants attending and completing the training programs.
- J. A copy of the manufacturer's standard statement of warranty proving all equipment provided for the school communications network is covered with the required **five-year** warranty shall be included with the project submittal. This statement of warranty shall be provided on the manufacturer's stationary.

## 1.5 QUALITY ASSURANCE

- A. Manufactures: Firms regularly engaged in manufacture of integrated communication systems, time keeping systems, and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for no less than five years.
- B. Installer's Qualifications: Firms with at least five years of successful installation experience with projects utilizing integrated communications systems and equipment similar to that required for this project.
- C. All items of equipment including wire and cable shall be designed by the manufacturer to function as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing all interconnections.
- D. The Contractor shall be an established communications and electronics Contractor that has had and currently maintains a locally run and operated business for at least five years. The Contractor shall be a duly authorized distributor of the equipment supplied with full manufacturer's warranty privileges.
- E. The Contractor shall show satisfactory evidence, upon request, that they maintain a fully equipped service organization capable of furnishing adequate inspection and service to the system. The Contractor shall maintain at their facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.
- F. Except where specifically noted otherwise, all equipment supplied shall be the standard product of a single manufacturer of known reputation and experience in the industry. The Contractor shall have attended the manufacturer's installation and service school and upon request must show proof of attending such a school.
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- H. Comply with NFPA 70.
- I. Comply with NEMA Standard SB-40 for Emergency Communications in K-12 schools.

## 1.6 IN-SERVICE TRAINING

- A. The contractor shall provide and implement a complete and comprehensive staff training program for all administrators, facility staff members, and teachers. This mandatory training program will provide school staff a complete understanding of how to utilize and properly operate all functions.

- B. The training program shall be implemented by a staff member/trainer employed by the contractor. The trainer must be factory certified to provide training on their product.
- C. All staff development training is to be coordinated through the owner's designated representative. As training sessions are completed, the trainer will provide the school's administrative staff and school district's staff a document listing all the staff and faculty members who attended, received, and completed the training program.

#### 1.7 WARRANTY

- A. Provide a **manufacturer's five-year extended limited warranty** of the school communications network equipment against defects in material and workmanship. This warranty will cover all electronic system components. Additional warranties cover clocks, speakers, and call-in switches. If any defects are found within the warranty period, the defective equipment shall be replaced at no cost (equipment only); a one-year warranty shall be provided for labor.
- B. The Contractor shall, at the Owner's request, make available a service contract offering continuing factory authorized service of this system after the initial warranty period.
- C. The system manufacturer shall maintain engineering and service departments capable of rendering advice regarding installation and final adjustment of the system.

#### 1.8 MANUFACTURERS

- A. Manufacturers: Full Network based solution Subject to compliance with requirements, provide a system by one of the following manufacturers which are currently in use by the owner:
  - 1. Telecor

### PART 2 - PRODUCTS

#### 2.1 SYSTEM REQUIREMENTS

- A. The system shall utilize a decentralized network structure not requiring any head-end equipment, central server, or any other control hardware to maintain system operation. Systems utilizing centralized electronics and subject to a single-point-of-failure (power supply, CPU, server, power, etc.) shall not be accepted unless the system has 100% duplication of all centralized operating equipment running concurrently and can automatically take over, including up to the minute programming configuration in the event of a failure of the main system head-end electronics or any required, centralized electronics required to make the system fully operational. Systems that are not based on decentralized structure or systems that do not provide 100% duplication of head-end

or systems that operate in a “down-graded” operational mode as the result of a centralized failure are not acceptable.

- B. All station devices shall receive power and data through a Power-Over-Ethernet switch. Once plugged into the LAN through a Power-over-Ethernet network switch, all networked devices shall be immediately operational and as applicable shall place or receive calls and pages from stations as well as page all devices in the network. Consoles, intercom stations, clocks, emergency displays, or speakers connected to the network shall not require any network configuration or administration to function.
- C. Each Intercom Station, Loudspeaker, clock/message display, shall be assignable to all or any combination of Unlimited Paging, Program Distribution or Time Zones in the system.
- D. Each Classroom shall be provided with two Call Stations located in separate locations in order to comply with NEMA Standard SB40 for Emergency Communications in K-12 Schools. One Call switch shall provide the ability to generate normal calls to a designated location while the other shall generate Emergency level calls.
- E. Speech shall be transmitted in the frequency range from 50 Hz to 7 kHz and shall use a maximum of 128 kbps of bandwidth during a call. In order to assure maximum intelligibility, all system audio shall be HD Audio as defined in Intel™ High Definition Audio Specifications, June 17, 2010.
- F. Intercom communications between consoles and system devices shall be non-blocking with no channel restrictions or limitations (other than network capacity) to the number of simultaneous conversations at any time between pairs of intercom stations, intercom station to console, console to console, console to speaker or zone of speakers, program source to a speaker or zone of speakers, or bell tones to a speaker or zone of speakers regardless of number of stations or consoles.
- G. Any and all devices shall have the ability to have their programming downloaded, individually or simultaneously via the network. Programming shall be downloadable in a series of human readable, industry standard comma-separated values (CSV) files that can be saved and edited using common spreadsheet applications. Consoles, intercom stations, clocks, displays, and speakers residing on a network shall have the ability to update their programming, simultaneously from a CSV file. Furthermore, all devices shall also have the capability to be configured directly, such that device numbers, names, zones, and call-in destinations can be altered in real time without the uploading or downloading of their programming. System shall be capable of uploading firmware updates to all device classes simultaneously, via the network, without the requirement of tools, by authorized technician or qualified facility technician or representatives.
- H. Audio communications between all devices shall be accomplished with latency values of a maximum of 0.1 seconds and connection times of 0.01s for 1 to 500 speakers.

- I. The system shall support a minimum of 50 channels of simultaneous duplex communication paths on the intercom system LAN, plus a minimum of 10 simultaneous duplex channels for PBX integration.
- J. The system shall be capable of routing calls from the Public Switched Telephone Network (PSTN) into any classroom, zone or the entire school via the District's SIP enabled Telephone System. This shall allow for remote monitoring and two-way voice communications from outside the facility to classrooms as well as paging into areas of the school. Additional features shall include:
  1. The ability to place call-ins from classroom call stations to SIP Telephones.
  2. The ability to initiate calls from SIP Telephones to eSeries Classroom Speakers.
  3. The ability to initiate zone and all call paging announcements from SIP Telephones to eSeries Speakers throughout the facility.
  4. The ability to make outside calls from Administrative Consoles to the PSTN via the Districts Phone System.
  5. The ability to receive Live District Wide Paging Announcements from the District Office
- K. The System shall allow users to configure multiple schedules per school, with an unlimited number of programmable events in each schedule. Each Event shall sound a user selectable tone, play a user provided audio file or an external audio source. In addition, a textual message shall be programmed to display on associated message displays throughout the school. All scheduling assignments shall be performed via a simple to use, Graphical User Interface (GUI) from a non-dedicated PC, residing in the School. Programming shall also be accomplished from a non-dedicated PC at the District Office. The following features and functions shall be provided. Systems that cannot provide these, shall not be acceptable.
  1. The system schedules shall facilitate the requirements of combined facilities (e.g. elementary and middle schools in a common building) where multiple schedules running concurrently would be required.
  2. Each event shall play any of the available tones, audio files or audio sources provided. Events shall be directed to any one or more Time Zones in the systems.
  3. Events shall include textual messages to clock/message displays. These shall be formatted as fixed, flashing or scrolling displays that can include up to 200 characters in length.
  4. Time Tones may be manually activated from Administrative Consoles or selected SIP phones residing on the schools IP PBX.
  5. An integral Master Clock shall provide time synchronization to all secondary, digital clock/Message Displays throughout the school. The communications shall be capable of obtaining it's time synch signal from any NTP timeserver.
- L. The System shall be capable of automatically distribute SMS and email notifications to relevant staff members when an emergency event is occurring the facility. Notifications shall be distributed to user alert devices such as mobile phones and smart devices.

Mobile phones shall receive the notifications as SMS messages while smart devices shall receive email messages. Emergency events include:

1. The activation of emergency-themed element icons on a PC GUI (e.g., Lockdown, Evacuate, etc.)
  2. Emergency Calls placed from Call Stations located room locations.
- M. The system shall automatically distribute SMS and email notifications to appropriate technical support staff in the event that the system is experiencing a fault.

## 2.2 EQUIPMENT AND MATERIAL

### A. Supervised Interactive Graphical User Interface

1. The system shall include an Interactive Graphical User Interface (subsequently referred to as IGUI). The software shall reside on Telecor provided PC and should have ability to interface to District Wide Emergency Communication system located in the district office.
2. The IGUI shall be supervised and shall utilize an easy-to-use graphical user interface for quick and easy graphically aided navigation to access functionality for all intercom stations, paging zones, and program distribution sources. Emergency operations shall be simplified through the IGUI allowing stored audio files and alphanumeric messages for message displays to be activated from the IGUI. The IGUI shall allow common operations such as daily announcements to become simplified into single touch activated icons; removing multi-step console set ups and dial strings.
3. The voice device used to originate voice communication for the IGUI to selected locations shall be a system console, telephone handset, or microphone independent from the computer hosting the IGUI. The voice device shall remain functional and accessible regardless of the operational state of a computer supporting the IGUI.
4. The IGUI shall allow the creation of a custom operating screen(s) based on the floor plans of the facilities. Icons representing intercom stations, zones used for paging, tone distribution, textual Message distribution, and audio program distribution shall be incorporated onto the floor plans. The IGUI software shall provide:
  - a. Simple routine call processing, including: hold, transfer, and forward
  - b. Activation of remote station auxiliary relays for applications such as door lock or release
  - c. Emergency functions
  - d. Paging
  - e. Audio program distribution
  - f. Customizable page elements
  - g. Customizable operating screen
  - h. Element library for emergency event icons
  - i. Initiation of emergency and non-emergency messaging, textual and audible

- j. Remote station volume adjustment
- k. Remote activation of do not disturb status and/or message waiting status
- l. Remote station trouble indication
- m. Remote station background music channel selection
- n. Dynamic zone management for interactive on-the-fly console specific zones
- o. Single touch emergency response (supporting both actual emergencies and drills) including but not limited to all or any combination of the following:
  - 1) Live voice notification
  - 2) Pre-recorded audio message
  - 3) Digital plain text messaging with simultaneous numerically coded message capability
  - 4) Remote system activation, i.e., access control systems, CCTV systems, door release systems, etc.
- 5. The IGUI must provide an efficient and reliable method of notifying the occupants within the facility of critical situations. A variety of emergency tone signals that reside within the intercom/paging system shall be activated by clicking on pre-programmed buttons on the IGUI screen, initiating the transmission of tone signals to speakers, and alphanumeric messages to message displays/digital clocks. A "lockdown" icon shall be designed as per Owner direction, with Owner selecting the appropriate tone. Whole building macros for emergency or off-normal response shall be built into the internal communication system as directed by the Owner. Each macro shall be capable of being activated by the console, the IGUI as indicated on plans or as directed by the Owner or AHJ. It shall be possible to activate a WAV file message or Owner selected tone coinciding with multi-language textual messages for distributions to zones as directed by the Owner, all from a single activation icon located on the IGUI. Other single action macros shall be activated in similar fashion via the IGUI and a custom-labeled icon. Plain language labeling of all icons on the IGUI shall be user changeable.

B. Emergency Notification

- 1. The system shall be capable of providing emergency notifications by email and SMS to mobile devices and designated PCs. during an emergency utilizing a district wide communication system. This feature will notify all relevant staff members so that they are made aware of the emergency event and can respond appropriately. Up to 100 users can be supported directly. When integrated with the facility's email server, it can effectively distribute notifications to an unlimited number of alert devices.
- 2. Alert devices may be mobile phones and smart devices. Mobile phones shall receive the notifications as SMS messages while smart devices shall receive email messages.
- 3. When deployed, the emergency notification feature shall support the fault monitoring capabilities of the Master Clock/Message Host. Trouble/fault

notifications from eSeries devices shall be annunciated on the IGUI with a flashing icon. Activation of this icon shall distribute notifications of a fault to appropriate technical support staff.

C. Emergency Alert

1. The Emergency Alert platform shall consist of displays, adapters, and integrators as located on the drawings and specifications.
2. The platform shall allow visual displays to be integrated into Telecor's eSeries System. These displays shall show the time, weather, information, alarms, messages, and emergency alarms. Multiple visual layouts and color schemes shall be available for use. The time shall be displayed as either an analog or digital clock. Messages and emergency alarms shall include plain text and audio. Messages shall have the ability to be scheduled to appear at certain times and days of the week. Live local weather at the facility shall also be shown on each screen.
3. Messages shall be configurable to appear on specific displays and zones (which shall group together multiple displays).
4. Severe weather notifications issued by the National Oceanic and Atmospheric Administration (NOAA) shall activate weather alerts automatically.
5. Emergency alarm screens shall be activated from the IGUI. This shall allow complete integration with an operational control from the facility's Telecor communications system. Emergency Alert alarms shall activate in conjunction with the delivery of SMS text messages and email notifications.
6. The Emergency Alert platform shall support an unlimited number of displays. All displays shall have adjustable brightness levels. A scheduled sleep mode feature shall be available for further energy conservation. Should a display lose power, it shall automatically resume regular operation upon power and network restoration.
7. Displays shall connect via wired Ethernet or wireless Wi-Fi to the facility LAN which shall have access to the Emergency Alert cloud-based web portal. This portal shall be used to manage and configure the Emergency Alert platform and its features. The cloud-based nature of the Emergency Alert platform shall provide the ability to manage different sites, each with their own sets of displays, through the web portal.
8. The Emergency Alert display shall consist of a 22" HD screen. The display shall be equipped with both wired and wireless network adapters for connection to the facility LAN.
9. The display shall be wall mounted with a surface mount bracket in either a landscape or portrait orientation.
10. The adapter shall allow any third-party display capable of receiving HDMI input to serve as an Emergency Alert display. This shall include large-format HD resolution displays. The adapter shall include wired and wireless network adapters to allow the display to connect to the facility LAN.
11. The integrator provide integration between Telecor's eSeries System and the Emergency Alert platform.



12. Emergency Alert platform messages and emergency alarms shall have the ability to be configured so that they can be activated from the IGUI.

D. Supervised SIP Trunk IP/PBX Interface

1. The system Session Internet Protocol (SIP) Interface shall be a VoIP PBX phone interface of the same manufacturer as the supervised network intercom and paging system. Third party gateway devices shall not be accepted.
2. The SIP Interface shall be supervised and shall connected directly to the facilities network and the PBX's network and shall provide the following:
  - a. Establish a barrier gateway between the intercom and paging network and the PBX and/or common computer network.
  - b. Transparent audio operation between VoIP PBX phones and any device on the supervised network intercom and paging system. Paging access from any telephone on the facility system VoIP PBX to any intercom speaker, speaker zone, intercom station, console, all speakers, or paging horns and zones throughout the facility.
  - c. Any call-in from the supervised network intercom and paging system shall be capable of being routed directly to a VoIP PBX phone. Call-in stations can be configured and programmed to automatically dial any number on the publicly switched telephone network, landline, or cellular number through the SIP interface and via the PBX.
  - d. Ability to escalate a call-in to be redirected to a VoIP PBX connected phone via the SIP Interface. Escalation can also include the ability to dial any number on the publicly switched telephone network, landline, or cellular number through the SIP interface via the PBX.
  - e. Ability to initiate alarm and crisis response protocols from any VoIP PBX connected phone.
  - f. Ability to require security access code to utilize the intercom or paging system emergency communication features.
  - g. Minimum of 10 simultaneous telephone channels of access to/from VoIP PBX phone system. Full caller ID support from any supervised network intercom call-in device to a VoIP PBX connected phone identifying the calling station ID/Location.
  - h. Emergency level call-in to be uniquely identified as emergency on the VoIP PBX phones.
  - i. Activation of all supervised networked intercom and paging system emergency tones and pre-recorded announcements from any phone connected to the building VoIP PBX phone system.
  - j. The SIP Interface shall additionally allow for calls to be placed from a console to any phone number on the publicly switched telephone network (landline or cellular). Additionally, intercom calls at a console may be transferred to any number on the publicly switched telephone network to any landline or cellular number through the SIP interface via the PBX.

3. Systems that connect to a building or district phone system and are limited to a SLT or CO connection will not be accepted as a substitute for a fully operational SIP Interface.

E. Control Interface

1. The Control Interface shall provide a Desktop Application for PC interaction with the Intercom and Paging system, a Command Interface Protocol for external system interaction with third party systems, Group Zone functionality, and a Scripting Engine supporting multiple sequential operations.
2. The system shall incorporate a Windows based Desktop application that makes use of a Command Protocol Interface, allowing external systems to interact with the Network Intercom and Paging System. Combined with the Scripting and Group Zones features, the Desktop application shall generate a preprogrammed series of operations from a single action. These features shall be used in conjunction with a graphical user interface and the Microsoft Windows desktop.
3. Default Scripts shall be used to generate customized shortcuts according to the needs of a facility. These shortcuts shall then be placed directly on the Windows desktop and shall activate virtually any Intercom and Paging function by clicking on the shortcut icon. These shall include activating:
  - a. Alerts, audio distributions, coded and plain text messages, intercom operations.
  - b. Pre-Recorded Evacuate, Lockdown, and All Clear audio files.
  - c. Companion text messages for audio alerts.
  - d. Coded messages on all secondary digital clocks and displays.
4. The Desktop Application shall also activate SMS text messages, computer pop-up notifications, and email distributions in conjunction with any script. Desktop icons such as a Panic Button shall send SMS notifications to a crisis team, advance warning to building occupants through pop-ups to heighten the level of awareness.
5. Any Desktop location running the Application shall have the ability to create and send an instant message using the Desktop's keyboard and display. The textual message can be sent independently or as a companion message to an audible alert.
6. The Desktop Application shall be capable of utilizing Soft Call and Panic buttons. Soft Call buttons shall be created to operate as a call button on the desktop with a normal or emergency call priority. They shall also be combined with other preset or on-the-fly custom text messages. Panic buttons shall allow a user to unobtrusively activate an audio path from the panic button location to another eSeries device at a security location. This shall allow security personnel to listen to an occurring situation and provide the appropriate response.
7. The System shall be capable of streaming multiple audio programs over 10 available channels, simultaneously, to speaker locations in the facility. The

- ability to turn the broadcast on or off to a specific location shall be controlled from the Desktop Application.
8. A user from the Desktop Application shall enable or disable Do Not Disturb (DND) mode for a group of devices such as speakers or intercom stations.
  9. Volume Adjustments to individual devices, devices in a zone, or all devices in the intercom and Paging System shall be made from the Desktop Application.
  10. The Desktop Application shall be used to create a call directory to provide the user with the ability to quickly and easily place calls to a large number of prospective recipients and locations. The shortcuts shall be customized with the name of the call recipient or location. The call directory shall also contain shortcuts that activate message-waiting indications in addition to the option of placing calls.
  11. The system shall interface with other external systems using a Command Interface Protocol. External systems include integrated security management or building management systems via devices such as computers, programmable logic controllers, or software-based annunciator panels.
  12. The Command Interface Protocol shall be used to send real time commands and receive real time status messages between the third party system and eSeries devices. The Command Interface Protocol shall be an ASCII protocol that includes both outbound messaging, and support for inbound command via a virtual COM port and a physical USB connection.
  13. Scripting shall allow operations to be carried out in sequence. Scripts shall be activated in various ways including: automatically based on the day of week and time of day, using a Console or a phone, by using the Desktop Application, or from other scripts.
  14. When scripts from a Console or PBX phone (via a SIP interface), the name of the script shall be displayed on the Console or phone. Then the user shall be presented with options to enable or disable the script (depending on the current state of the script). Consoles and PBX phones that dial the script number shall hear voice prompts for enabling or disabling the script.
  15. Scripts shall be used for scheduling time tone programs that include tones, pre-recorded messages, and textual messages displayed on Message Display/Calendar Clocks reoccurring at specific times and days.
  16. Scripts shall perform cascading evacuation operations where evacuation audio messages are automatically first distributed to zones closest to the location of an emergency before spreading outwards to other zones according to a time schedule, thus reducing evacuation route congestion throughout the facility.
  17. Group Zones shall allow groups of page zones or devices to be defined as a group zone with a dial number. Group Zones shall be accessed from the Desktop Application, Consoles or PBX phones.
  18. Group zones shall be the destination for various functions including textual messages, or audio operations, such as pages or audio program

distributions). Group zones shall be assigned customized names, which will appear on Console or phone displays when they are dialed.

19. Group Zones shall make it possible for a dial number to be forwarded to different destinations based on time and day. For example, common audio operations directed to a Group Zone dial number shall be configured to go to the usual destination during regular hours but to a different destination outside of regular hours.
20. Group Zone shall support designated priorities, such as emergency. Operations that are to a zone with a priority are automatically elevated to override any normal or lower priority operations the devices in that group zone are receiving.

F. Alarm Manager

1. The Alarm Manager shall be a Telecor Model eAM equipped with eVCAM software or approved equal. The Alarm Manager shall manage system wide communications during an alarm condition in the facility through a GUI and associated software. The Alarm Manager and associated software shall reside on the facility-provided PC.
2. During an alarm condition, all non-emergency operations shall be restricted. Operations shall be transferred to an Alarm Management Console located at the Command Center location within the facility. The command Center shall be equipped with a Console, associated GUI, PC and software to manage emergency operations during an alarm condition.
3. Included in the GUI shall be ICONS that represent the following alarm types:
  - a. Lockdown
  - b. Lockout
  - c. Evacuation
  - d. Reverse Evacuation
  - e. Severe Weather
  - f. Tornado
  - g. Fire
  - h. CO Detection
  - i. General Emergency
  - j. All Clear
4. Alarms shall be activated by "Clicking" on the respective ICON on the GUI. When the corresponding alarm becomes active, the ICONS shall visually change to reflect the current condition.
5. Operation of the Alarm Management Console shall be consistent with NFPA72 Emergency Communication Requirements. Operations activated by an Alarm Management Console shall have the highest priority and shall not be overridden by another operator. This shall eliminate the risk of different operators issuing conflicting instructions.
6. The Alarm Management Console shall perform live paging announcements which shall automatically suspend a pre-recorded portion of an alarm until the conclusion of the paging announcement.

7. From the Command Center, it shall be possible to change the type of alarm, silence an alarm, perform live paging in the alarmed areas, covertly listen to stations, as well as clear the alarm.
8. Call-ins placed from stations in an alarmed area shall automatically be routed to the Alarm Management Console during an alarm condition.
9. Locations designated for "Shelter in Place" such as classrooms, offices, and areas of refuge shall be equipped with Alarm Acknowledgment call stations. These stations shall be used to confirm the status of the occupants in these locations during a Lockdown Alarm Condition. Call stations shall receive pre-recorded verbal instructions to be carried out to secure the "Shelter in Place" locations. Once secure, the status shall be acknowledged by pressing a touch point on the Alarm Acknowledgement Call Station.
10. All "Shelter in Place" locations shall be monitored on the Command Center GUI in real time using the Alarm Manager software. A graphic of the school floor plan shall display the status of the room with color-coded ICONS.
  - a. Orange shall indicate that the room has received instructions to secure the room and acknowledgement is pending.
  - b. Green shall indicate that the room has acknowledged that the room is secure.
  - c. Red shall indicate that the room status is unknown as no acknowledgement has been received from the room.
11. If the Alarm Acknowledgement is not received from the room location after a preset period of time, the station shall automatically place a call to the Alarm Management Console. The Console Operator shall answer the incoming calls utilizing the covert listen function, which allows the operator to aurally monitor the room without the occupant's knowledge. During a covert listen operation, the pre-announce and supervisor tones are suspended. Once the operator determines that the conditions in the room are typical of the situation, the operator shall establish a two-way intercom conversation with the classroom to determine why people in a Shelter-in-Place location did not complete the emergency response procedure.
12. The Alarm Manager shall support Medical and Security Alert Calls from Alert Call stations. Calls from these stations shall be annunciated at the Alarm Management Console, identifying the origin and type of Call. In addition, a pre-recorded announcement stating the origin and type of alarm shall be broadcast over the local speaker, and a textual message shall be scrolled on the local Message display. The audio broadcast and the textual message shall also be broadcast to one of more zones of loudspeakers.

G. Master Clock/Message Host

1. The Master Clock/Message Host shall be a time master device for the eSeries network which enables configuration and activation of eSeries operations from a web-based graphical user interface (GUI). An unlimited number of operations shall be managed for activation by schedules or users. The application shall be web-based and secured via HTTPS certification. It shall be preconfigured with a variety of default operations, schedules,

- audio, and icons for quick customization. Users shall log into the application from any desktop computer or mobile smart device using a supported web-browser. Supported web browsers shall include Microsoft Edge, Mozilla Firefox, Google Chrome, and Apple Safari.
2. Master Clock/Message Host functionality shall include central time keeping and synchronization of all other eSeries devices throughout the eSeries network.
  3. The Master Clock/Message Host shall manage an unlimited number of calendar-based schedules, which are collections of operations intended to be performed frequently, periodically, or on specific dates and times. For example, a schedule may be a series of bell tones that consistently indicate class changes. Users shall set schedules so that the operations they contain will activate accordingly.
  4. Schedules shall be viewed, enabled or disabled in a calendar. The calendar shall display schedules on a daily, weekly, monthly or yearly basis. The Master Clock shall support scheduling operations up to 10 years into the future.
  5. An unlimited number of holidays shall be specified and marked on the calendar. This shall indicate days where disabling all schedules may be appropriate.
  6. The Master Clock/Message Host shall obtain time from and synchronizes with Network Time Protocol (NTP) servers directly or via an NTP-enabled SIP interface present on the eSeries network.
  7. Operations shall include several components, including: pre-announce tones, pre-recorded audio, scrolling textual messages, and coded messages. If desired, specific details of the components shall be customized. Customization shall include: the number of times the pre-announce tone plays, the message scroll speed, and the delay before pre-recorded audio repeats. Depending on the operation type, user-activated operations shall be distributed immediately or queued for later distribution.
  8. The Home page shall provide a quick overview of Master Clock/Message Host managed operations. This shall include the next scheduled operation, the schedules that are currently active, and the next scheduled school drill. The Master Clock/Message Host shall include user specific short tutorial videos that explain various aspects of the GUI and provides built-in on demand training.
  9. The Live page shall show currently active and upcoming operations. A history of recently performed operations shall confirm operations occurred as intended. Also, users shall easily initiate on-the-fly operations on the Live page by configuring and activating them on demand.
  10. Routine operations shall include an unlimited number of pre-configured common audio distributions. Examples shall include announcements for special assemblies, bus arrivals, staff meetings, and festive events.
  11. Operations shall be associated with eSeries scripts so that they shall be activated by users. The Master Clock/Message Host GUI shall indicate if the script is active even if it was activated via other means such as dial access

- code or IGUI. Other emergency operations (such as Lockdown) shall also be seamlessly integrated with the IGUI.
12. Audio files shall be used for tones or announcements while images shall be used as icons throughout the GUI to represent different operations or schedules. Audio file formats shall include (WAV and MP3) and images to support operations.
  13. Access shall be user-account controlled. An unlimited number of users shall be supported with a high level of individual customization. Users shall be given access to only the pages and operations relevant to their intended roles. For each page, users shall be granted permissions to activate or configure operations and schedules from a desktop or, for certain users, from mobile devices. An administrator account shall have full access to view and make configuration changes on all pages, while an operator account shall be limited to activating routine or emergency operations and enabling or disabling schedules.
  14. Users with administrative privileges shall have the ability to configure the site name, time, time zone, test zone, and import and export databases. To aid installers with initial configuration, a test mode shall be provided as well as a database import/export feature. Test mode shall redirect all activated operations to a test zone (that only the installer occupies) to prevent disrupting other people during configuration and testing. Database import/export shall allow the configuration to be exported for backup purposes or to copy to other installations.
  15. The system shall be configured for an unlimited number of dedicated emergency response operations. A corresponding drill operation shall be automatically created for each emergency situation. Users shall activate emergency response operations from facility PCs or remote mobile devices.
  16. The Master Clock/Message Host shall support the operation of Virtual Call Stations that reside on client PCs, including management of all network connections between Virtual Call Stations and the Network Intercom and Paging System.
  17. The Master Clock/Message Host shall feature a Maintenance Portal. The portal shall provide trouble notifications for faults being experienced by any eSeries device on the eSeries Network.
    - a. The notification includes a details fault report that provides the device name, dial number and the nature of the fault. These shall be easily copied into other documents and emails.
    - b. The Portal shall be configured to use an email account to automatically send trouble notification emails to a list of designated addresses. These emails shall list the details of all the current faults.
    - c. A link to the Master Clock/Message Host web interface shall be provided in order for the recipient to perform trouble shooting actions such as viewing up to-do-date fault information, enabling service mode status, and making configuration changes.
    - d. The volume of station devices shall be remotely adjustable via a web browser.

H. Mobile Quick Access

1. The system shall include a Mobile Quick Access feature that allows staff members to quickly activate Emergency Notifications. (e.g. Lockdown) using mobile smart devices.
2. Notifications shall include the broadcast of pre-recorded audio announcements over the facility's public address speakers and textual messages to eSeries displays with a single activation.
3. The feature shall include emails and SMS messages that shall be delivered to custom lists of recipients.
4. Button options shall be customizable allowing staff a choice of notifications from their mobile device depending on the staff's authority.

I. Supervised Speaker Breakout Module

1. The Speaker Breakout Module shall provide the means of integrating traditional analog speakers and call initiating devices to the eSeries System. The Speaker Breakout Module shall also be a Single Zone Paging Adapter that can drive an amplifier to provide paging coverage in a facility. The Speaker Breakout Module shall have three relay outputs that can activate automatically during a call processing operation.
2. The Speaker Breakout Module shall receive power and data through a Power-Over-Ethernet switch. Once plugged into the LAN through a Power over Ethernet network switch, the Speaker Breakout Module shall place or receive calls and pages from the eSeries network. The Speaker Breakout Module shall not require any network configuration or administration to function.
3. Speech shall be transmitted through the Speaker Breakout Module in crystal-clear HD Audio. Audio shall be transmitted in the frequency range from 50 Hz to 7 kHz and shall use a maximum of 128 kbps of bandwidth during a call. Audio between the Speaker Breakout Module and Consoles shall be non-blocking.
4. The Speaker Breakout Module shall support Ceiling Inlay Speakers which shall connect to the Speaker Breakout Module via a standard CAT5 cable or conventional 8Ω/25V/70V speakers to provide paging and talkback operation from Consoles or phones via a SIP interface and an IP-PBX.
5. The volume of the speakers shall be adjustable individually, by zone, or across the entire eSeries network via the Management Interface or Control Interface. Volume controls incorporated into certain call station models shall also allow a user to adjust the speaker volume locally. Volume levels shall be set by specific functions: intercom, paging, emergency paging, and Public Channel operations.
6. Call-in capabilities shall be provided with the addition of call stations. Call stations models shall be able to initiate normal calls, emergency calls, or both. Advanced stations that provide additional features shall also be available. These features shall include Privacy mode, Do Not Disturb mode, volume control, and Public Channel select. All call stations shall also provide "message waiting" indication.



7. The Speaker Breakout Module shall also support placing normal and emergency priority call-ins from simple pushbutton call switches. Pressing the normal call switch shall initiate a normal call-in, and either pressing it three times quickly or pressing and holding it for three seconds shall place an emergency call-in. Pressing the emergency switch once shall place an emergency call-in.
8. The Speaker Breakout Module shall have the ability to direct normal and emergency call-ins to different devices. If the device that is configured to receive the call-in loses network connectivity, the Speaker Breakout Module shall automatically search for an alternate destination. If no other suitable call-in destinations exist, the Speaker Breakout Module shall audibly and visually indicate a fault.
9. The Speaker Breakout Module shall have a call-in roll-over feature where if a call-in to the primary call destination is not answered after a pre-set amount of time, the call shall be automatically copied to a secondary call destination. If both the primary and secondary call destinations are unavailable, the call shall be redirected to a back-up Console.
10. The Speaker Breakout Module shall have the capability to be configured as a member of one or more paging zones.
11. The Speaker Breakout Module shall have a built-in 4-watt audio amplifier that shall drive up to 4 watts of audio to a small zone of 25/70 volt loudspeakers. The Speaker Breakout Module shall provide a line level audio output that can connect to an external power amplifier for applications where the speaker zone load exceeds 4 watts.
12. The Speaker Breakout Module shall be monitored for network connectivity. If the Speaker Breakout Module 's network connection is lost, targeted Consoles shall report that station as absent and display its dial number. When the Speaker Breakout Module is used with Call Stations, the Speaker Breakout Module shall also provide full supervision and monitoring for Call Station and call-in destination connectivity. If a wiring fault is detected between a Call Station and the Speaker Breakout Module, the Speaker Breakout Module shall audibly and visually indicate the error utilizing the status LEDs on the Speaker Breakout Module. The Call Stations shall pulse their status LED to indicate a trouble condition. In case of a fault, the Management Interface or Logging Interface shall log the location, time, date and type of fault. If so configured, the Management Interface, Logging Interface, and Network Amplifiers shall also generate an alarm tone.
13. The Speaker Breakout Module's status LED shall flash in different patterns to indicate normal operation, call-in assurance, message-waiting, a call or paging audio in progress, or to indicate an error.
14. The Speaker Breakout Module shall be equipped with three relays that can be used to operate auxiliary devices such as strobe lights, tone initiating devices and door locks.
15. The Speaker Breakout Module shall be wall-mounted using the attached mounting brackets.
- 16.

J. General Purpose I/O Device

1. The General Purpose Input/Output Device shall be a Telecor model eNODE or approved equal. It shall allow third party devices and systems to interface with Network Intercom and Paging System through contact closures.
2. The I/O Device shall have a minimum of 4 inputs and 4 outputs.
3. The inputs shall connect to dry relay contacts of third-party devices and shall activate any eSeries operations. Each input shall be configurable and shall support connection to sustained or momentary contact closures. Inputs shall differentiate between single or multiple momentary contact closures.
4. Outputs shall activate third party devices and systems. Outputs shall activate in response to:
  - a. Paging Audio or intercom calls
  - b. Scripts
  - c. Alarms
  - d. Events in the Master Clock / Message Host
  - e. Manual Dialing of an dial number
  - f. Analog Clock Correction
  - g. Trouble Status Indication
  - h. Service Mode
5. The I/O Device shall support tracking features where the output will automatically activate if the I/O Device detects the activation of paging audio, call-ins, Scripts and Alarms.
6. The I/O Device Output shall be capable of being manually dialed and activated from a console, or a phone on the facility's PBX. Once dialed, the caller shall be prompted by voice commands.
7. The I/O Device shall be integrated with the Master Clock/Message Host, allowing outputs to be activated according to scheduled events. The outputs can also be programmed to provide correction to synchronous movement analog clocks.
8. All I/O Device Inputs and Outputs shall be monitored and shall detect opens, shorts and ground faults on the connection between the third-party device and the I/O device. If any of these conditions are detected, a fault condition shall be raised on the system.

K. Supervised Network Administrative Console

1. The Administrative Console shall be supervised and allow the operator to establish two-way communications with an intercom station, talkback speaker, or another Console using the handset or speakerphone. VOX functioning shall be automatically enabled when the handset is used. The Push-to-Talk button shall toggle the Console between talk and listen mode when the speakerphone is used. The Console shall provide a 2-line by 20-character LCD display. The display shall be adjusted to a range of angles for optimum viewing. When there are no active calls, the display shall show the Console name and dial number. If a time server is connected to the network, the display shall also show the time and date.

2. Incoming calls to a Console shall show the originating station dial number and name on the Console display. Calls shall be displayed in the order they are received. The operator shall scroll through the list of calls and answer them out of sequence. Emergency call-ins shall be distinctly annunciated both visually and audibly.
3. The Console shall allow call-ins to be forwarded to another Console, or for calls to be put on hold or transferred to another Console location. Additionally, call-ins or calls shall be forward/transfer-able to PBX telephone extensions via a SIP trunk interface.
4. The Console shall select remote audio sources connected at any location on the local area network, and distribute the audio broadcast from the source to all speakers in a facility or to selected areas such as a speaker zone or a selection of speakers. The Console shall be capable of audio source verification by attendant prior to page zone activation. In this manner, attendants shall listen to the audio source locally, including listening to pre-recorded announcements, prior to system broadcast.
5. The Console shall select a tone or a pre-recorded announcement and broadcast the tone or announcement to all facility speakers or to select areas, such as a speaker zone or a selection of speakers.
6. The Console shall be equipped with digital volume control that shall allow for the separate adjustment of the speaker listen and handset listen volumes. The levels for intercom listen, tones, and program distributions shall be independently adjusted and stored in memory.
7. The system shall allow user programming of alphanumeric architectural room names and numbers. The Console shall be capable of using 1 to 7 digit sequences for dial out and call-in identification, and shall display station numbering, station name, and call-in priority.
8. The end-user shall be allowed to choose and determine the number and location of Consoles. The end-user shall not be limited by pre-set manufacturer limitations of the number of Consoles required by this project; allowing for unrestricted future expansion. Consoles may be added at any time. Consoles added by the end-user that exceed the engineered design for this project shall be at owner's expense. Communication between consoles or consoles and intercom stations or rooms shall not be inhibited by channel number restrictions.
9. The Console shall be capable of displaying room statuses such as Privacy and Do Not Disturb and shall have the ability to override any status limiting communication between the Console and a station with Privacy or Do Not Disturb status activated. Temporary override shall not interfere with continued activation of Privacy and Do Not Disturb after communication has been established and electively terminated.

L. Supervised Network Amplifiers

1. The Supervised Network Amplifier (subsequently referred to as Network Amplifier) shall provide a minimum of 25 watts for paging and public address and shall be capable of utilizing analog amplifiers to increase the

- amount of amplified signal from the network amplifier. The Network Amplifier shall be connected directly to the network switch by an RJ45 connector and shall receive signals directly from the network.
2. The Network Amplifier shall be supervised and in the event that network communications is lost, an audible alert shall sound on the Amplifier. The Network Amplifier shall provide a silence feature to mute the audible alert for 24 hours.
  3. The Network Amplifier shall also be capable of receiving local input from local devices such as tape decks, iPod docks, CD players, etc. The network amplifier shall be capable of transmitting signals received from the local input to other network locations or locally to directly connected 25/70 volt or 8-ohm analog speakers.
  4. Each Network Amplifier shall be capable of providing two audio inputs for local devices and shall be programmable as either a microphone or line-level input.
  5. The Network Amplifier shall be controlled remotely such that audio programs, input, tones, textual messages, or announcements may be initiated by other devices connected at different locations on the local area network.
  6. The Network Amplifier shall have a minimum of 4 local tone/pre-recorded announcement audio message control lines which when activated will distribute tones/pre-recorded audio messages to intended network amplifiers for re-distribution, network talk-back speakers (or a zone), and/or local 25/70 volt or 8-ohm analog speakers directly connected to amplifier. Each network amplifier shall be capable of storing four (4) pre-recorded announcements in addition to a minimum of 16 tones. Tones and announcements shall be activated locally or from other network devices.
  7. The Network Amplifier shall store and transmit companion textual messages for each stored audio announcements. Textual messages shall be automatically broadcasted to the same zones along with the audio messages such that any device programmed for that zone automatically receives both the audio and textual announcement/message and automatically reproduced each or both messages to the extent of the devices' capabilities.
  8. The Network Amplifier shall be capable of transmitting HD level audio as defined by Intel™ High Definition Audio specifications, June 17th, 2010 at a minimum.
  9. The Network Amplifier shall shut down to protect itself should an output short circuit fault or overload occur that jeopardizes the integrity of the Network Amplifier.

M. Power Amplifiers

1. Power Amplifiers shall be used to drive groups of speakers located in corridors and outdoor locations that are assigned to speaker zones. Amplifier Zones shall be sized at 1 watt per corridor speaker, and 3.5 watts per horn. The amplifier load shall not exceed 80% capacity.

2. The Power Amplifiers shall be capable of producing an audio output of 60, 125 or 250 watts RMS at less than 1% distortion with balanced output.
3. They shall be designed to operate on a line voltage of 115 AC.

N. Supervised Call Stations

1. The Supervised Call Stations, as indicated on the drawings, shall be Telecor model eCS-1 eCS-2, eCS-3, eCS-6 or approved equal. The station shall be used to initiated calls from remote locations to eSeries Consoles.
2. Call Stations shall be monitored for call line failure. In the event of an open circuit, short circuit or short to ground, the System shall detect the fault and notify a designated console operator automatically. The type of fault and its identity on the system shall be displayed on a designated console screen.
3. Call Stations shall provide "message waiting" indications to staff members. If no one is present in a room to respond to a call, or the room is in Privacy or Do Not Disturb mode, the console operator shall have the option to leave a Message Waiting (MW) indication at the Station. If the MW option is chosen, the LED indicator on the room call switches shall begin to pulse. When a call-in is initiated from the room, the MW indication shall be automatically deactivated, and the call-in shall be automatically routed to the console that left the MW indication.
4. Call Stations shall utilize a momentary contact touchpoint to initiate a "Normal" priority level call. Stations equipped with an "Emergency" touchpoints shall initiate "Emergency" priority level calls. All stations shall have a Call Assurance LED. The LED shall flash when a call in initiated, confirming call placement to the user. The LED shall continue to flash until the call is answered by the console operator.
5. Calls Stations that are equipped with "Privacy" touchpoints shall place the room into a "Privacy" state, preventing the monitoring of audio activity in that room. When in the state privacy, the touchpoint shall illuminate indicating privacy status. When a call is initiated from the Call Station, the privacy state shall automatically be suspended for the duration of the call and automatically re-enabled when the call is complete. If a Console places a call to a location that has a Call Station that is in "Privacy", the caller shall be given verbal instructions, automatically generated by the console, that the room has been placed in privacy and the caller's options are to cancel the call, leave a message waiting indication or connect regardless. If they choose to connect, the audio shall be allowed to be transmitted from the console to the room, but the calling party shall not listen to the room audio unless the party in the room turns off the privacy feature.
6. Call stations that are equipped with "DO NOT DISTURB" (DND) touchpoints shall place the room into DND mode when pressed. When DND mode is enabled, the back lit LED on the station shall illuminate, indicating that the station is in a DND state. Schedule scheduled events, zone pages and normal priority audio programs shall be blocked from being broadcast into a room that is set into the DND state. However, Emergency pages, manual tones and high priority audio programs shall continue to be broadcast into the

room. If a call-in is initiated from a room is set to DND, the DND status shall be automatically suspended for the duration of the call, and automatically re-enabled when the call is completed. If a call is placed from a Console to a location that has a Call Station set to DND, the caller shall be given verbal instructions, automatically generated by the console, that the room has been placed in DND and the callers options are to cancel the call, leave a message waiting indication or connect regardless. If they choose to connect, the intercom call shall proceed normally allowing the caller to speak to the party in the room

7. Call Stations denoted with a V suffix (eCS-1V, eCS-2V eCS-6V) shall have the ability to control the volume of the local eSeries room speaker. Call Stations with Volume Controls shall include volume up and volume down momentary contact touchpoints to adjust volume of audio being broadcast over the speaker. Separate user-set volume levels shall be maintained for intercom calls, normal and emergency priority paging announcements. Volume controls shall be disabled when there is no audio being broadcast to the speaker.

O. Alarm Acknowledge and Alert Call Stations

1. The Alarm Acknowledge and Alert Call Stations, as indicated on the drawings, shall be Telecor model eCS-9 or eCS-10 or approved equal. The station shall have the ability to generate Emergency Priority Level call-ins, perform Alarm acknowledge operations and initiate Medical and Security Alerts. The station shall be designed to operate in conjunction with the Alarm Manager.
2. Call Stations shall be monitored for call line failure. In the event of an open circuit, short circuit or short to ground, the System shall detect the fault and notify a designated console operator automatically. The type of fault and its identity on the system shall be displayed on a designated console screen.
3. The Stations shall initiate Emergency priority level call-ins from remote locations to Consoles. Stations shall be equipped with a Call assurance LED that shall provide call confirmation whereby the LED shall flash, confirming the call-in placement. The LED shall continue to flash until the call in is answered.
4. Locations for "Shelter-in-Place" such as classrooms, offices and areas of refuge, as noted on the drawings, shall be equipped with Alarm Acknowledge or Alert Call Stations. During an Alarm Condition these stations shall notify the Alarm Management Console of the completion of alarm related emergency responses by the occupants of a "Shelter-in-Place" location.
5. The eCS-10 or approved equal stations shall have all the features the eCS-9 station, as well as additional Medical and Security Alert touchpoints. These touchpoints shall have the ability to place call-ins to Console identifying the call as a Medical or Security alert priority level.
6. Medical or Security level call-ins shall combine a call-in, audio announcement, and a scrolling textual message into a single emergency

priority operation. The origin and priority of the call shall be displayed at the Console location. Additionally, an announcement shall be broadcast over a selected zone(s) of loudspeakers, broadcasting the location and type of alarm. A textual message identifying the origin of the alarm and alarm type shall also scroll across selected message display(s). The broadcast and messages shall continue to scroll until the call-in is answered.

P. Virtual Call Stations

1. The system shall include Virtual Call Stations that shall reside on classroom PC's as well as portable PC's that are used in classroom locations that are equipped with network speakers. Virtual Call Stations shall mimic the look and behavior of physical Call Stations. These shall feature interactive and animated buttons which react to user inputs such as mouse clicks or finger presses on touch screen devices.
2. Virtual Call Stations shall include Call Assurance indication via a virtual LED representation. When a call is placed the virtual LED shall blink to indicate that the call has been placed.
3. Virtual Call Stations shall be customizable to have any or all of the following configurations:
  - a. Push to Call
  - b. Emergency
  - c. Privacy
  - d. Do Not Disturb
  - e. Channel Select
  - f. Volume
  - g. Alarm Acknowledgment
  - h. Medical Alert
  - i. Security Alert
4. Virtual Call Stations shall be configured with Volume buttons that shall adjust the volume in a room. Volume adjustments shall only affect the current active audio broadcast into the room, for example lowering the volume of paging announcements and not affecting the volume of intercom or emergency announcements.
5. When used with the Call Manager feature, Virtual Call Stations shall support Alarm Acknowledgement as well as Medical and Security Alert functionality. Alarm Acknowledgement functionality shall be used in conjunction with Alarm Manager operations to signal completion of emergency response instructions. Medical and Security Alert touchpoints shall activate a combined emergency response that shall initiate a priority call-in, as well as an audio broadcast and a scrolling text message on Message Displays.
6. When used with portable PC's that are moved between locations, users shall be prompted to enter the room number of their current location.
7. The implementation of the Virtual Call Station shall be a client-server model. The server software shall reside in the Master Clock and Message host hardware. The client portion shall be installed on computers throughout the facility and connected to the facility network.

- Q. SUPERVISED MESSAGE DISPLAY/CALENDAR CLOCK/SPEAKER/STROBE
1. The Supervised Message Display/Calendar Clock/Speaker/Strobe Assembly (subsequently referred to as MDCSS Assembly), as indicated on the drawings, shall be a Telecor model e2444-LD or approved equal
  2. The MDCSS Assembly shall receive power and data over a RJ45 connect CAT5E/6 cable via a Power-Over-Ethernet switch port. Once plugged into the LAN through a Power over Ethernet network switch, the MDCSS shall be immediately functional and shall not require any network configuration or administration to function
  3. The MDCSS Assembly shall be supervised and monitored for connectivity to the network. Additionally, any Call Stations connected to the MDCSS shall be monitored for call line failure. In the event of an open circuit, short circuit or short to ground, the System shall detect the fault and notify a designated console operator automatically
  4. The MDCSS Assembly's Speaker shall have a power rating of 10 watts of audio signal and provide a minimum of 92db @ 1 meter SPL for maximum intelligibility.
  5. The MDCSS Speaker shall provide transmission of HD audio as generated from intercom console and/or associated push-to-talk, intelligent microphone, supervised network amplifier, or program sources connected to the network.
  6. The MDCSS Speakers shall support talkback; to optimize intelligibility talkback capabilities shall be supported.
  7. The MDCSS Assembly shall support the direct connection with RJ45 connectors of two supervised room Call Stations. The stations shall provide the means for: normal calls, emergency calls, privacy mode, and do not disturb mode, as well as for the adjustment of Audio Volume. Call Stations shall include a call placed assurance status LED to indicate a call has been placed. Call Stations shall be supervised and immediately indicate disconnection or a wiring fault.
  8. Emergency Call Stations shall be separate and clearly labeled with a red button so as to impart obvious operation in the event of an emergency. Systems that only provide a single call station with dual emergency and normal operation based on a sequence of button presses shall not be acceptable.
  9. The volume of the MDCSS Speaker shall be adjusted individually, by zone, or across the entire network. Volume controls incorporated into certain Call Station models shall allow a user to adjust the volume of a local MDCSS speaker. Volume levels can be set for specific functions: intercom, paging, emergency paging, and Public Channel operations.
  10. Volume controls shall be capable of establishing and maintaining levels for intercom, paging, program distribution, and tones, independently for each of the above functions. Emergency announcements shall not be affected by the adjustment of other speaker volume/levels such as paging, intercom, or other lower priority audio broadcasts. Systems that utilize a manually



- operated transformer or resistive volume control design shall not be acceptable.
11. The MDCSS Speaker shall have the capability to be configured as a member of one or more paging zones.
  12. The MDCSS Assembly shall include an integral LED Strobe that shall illuminate for the duration of an announcement being broadcast over the MDCSS speaker to alert room occupants of the announcement in progress.
  13. The LED Strobe shall be configured to illuminate in up to 4 colors (white, red, green or blue) with various flash patterns. Patterns can be set to activate based on the priority of announcements. For example, using a distinct color and flash pattern for an Emergency Announcement while a routine announcement or intercom call can be assigned another pattern and color.
  14. The MDCSS Assembly shall include a Message Display/Clock that shall simultaneously display plain text emergency or routine messages and independent numerically-coded messages. When not displaying a message, it shall display the current time and date. Hours and minutes shall be displayed with large 2.25" digits. Seconds shall be slightly smaller for easy distinction. The date shall be displayed in plain text by a 10-character, dot matrix display showing the day of the week, followed by the month and date. The date shall be displayed in the English, Spanish or French language.
  15. The Message Display/Clock shall automatically broadcast the audio announcement and a corresponding text message that is initiated on the over the communications system. These shall be enhanced by strobe illumination.
  16. The Message Display/Clock shall also display text-only messages independent of any audio messages.
  17. In addition to plain text messages, the Message Display/Clock shall also simultaneously display numerically-coded messages which can be activated independently to provide trained staff with additional context to the plain text messages.
  18. The Message Display/Clock shall include elapsed timer and count-down functions. Used in conjunction with a Timer Button Panel, users shall set the Clock to count upwards from zero to 24 hours or count down from a specified value to zero. Additionally, the unit shall have a local input that will accept a relay closure to activate the elapsed or countdown timer operation. Timers embedded into pre-set plain text messages shall display messages for a pre-set period of time.
  19. All Message Display/Clocks shall be continuously synchronized to a Time Master connected anywhere on the same network. Time corrections shall be performed instantaneously so that all Clocks display the correct time. If communication is lost with the Time Master, Clocks shall maintain the time independently and stay synchronized with each other. Once communication with the Time Master is re-established, the displays shall automatically resynchronize with the Time Master.

20. The MDCSS Assembly shall integrate with the Classroom Sound Field System and automatically mute the System during an intercom call, paging announcement or class change tone signal. Integration shall include the ability for an Emergency level call to be initiated from the Sound Field pendant microphone to the Administrative Console.
  21. The MCDSS Assembly shall be equipped with 3 control relays to support integration with ancillary classroom devices. The relays shall be automatically activated during an emergency call-in or when receiving a broadcast or textual emergency message.
  22. The LED strobe shall require Class 4, PoE+ power from the Network Switch.
  23. The MCDSS Assembly shall be flush mounted using an e2444-BBF, or approved equal enclosure. In applications where surface mounting is required, an e2444-BBS or approved equal enclosure shall be provided.
- R. Supervised Message Display/Calendar Clock/Speaker
1. The Supervised Message Display/Calendar Clock/Speaker Assembly as indicated on the drawings, shall be a Telecor model e2444 or approved equal.
  2. The Assembly shall be identical to the Supervised Message Display/Calendar Clock/Speaker/Strobe Assembly as described in section 2.16 of the specifications, however it will not be equipped with the LED Strobe.
- S. Digital Message Display/Calendar Clock
1. The Digital Message Display/Calendar Clocks, as indicated on the drawings, shall be a Telecor model e365-TB or approved equal. The unit shall simultaneously display the current time and date. The time is displayed in hours, minutes, and seconds. Hours and minutes are displayed with large 2.25" digits. Seconds are slightly smaller for easy distinction. The date is displayed in plain text by a 10-character, dot matrix display showing the day of the week, followed by the month and date. The date shall be displayed in the English, Spanish or French language.
  2. The Digital Message Display/Calendar Clock shall receive power and data over a RJ45 connect CAT5E/6 cable via a Power-Over-Ethernet switch port. Once plugged into the LAN through a Power over Ethernet network switch, the Display shall be immediately functional and shall not require any network configuration or administration to function.
  3. The Digital Message Display/Calendar Clock shall be supervised and monitored for connectivity to the network. Additionally, any Call Stations connected to the Display shall be monitored for call line failure. In the event of an open circuit, short circuit or short to ground, the System shall detect the fault and notify a designated console operator automatically
  4. These Displays shall be designed for use in conjunction with the Master Clock/Message Host. All secondary clocks shall be synchronized with the Master Clock. Corrections shall be done instantaneously and all clocks shall display the identical time and date. In the event of a power failure, the System shall maintain accurate timekeeping during the outage. Once power

is restored, all clocks shall be immediately updated with the correct time and date.

5. In addition to displaying the time, the Unit shall display textual messages in the dot matrix section of the display to the audio announcement that is being broadcast over the communication system speakers. These messages shall be used to alert personnel of an emergency or a situation of concern.
6. The Unit shall also display text-only messages independent of any audio messages.
7. In addition to plain text messages, the Digital Message Display/Calendar Clock shall also simultaneously display numerically-coded messages which can be activated independently to provide trained staff with additional context to the plain text messages.
8. The Digital Message Display/Calendar Clock shall include elapsed timer and count-down functions. Used in conjunction with a Timer Button Panel, users shall set the Clock to count upwards from zero to 24 hours or count down from a specified value to zero. Additionally, the unit shall have a local input that shall accept a relay closure to activate the elapsed or countdown timer operation. Timers embedded into pre-set plain text messages shall display messages for a pre-set period of time.
9. Messages shall be programmed using the Editor software or from a web based Graphical User Interface (GUI). Messages can be activated by the Master Clock/Message Host, allowing text to be displayed at specific times and days of the week. Messages shall be displayed using a variety of visual effects including scrolling or flashing single lines of text, as well as alternating between different lines of text. The dot matrix display shall default back to the date when not displaying messages.
10. The Digital Message Display/Calendar Clock shall be suitable for surface or recessed installations using the appropriate enclosure. For surface installations, the 2431-BBS enclosure is required. For recessed installations, the 2431-BBF enclosure is used. Two surface-mount enclosures shall be mounted back-to-back with a 2423 Dual Mounting Kit, creating a double-faced version.

T. Supervised Network Intercom Talk Back Speaker

1. The Supervised Network Intercom Talk-Back Speaker (subsequently referred to as Network Speaker) shall be a Telecor model eS8-TB. The Network Speaker shall be supervised and capable of up to 10 watts of audio signal and provide a minimum of 92db @ 1 meter SPL for maximum intelligibility. Speaker spacing shall be as defined by manufacturer to provide maximum intelligibility.
2. The Network Speaker shall provide transmission of HD audio as generated from intercom console and/or associated push-to-talk, intelligent microphone, supervised network amplifier, or program sources connected to the network.

3. The Network Speaker shall provide a dry contact output that can be activated remotely from a station or from a console, such as may be required in a door release application.
4. The Network Speaker shall receive power and data over a RJ45 connect CAT5E/6 cable via a Power-Over-Ethernet switch port. Once plugged into the LAN through a Power over Ethernet network switch, the Network Speaker shall be immediately functional and receive calls and pages from consoles on the network. The Network Speaker shall not require any network configuration or administration to function.
5. The Network Speakers shall support talkback; to optimize intelligibility talkback capabilities shall be supported via a microphone conditioned for low noise, HD audio, and with compression and noise gate capability. Stations that use the speaker instead of a separate microphone for talkback capability shall not be accepted.
6. The Network Speaker shall have a call-in roll-over feature where if it places a call-in to a primary call destination which is not answered after a preset amount of time, the call-in shall be automatically escalated to a secondary call-in destination. If both the primary and secondary call-in destinations are unavailable, the call-in shall be redirected to a back-up Station, Console, or telephone device.
7. The Network Speaker shall have the capability to be configured as a member of one or more paging zones.
8. The Network Speaker shall support the direct connection with RJ45 connectors of two, supervised room notification stations. The stations shall provide the means for: normal calls, emergency calls, privacy mode, and do not disturb mode. Notification stations shall include a call placed assurance status LED to indicate a call has been placed. Notification stations shall be supervised and immediately indicate disconnection or a wiring fault.
9. In addition to the visual call-in assurance status indicators on the notification stations, call-in assurance status indication must also be provided on the associated speaker. Also, in addition to visual call-in assurance, audible call-in assurance shall also be provided in support of persons with visual disabilities.
10. Under blackout conditions, the notification station shall be illuminated such that it can be located in the dark.
11. Normal call stations must support the ability to activate emergency call-in signals via multiple button presses and press and hold operations. Emergency call stations shall be separate and clearly labeled with a red button so as to impart obvious operation in the event of an emergency. Systems that only provide a single call station with dual emergency and normal operation shall not be acceptable.
12. The Network Speaker shall provide local, visual indication of operation or failed-communication and shall immediately annunciate a loss of communication at the main console location.
13. Network Speaker volume must be capable of individual level settings through the network. Settings must not be adjustable without

authorization. Volume controls located in rooms must be centrally lockable via the network. Systems that allow a volume adjustment without authorization shall not be acceptable. Systems that utilize a manually operated transformer or resistive volume control design shall not be acceptable. Volume controls shall be capable of establishing and maintaining levels for intercom, paging, program distribution, and tones, independently for each of the above functions. Emergency announcements shall be sent at a volume/level as required by the AHJ and shall not be affected by the adjustment of other speaker volume/levels for the purposes of paging, intercom, or other lower priority audio events.

U. Supervised Network Master/Satellite Talkback Speaker

1. The Supervised Network Master/Satellite Talkback Speaker (subsequently referred to as the Master Talkback Speaker) shall be a Telecor model eS8-TB4 or approved equal. The Master Talkback Speaker shall support all functionality of the Telecor model eS8-TB (specified above).
2. The Master Talkback Speaker shall be supervised and shall support the connection of Satellite Speakers, and support up to four watts of additional 25V Satellite Speaker load. Satellite Speakers shall be Telecor model S8T2570 or approved equal.
3. The Satellite speakers shall not support talkback; to optimize intelligibility talkback capabilities shall be supported from a single point via a microphone conditioned for low noise, HD audio, and with compression and noise gate capability. Stations that use the speaker instead of a separate microphone for talkback capability shall not be accepted.
4. The Satellite Speaker shall receive power over a RJ45 connect CAT5E/6 cable via the Supervised Network Master/Satellite Talkback Speaker. Both the Supervised Network Master/Satellite Talkback Speaker and the Satellite Speaker shall receive all power through a single Power-Over-Ethernet switch port. Systems that require auxiliary power or additional external or supplementary audio power amplification are not acceptable.

V. Security Intercom Stations

1. The Security Intercom Stations as indicated on the drawings, shall be a Telecor model eSTN-1 or approved equal. The Station shall provide for two-way communications as well as call-in capabilities.
2. The Station shall receive power and data through a Power-Over-Ethernet switch. Once plugged into the LAN through a Power over Ethernet network switch, the Station shall receive calls and pages from the eSeries network. The Station shall not require any network configuration or administration to function.
3. The Station shall have a call-in roll-over feature whereby if a call-in to the primary call destination is not answered after a preset amount of time, the call shall be automatically copied to a secondary call destination. If both the primary and secondary call destinations are unavailable, the call shall be redirected to a back-up Station or Console.

4. The Station shall have the capability to be configured as a member of one or more paging zones
5. The Station shall be tamper-proof in design and construction and shall provide for two-way communications as well as call-in capabilities. The faceplate shall be fabricated from 11-gauge stainless steel with a brushed, mar-resistant finish. The speaker shall be protected against tampering by three barriers located between the faceplate and the speaker cone. A Mylar speaker cone shall be used in order to prevent damage to the speaker from liquids.
6. The Security Intercom Stations shall mount onto standard, three-gang electrical boxes, of a depth of no less than 2.875". Mounting hardware shall be tamper-proof. The switch actuator shall be fabricated from solid metal, and connected to the faceplate by a pair of welded studs. It shall be no less than 1/2" in diameter and shall be situated flush to the front of the faceplate. The actuator shall activate a momentary contact switch whose movement shall be limited by a mechanical stop to prevent damage caused by heavy impact.

W. LED Strobes

1. The LED Strobes, as indicated on the drawings, shall be a Telecor model eLD1 or approved equal. The LED strobes shall illuminate for the duration of an announcement being broadcast over local speaker or horn to alert room occupants of the announcement in progress
2. The LED Strobe shall receive power and data through a Power-Over-Ethernet switch. Once plugged into the LAN through a Power over Ethernet network switch. When the LED strobe is installed in locations with an associated Talkback Speaker, Breakout Module or Message Display Calendar Clock, the Strobe and the associated device shall only require a single Ethernet drop.
3. The LED Strobe shall be configured to illuminate in up to 4 colors (white, red, green or blue) with various flash patterns. Patterns can be set to activate based on the priority of announcements. For example, using a distinct color and flash pattern for an Emergency Announcement while a routine announcement or intercom call can be assigned another pattern and color.
4. The LED Strobe shall be assigned to an associated speaker, an individual speaker zone, multiple zones or all zones. The Strobe shall be activated by placing an intercom call to the room speaker associated with the Strobe, broadcasting an announcement to that speaker, or by an activation of an alarm event such as a Lockdown. The Strobe shall illuminate for the duration of the announcement or event
5. The LED strobe shall require Class 4, PoE+ power provided from the Network Switch
6. The LED Strobe shall be flush mounted using a standard 4, 11/16" square x 2" deep backbox.

X. Vandal Resistant Horn/Loudspeaker

1. The Vandal Resistant Horn/Loudspeakers, as indicated on the drawings, shall be a vandal-resistant loudspeaker assembly that utilizes a double re-entrant horn compression type loudspeaker. It shall be used in locations as indicated on the drawings.
2. These are weatherproof units that are designed for outdoor installation. They are capable of delivering 16 watts of continuous power and include an integral 25/70 volt line-matching transformer. The transformer features color-coded primary taps at 16, 8, 4, 2, and 1 watts. The nominal frequency range is 350 Hz to 10 kHz, with a sensitivity of 96 dB SPL (1 watt/1 meter).
3. The Vandal Resistant Horn/Loudspeaker shall be assembled onto a 16-gauge steel baffle that incorporates a unique interwoven steel security screen for maximum speaker protection while remaining acoustically transparent. This shall prevent any object from penetrating the loudspeaker. The baffle shall be finished in a powder epoxy coating that provides a resilient surface suitable for harsh environments.
4. The Vandal Resistant Horn/Loudspeakers shall be secured to the backbox with "pin-in-torx" tamper-proof screws, which are included with the unit. The Vandal Resistant Horn/Loudspeakers shall be suitable for flush mounting using the H16 Recessed Back Box. Alternatively, surface installations shall be accommodated using the SH-16 Surface Enclosure.

Y. Loudspeakers

1. The Speakers, as indicated on the drawings, shall be 24" x 24 Lay-in Tile Speaker Assemblies, 12" x 24" Lay-in Tile Speaker Assemblies, and Pre-assembled 8" Packaged Ceiling Speakers or approved equals.
2. The 24" x 24" Lay-in Tile Speaker Assembly shall incorporate an 8" cone loudspeaker, equipped with a dual 25/70 volt line-matching transformer, pre-assembled into a 24" x 24" square perforated steel baffle and combination backbox, designed to be installed flush in a suspended ceiling.
3. The loudspeaker shall have a wide frequency response for general-purpose voice and music reproduction. The line-matching transformer shall have primary taps at 5, 2.5, 1.25, 0.63, and 0.32 watts. The baffle is finished in a mar-resistant, white epoxy coating. The baffle is finished in a mar-resistant, white epoxy coating.
4. The speaker assembly shall be designed to be installed in a suspended ceiling. Installation is quick and simple as the 24" x 24" is designed to fit into a common 2-foot square ceiling grid. Tie off tabs allow the assembly to be secured to the building structure or ceiling grid to address any safety concerns.
5. The 12" x 24" Lay-in Tile Speaker Assembly shall incorporate an 8" cone loudspeaker, equipped with a dual 25/70 volt line-matching transformer, pre-assembled into a 12" x 24" square perforated steel baffle and combination backbox, designed to be installed flush in a suspended ceiling.
6. The loudspeaker shall have a wide frequency response for general-purpose voice and music reproduction. The line-matching transformer shall have

primary taps at 5, 2.5, 1.25, 0.63, and 0.32 watts. The baffle is finished in a mar-resistant, white epoxy coating. The baffle is finished in a mar-resistant, white epoxy coating.

7. The speaker assembly shall be designed to be installed in a suspended ceiling. Installation is quick and simple as the 12" x 24" is designed to fit into a common 2-foot square ceiling grid. Tie off tabs allow the assembly to be secured to the building structure or ceiling grid to address any safety concerns.
8. The Pre-assembled 8" Packaged Ceiling Speaker shall include the loudspeaker/transformer/baffle assembly.
9. The loudspeaker size shall be 8 inches in diameter and have a power handling capacity of 15 watts. The voice coil shall be of high-temperature bonded construction, be one inch in diameter and have an impedance of 8 ohms. The speaker shall have a frequency range of at least 65 Hz to 17,000 Hz and an axial sensitivity of 92dB at 1 m, with a 1 watt input signal @ 1000 Hz. The loudspeaker shall be equipped with a factory wired 25/70 volt line-matching transformer. The transformer shall have the primary taps at 5/16, 5/8, 1-1/4, 2-1/2, and 5 watts. The insertion loss shall be no greater than 1.0 dB. The transformer shall be mounted to the speaker with the secondary leads soldered to the speaker terminals.
10. The assembly shall include a baffle constructed of 22 gauge, cold-rolled steel finished with a mar-resistant white, semi-gloss, epoxy coating. The baffle shall have a diameter of 13".
11. The Pre-assembled 8" Packaged Ceiling Loudspeaker shall mount to a T7 support bridge, used to attach the assembly to suspended ceilings. The support bridge shall accept an enclosure, model H7, for applications where a protective enclosure is required. The H7 enclosure shall attach to the support bridge with appropriate mounting screws. The enclosure shall be a Telecor H7 or approved equal. A circular molded polystyrene damping pad shall be fitted to the inside top of the enclosure to prevent acoustical and mechanical resonances. The pad's surface shall be molded with a triangular pattern for enhancing low frequencies and shall optimize the audio response of the enclosure.

Z. Re-entrant Horn/Loudspeakers

1. The Re-Entrant Horn/Loudspeakers, as indicated on the drawings, shall be a double re-entrant type, with a flared bell and an integral compression driver rated for 15 watts of continuous audio power. The frequency response shall be 375 -14,000Hz. Nominal sensitivity shall be such that a sound pressure level of 110 dB at 1000 Hz. (on axis) at distance of one meter is produced with an input of one watt. Sound dispersion shall be no less than 100 degrees, regardless of the mounting position. The horn shall contain a weatherproof, built-in, 25/70 volt line-matching transformer. Power taps shall be at 0.48, 0.94, 1.8, 7.5 or 15 watts for a 25V line and 1, 2, 3.8, 7.5 or 15 watts for a 70 V line. The power taps shall be screwdriver adjustable. Impedance selection shall be 5,000, 2500, 1300, 666, 333, 87, or 45 ohms.



2. The unit shall include a die-cast universal mounting bracket, allowing the horn to be positioned both in the vertical and horizontal planes with a single adjustment. The wiring terminals and the screwdriver power tap shall be enclosed by a clear plastic cover for security and weather protection. The horn shall be finished in a grey epoxy. Dimensions shall be 9 1/4" deep with a diameter of 8".

AA. Digital Clocks

1. The Digital Clocks shall be Telecor model eCLK-2.5 / eCLK-4 or approved equal.
2. The eCLK-2.5 shall incorporate a 2.5" display and located as indicated on the drawings. It shall be suitable for surface or recessed installations using the appropriate enclosure. For surface installations, the 2421-BBS or approved equal Enclosure shall be used. For recessed installations, the 2421-BBF or approved equal Enclosure shall be used.
3. The eCLK-4 shall incorporate a 4" display and located as indicated on the drawings. It shall be suitable for surface or recessed installations using the appropriate enclosure. For surface installations, the 2431-BBS or approved equal Enclosure shall be used. For recessed installations, the 2431-BBF or approved equal Enclosure shall be used
4. The Digital Clocks shall utilize seven-segment, AlGaAs "Supper Bright" LED displays which provide exceptional visibility. The Clocks shall incorporate a single piece front cover that is free of grooves and gaps. This shall keep infectious contaminants out of the eClock. The cover's non-porous surface shall allow for easy, comprehensive, hygienic cleaning with anti-bacterial agents.
5. The Digital Clocks shall receive power and data through a Power-Over-Ethernet switch. The Digital Clocks shall not require any network configuration or administration to function. Once plugged into the LAN through a Power over Ethernet network switch, the Digital Clocks shall be functional.
6. These Displays shall be designed for use in conjunction with the Master Clock/Message Host. All secondary clocks shall be synchronized with the Master Clock. Corrections shall be done instantaneously and all clocks shall display the identical time and date. In the event of a power failure, the System shall maintain accurate timekeeping during the outage. Once power is restored, all clocks shall be immediately updated with the correct time and date.
7. Two surface-mount enclosures shall be mounted back-to-back with a 2423 Dual Mounting Kit, creating a double-faced version.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with the Installer present, for compliance with requirements and other conditions affecting the performance of the School Communications and School Safety Network.
- B. Do not proceed until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install system in accordance with NFPA 70 and other applicable codes. Install equipment in accordance with manufacturer's written instructions.
- B. Furnish and install all material, devices, components, and equipment for a complete operational system.
- C. Impedance and Level Matching: Carefully match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
- D. Control Circuit Wiring: Install control circuits in accordance with NFPA 70 and as indicated. Provide number of conductors as recommended by system manufacturer to provide control functions indicated or specified.
- E. All housings are to be located as indicated.
- F. The contractor shall provide necessary transient protection on the AC power feed, all copper station lines leaving or entering the building, and all central office trunks. All protection shall be as recommended by the equipment supplier and referenced to earth ground.
- G. Wiring within Enclosures: Provide adequate length of conductors. Bundle, lace, and train the conductors to terminal points with no excess. Provide and use lacing bars.
- H. Provide physical isolation from speaker-microphone, telephone, line-level wiring, and power wiring. Run in separate raceways, or where exposed or in same enclosure, provide 12-inch minimum separation between conductors to speaker-microphones, telephone wiring and adjacent parallel power. Provide physical separation as recommended by equipment manufacturer for other system conductors.
- I. Identification of Conductors and Cables: Use color coding of conductors and apply wire and cable marking tape to designate wires and cables so all media are identified in coordination with system wiring diagrams.
- J. Weatherproofing: Provide weatherproof enclosures for items to be mounted outdoors or exposed to weather.

### 3.3 GROUNDING

- A. Provide equipment grounding connections for Integrated Electronic Communications Network systems as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.
- B. Ground equipment, conductor, and cable shields to eliminate shock hazard and to minimize to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.
- C. Provide all necessary transient protection on the AC power feed and on all copper station lines leaving or entering the building. Note in system drawings, the type and location of these protection devices as well as all wiring information.

#### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide services of a duly factory authorized service representative for this project location to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.
- B. Inspection: Make observations to verify that units and controls are properly labeled, and interconnecting wires and terminals are identified. Provide a list of final tap settings of paging speaker line matching transformers.
- C. Testing: Rectify deficiencies indicated by tests and completely re-test work affected by such deficiencies at Contractor's expense. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

#### 3.5 FINAL ACCEPTANCE TEST

- A. The Final Acceptance Testing shall be provided to the Owner or the Owner's designated representative only. Final acceptance testing to any other trade or service provider for the project will not comply with the requirements of this section.
- B. The contractor will provide a Final Acceptance Test record document signed by both the contractor and the Owner or designated Owner's Representative establishing the "In Warranty" date. The warranty period will not commence until the Final Acceptance Test is completed.
- C. Be prepared to verify the performance of any portion of the installation by demonstration, listening and viewing test, and instrumented measurements. Make additional adjustments within the scope of work and which are deemed necessary by the Owner because of the acceptance test.

#### 3.6 COMISSIONING

- A. The contractor shall train the Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventative maintenance of the system. This training will be in accordance with the training as outlined in Section 1.6 of these specifications. In addition to the Training Materials provided, the contractor will also furnish Operators Manuals and Users Guides at the time of this training.
- B. Schedule training with Owner through the owner's representative, with at least seven days advance notice.

### 3.7 OCCUPANCY ADJUSTMENTS

- A. The contractor shall provide Occupancy Adjustments in accordance with Section 1.6 of these specifications. A response scenario amenable to both the owner and the contractor will be established and followed for the first year of service.

### 3.8 CLEANING AND PROTECTION

- A. Prior to final acceptance, the contractor shall vacuum and clean all system components and protect them from damage and deterioration. All blank spaces in equipment cabinets will be covered with blank panels. Top and side panels, and all cabinet doors will be installed. All general areas within and around all equipment rack/cabinets in the facility will be swept, vacuumed, and cleaned up. No cabinets will be left unlocked and all cabinet keys will be turned over to the owner or designated owner's representative.

END OF SECTION

## SECTION 28 05 13

### CONDUCTORS AND CABLES 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 Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section Includes:

1. UTP cabling.
2. 50/125] or 62.5/125-micrometer, multimode optical fiber cabling.
3. Coaxial cabling.
4. RS-232 cabling.
5. Low-voltage control cabling.
6. Control-circuit conductors.
7. Fire alarm wire and cable.
8. Identification products.

##### 1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- E. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

##### 1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Pathways 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."

## 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
  1. For coaxial cable, include the following installation data for each type used:
    - a. Nominal OD.
    - b. Minimum bending radius.
    - c. Maximum pulling tension.
- B. Shop Drawings: Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
  1. Vertical and horizontal offsets and transitions.
  2. Clearances for access above and to side of cable trays.
  3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
- C. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- D. Seismic Qualification Certificates: For pathways, 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.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Operation and Maintenance Data: For wire and cable to include in operation and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  1. Allowable pulling tension of cable.
  2. Cable connectors and terminations recommended by the manufacturer.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An NRTL.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.
- 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.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
  - 1. Test each pair of UTP cable for open and short circuits.

## 1.8 PROJECT CONDITIONS

- A. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.
  - 1. Indications that wire and cables are wet or moisture damaged include, but are not limited to, discoloration and sagging of factory packing materials.
- B. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## PART 2 - PRODUCTS

### 2.1 PATHWAYS

- A. Support of Open Cabling: NRTL labeled for support of Category 6 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.

- B. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
- C. Outlet boxes shall be no smaller than those specified on plans.

## 2.2 LOW-VOLTAGE CONTROL CABLE

- A. Paired Cable: NFPA 70, Type CMG.
- B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP. As specified on plans and or as follows:
  - 1. 1 pair, twisted, No. 16 AWG, stranded (19x29) and No. 18 AWG, stranded (19x30) tinned copper conductors.
  - 2. PVC insulation.
  - 3. Unshielded.
  - 4. PVC jacket.
  - 5. Flame Resistance: Comply with NFPA 262.

## 2.3 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in raceway..
- B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in raceway.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

## 2.4 IDENTIFICATION PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation.
  - 2. HellermannTyton.
  - 3. Kroy LLC.
  - 4. PANDUIT CORP.
- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."



## 2.5 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-B.3.
- E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA-569-B.
- B. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.
- C. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." for installation of conduits and wireways.
- D. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- E. Pathway Installation in Equipment Rooms:
  - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
  - 2. Install cable trays to route cables if conduits cannot be located in these positions.
  - 3. Secure conduits to backboard when entering room from overhead.
  - 4. Extend conduits 3 inches (75 mm) above finished floor.
  - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- F. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

### 3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems." for installation of supports for pathways, conductors and cables.

### 3.3 WIRING METHOD

- A. Install wiring in metal raceways and wireways. Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch (21 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.
- B. Install wiring in raceways except in accessible indoor ceiling spaces and in interior hollow gypsum board partitions where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch (21 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.
- C. Install cable, concealed in accessible ceilings, walls, and floors when possible.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

### 3.4 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.
- C. General Requirements for Cabling:
  - 1. Comply with TIA/EIA-568-B.1.
  - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  - 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
  - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.

6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

D. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

### 3.5 POWER AND CONTROL-CIRCUIT CONDUCTORS

- A. 120-V Power Wiring: Install according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.
- B. Minimum Conductor Sizes:
  - 1. Class 1 remote-control and signal circuits, No. 14 AWG.
  - 2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
  - 3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

### 3.6 CONNECTIONS

- A. Comply with requirements in Division 28 Section "Intrusion Detection" for connecting, terminating, and identifying wires and cables.
- B. Comply with requirements in Division 28 Section "Access Control" for connecting, terminating, and identifying wires and cables.
- C. Comply with requirements in Division 28 Section "Video Surveillance and video management software systems" for connecting, terminating, and identifying wires and cables.
- D. Comply with requirements in Division 28 Section "PLC Electronic Detention Monitoring and Control Systems" for connecting, terminating, and identifying wires and cables.
- E. Comply with requirements in Division 28 Section "Digital Addressable Fire-Alarm System and or Zoned (DC Loop) Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

### 3.7 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA-569-B, "Firestopping" Annex A.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.8 GROUNDING

- A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

### 3.9 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### 3.10 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. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
  - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - 3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  - 4. Optical Fiber Cable Tests:
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    - b. Link End-to-End Attenuation Tests:
      - 1) Multimode Link Measurements: Test at 850 or 1300 nm in 1 direction according to TIA-526-14-A, Method B, One Reference Jumper.
      - 2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
  - 5. Coaxial Cable Tests: Comply with requirements in Division 27 Section "Structured Cabling for voice and data"

- D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 28 05 13

## SECTION 28 05 28

### PATHWAYS 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 Division 01 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetallic conduits, tubing, and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Metal wireways and auxiliary gutters.
5. Nonmetallic wireways and auxiliary gutters.
6. Surface pathways.
7. Boxes, enclosures, and cabinets.
8. Handholes and boxes for exterior underground cabling.

- B. Related Requirements:

1. Section 26 05 33 "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.
2. Section 27 05 33 "conduits and backboxes for communication systems."

##### 1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.



- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of pathway groups with common supports.
- B. Source quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, [provide products by the following] provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 3. Alpha Wire Company.
  - 4. Anamet Electrical, Inc.
  - 5. Electri-Flex Company.
  - 6. O-Z/Gedney; a brand of EGS Electrical Group.
  - 7. Picoma Industries; Subsidiary of Mueller Water Products, Inc.
  - 8. Republic Conduit.
  - 9. Robroy Industries
  - 10. Southwire Company.
  - 11. Thomas & Betts Corporation.
  - 12. Western Tube and Conduit Corporation.
  - 13. Wheatland Tube Company; a division of John Maneely Company.
- B. General Requirements for Metal Conduits and Fittings:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Comply with TIA-569-B.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.

- F. EMT: Comply with ANSI C80.3 and UL 797.
- G. FMC: Comply with UL 1; zinc-coated steel.
- H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
  - 2. Fittings for EMT:
    - a. Material: Steel..
    - b. Type: compression.
  - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 467, rated for environmental conditions where installed, and including flexible external bonding jumper.
  - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 3. Anamet Electrical, Inc.
  - 4. Arnco Corporation.
  - 5. CANTEX Inc.
  - 6. CertainTeed Corp.
  - 7. Condux International, Inc.
  - 8. Electri-Flex Company.
  - 9. Kraloy.
  - 10. Lamson & Sessions; Carlon Electrical Products.
  - 11. Niedax-Kleinhuis USA, Inc.
  - 12. RACO; a Hubbell Company.
  - 13. Thomas & Betts Corporation.
- B. General Requirements for Nonmetallic Conduits and Fittings:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Comply with TIA-569-B.
- C. ENT: Comply with NEMA TC 13 and UL 1653.
- D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- E. LFNC: Comply with UL 1660.
- F. Rigid HDPE: Comply with UL 651A.
- G. Continuous HDPE: Comply with UL 651B.
- H. RTRC: Comply with UL 1684A and NEMA TC 14.
- I. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- J. Fittings for LFNC: Comply with UL 514B.
- K. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- L. Solvent cements and adhesive primers 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."

### 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. Cooper B-Line, Inc.
  2. Hoffman; a Pentair company.
  3. Mono-Systems, Inc.
  4. Square D; a brand of Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
  1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Comply with TIA-569-B.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type unless otherwise indicated.

- E. Finish: Manufacturer's standard enamel finish.

## 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Adalet.
  - 2. Cooper Technologies Company; Cooper Crouse-Hinds.
  - 3. EGS/Appleton Electric.
  - 4. Hoffman; a Pentair company.
  - 5. Hubbell Incorporated; Killark Division.
  - 6. Milbank Manufacturing Co.
  - 7. Mono-Systems, Inc.
  - 8. RACO; a Hubbell Company.
  - 9. Thomas & Betts Corporation.
  - 10. Wiremold / Legrand.
  
- B. General Requirements for Boxes, Enclosures, and Cabinets:
  - 1. Comply with TIA-569-B.
  - 2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.
  
- C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
  
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy Type FD, with gasketed cover.
  
- E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
  
- F. Metal Floor Boxes:
  - 1. Material: Cast metal or sheet metal.
  - 2. Type: Fully adjustable.
  - 3. Shape: Rectangular.
  - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  
- G. Nonmetallic Floor Boxes: Nonadjustable, rectangular.
  - 1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- J. Gangable boxes are prohibited.
- K. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 4 with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Nonmetallic Enclosures:
    - a. Material: Fiberglass.
    - b. Finished inside with radio-frequency-resistant paint.
  - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- M. Cabinets:
  - 1. NEMA 250, Type 12, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.
  - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND CABLING

- A. General Requirements for Handholes and Boxes:
  - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
  - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 3. Comply with TIA-569-B.

### PART 3 - EXECUTION

#### 3.1 PATHWAY APPLICATION

- A. Indoors: Apply pathway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
  - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
- B. Minimum Pathway Size: 3/4-inch (21-mm) trade size. Minimum size for optical-fiber cables is 1 inch (27 mm).
- C. Pathway Fittings: Compatible with pathways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  - 3. EMT: Use compression fittings. Comply with NEMA FB 2.10.
  - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- E. Install surface pathways only where indicated on Drawings.
- F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C)

#### 3.2 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- B. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Complete pathway installation before starting conductor installation.

- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications wiring conduits for which only two 90-degree bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- I. Pathways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot (3-m) intervals.
  - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange pathways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
- J. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for pathways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- N. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to conduit assembly to assure a continuous ground path.

- P. Cut conduit perpendicular to the length. For conduits of 2-inch (53-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- R. Surface Pathways:
  - 1. Install surface pathway for surface electrical outlet boxes only where indicated on Drawings.
  - 2. Install surface pathway with a minimum 2-inch (50-mm) radius control at bend points.
  - 3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- S. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.
- T. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service pathway enters a building or structure.
  - 3. Where otherwise required by NFPA 70.
- U. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- V. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- W. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- X. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- Y. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.



Z. Set metal floor boxes level and flush with finished floor surface.

AA. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

3.4 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 28 05 28

**SECTION 28 13 00**

**ACCESS CONTROL/CAMERA SURVEILLANCE**

1.01 Definitions

- A. ACS – Access Control System
- B. ALPR – Automatic License Plate Recognition
- C. CSA – Client Software Application
- D. DGM – Dynamic Graphical Maps
- E. SDK – Software Development Kit
- F. GLM – Genetec Lifecycle Management
- G. SSM – Server Software Module
- H. UI – User Interface
- I. USP – Unified Security Platform
- J. USW – Unified Web Client
- K. VMS – Video Management System

1.02 Qualifications

- A. The system programmer shall have attended manufacturer training and obtained certification in
  - 1. Genetec™ Security Center - Synergis™ Technical Certification.
  - 2. Genetec Security Center - AutoVu™ Technical Certification
  - 3. Genetec Security Center - Omnicast™ Technical Certification
- B. Optionally, the system programmer shall have attended manufacturer training and obtained certification in Genetec Security Center - Enterprise Technical Certification.
- C. The system programmer shall be a Genetec certified partner with the following level of qualification:
  - a. Certified Reseller or up
  - b. Elite Reseller or up
  - c. Unified Elite Reseller
- D. The system programmer shall submit proof of certifications.

## Part 2 - USP General Requirements

- 2.01 The Unified Security Platform (USP) shall be an enterprise class IP-enabled security and safety software solution.
- A. The USP shall support the seamless unification of IP access control system (ACS), IP video management system (VMS), and IP automatic license plate recognition system (ALPR) under a single platform. The USP user interface (UI) applications shall present a unified security interface for the management, configuration, monitoring, and reporting of embedded ACS, VMS and ALPR systems, and associated edge devices.
- B. Functionalities available with the USP shall include:
1. Configuration of embedded systems, such as ACS and VMS systems.
  2. Live event monitoring.
  3. Live video monitoring and playback of archived video.
  4. Alarm management.
  5. Reporting, including creating custom report templates and incident reports.
  6. The Federation™ feature for global monitoring, reporting, and alarm management of multiple remote and independent ACS, VMS, and systems spread across multiple facilities and geographic areas.
  7. Global cardholder management across multiple facilities and geographic areas each with their own independent ACS system.
  8. Microsoft Active Directory integration for synchronizing USP user accounts and ACS cardholder accounts.
  9. Integration with third party systems and databases via plug-ins (access control, video analytics, point of sale, and more).
  10. Dynamic graphical map viewing.
  11. Asset management system integration
- C. The USP shall be deployed in one or more of the following types of installations:
1. Unified access and video platform, and any combination thereof.
  2. Standalone access control, video platform.
  3. Unified access and video platform that federates multiple remote ACS, VMS.
  4. Standalone access control that federates multiple independent remote ACS.
- D. Licensing:
1. A single central license shall be applied centrally on the configuration server.

2. There shall be no requirement to apply a license at every server computer or client workstation.
  3. Based on selected options, one or more embedded systems shall be enabled or disabled.
- E. Hardware and Software Requirements:
1. The USP and embedded systems (video, license plate recognition, and access control) shall be designed to run on a standard PC-based platform loaded with a Windows operating system. The preferred operating system shall be coordinated with the Owner following the manufacturer supported operating systems.
  2. The core client/server software shall be built in its entirety using the Microsoft .NET software framework and the C# (C-Sharp) programming language.
  3. The USP database server(s) shall be built on Microsoft's SQL Server. The preferred SQL version shall be coordinated with the Owner and compatible with the USP.
  4. The USP shall be compatible with virtual environments, including VMware and Microsoft Hyper-V.
  5. The USP shall use the latest user interface (UI) development and programming technologies such as Microsoft WPF (Windows Presentation Foundation), the XAML markup language, and .NET software framework.

## 2.02 USP Architecture

- A. The USP shall be based on a client/server model. The USP shall consist of a standard Server Software Module (SSM) and Client Software Applications (CSA).
- B. The USP shall be an IP enabled solution. All communication between the SSM and CSA shall be based on standard TCP/IP protocol and shall use TLS encryption with digital certificates to secure the communication channel.
- C. The SSM shall be a Windows service that can be configured to start when the operating system is booted and run in the background. The SSM shall automatically launch at computer startup, regardless of whether or not a user is logged on the machine.
- D. Users shall be able to deploy the SSM on a single server or across several servers for a distributed architecture. The USP shall not be restricted in the number of SSM deployed.
- E. The USP shall support the concept of The Federation feature whereby multiple independent ACS, VMS installations can be merged into a single large virtual system for centralized monitoring, reporting, and alarm management
- F. The USP shall protect against potential database server failure and continue to run through standard off-the-shelf solutions.
- G. The USP shall support up to one thousand instances of CSA connected at the same time. However, an unrestricted number of CSA can be installed at any time.

- H. The USP shall support an unrestricted number of logs and historical transactions (events and alarms) with the maximum allowed being limited by the amount of hard disk space available.
- I. Roles-Based Architecture:
  - 1. The USP shall consist of a role-based architecture, with each SSM hosting one or more roles.
  - 2. Each role shall execute a specific set of tasks related to either core system video (VMS), or access control (ACS) functionalities, among many others. Installation shall be streamlined through the ability of the USP to allow administrators to:
    - a. Deploy one or several SSM across the network prior to activating roles.
    - b. Activate and deactivate roles as needed on each and every SSM.
    - c. Centralize role configuration and management.
    - d. Support remote configuration.
    - e. Move roles over from one SSM to another.
  - 3. Each role, where needed, shall have its own database to store events and role-specific configuration information.
  - 4. Roles without databases, such as The Federation feature, Active Directory, and Global Cardholder Management, shall support near real-time standby without any third party failover software being required.
  - 5. Directory Role:
    - a. The Directory Role shall manage the central database that contains all the system information and component configuration of the USP.
    - b. The Directory Role shall authenticate users and give access to the USP based on predefined user access rights or privileges, and security partition settings.
    - c. The Directory Role shall support the configuration/management of the following components common to the ACS and VMS sub-systems:
      - i. Security Partitions, users, and user groups
      - ii. Areas
      - iii. Zones, input/output (IO) linking rules, and custom output behavior
      - iv. Alarms. Schedules, and scheduled tasks
      - v. Custom events
      - vi. Macros or custom scripts
    - d. The Directory Role shall support the configuration/management of the following components specific to VMS:

- i. Video servers and their peripherals (for example audio, IOs, and serial ports)
    - ii. PTZ
    - iii. Camera sequences
    - iv. Recording and archiving schedules
  - e. The Directory Role shall support the configuration/management of the following components specific to ACS:
    - i. Door controllers, and input and output (IO) modules
    - ii. Doors, Elevators, and Access rules
    - iii. Cardholders and cardholder groups, credentials, and badge templates
2. The Video Archiver Role shall be responsible for managing cameras and encoders under its control and archiving.
3. The Media Router Role shall be responsible for routing video and audio streams across local and wide area networks from the source (for example DVS) to the destination (for example CSA).
4. The Access Manager Role shall be responsible for synchronizing access control hardware units under its control, such as door controllers and I/O modules. This role shall also be responsible for validating and logging all access activities and events when the door controllers and I/O modules are online.
5. The Zone Manager Role shall be responsible for managing all software zones (collection of inputs) and logging associated zone events. Zones shall consist of inputs from both access control and video devices.
6. The Health Monitoring Role shall be responsible for monitoring and logging health events and warnings from the various client applications, roles, and services that are part of the USP. This role shall also be responsible for logging events within the Windows Event Log and for generating reports on health statistics and health history.
7. Optional Roles
  - a. The Active Directory Role shall be responsible for synchronizing user accounts and cardholder accounts with a Microsoft Active Directory server
  - b. The Intrusion Manager Role shall be responsible for managing third party intrusion devices such as alarm panels and perimeter detection devices. This role shall also be responsible for logging all intrusion events in a database.
  - c. The Asset Manager Role shall be responsible for integrating and synchronizing with third party asset management systems and logging asset related events. This role shall also be responsible for supporting the execution of asset-related reports such as inventory reports and asset activity reports

- d. The Plug-in Manager Role shall be responsible for the communication between the USP and third party systems such as video analytics, access control, videoand and building management systems.
  - e. The Web SDK Role shall be responsible for connecting the USP to any application or interface developed with the Web Service SDK. Applications developed with the Web Service SDK shall be platform independent and rely on the REST protocol for communications.
  - f. The Communication Management Role shall be responsible for registering the SIP communication endpoints and for managing the call routing.
- J. Server Monitoring Service (Watchdog):
- 1. The USP shall include a Server Monitoring Service that continuously monitors the state of the Server Software Module (SSM) service.
  - 2. The Server Monitoring Service shall be a Windows service that automatically launches at system startup, regardless of whether or not a user is logged into his account.
  - 3. The Server Monitoring Service shall be installed on all PCs/servers running an SSM. In the event of a malfunction or failure, the Server Monitoring Service shall restart the failed service. As a last resort, the Server Monitoring Service shall reboot the PC/server should it be unable to restart the service.

#### 2.03 USP Access Control, Video Unification.

- A. The Monitoring UI shall present a true Unified Security Interface for live monitoring and reporting of the ACS, VMS. Advanced live video viewing and playback of archived video shall be available through the Monitoring UI.
- B. The Configuration UI shall present a true Unified Security Interface for the configuration and management of the ACS, VMS.
- C. The user shall be able to associate one or more video cameras to the following entity types: areas, doors, elevators, zones, alarms, intrusion panels.
- D. It shall be possible to view video associated to access control events when viewing a report.
- E. It shall be possible to view video associated to intrusion panel events when viewing a report.

#### 2.04 USP Alarm Management

- A. The USP shall support the following Alarm Management functionality:
  - 1. Create and modify user-defined alarms. An unrestricted number of user-defined alarms shall be supported.
  - 2. Assign a time schedule or a coverage period to an alarm. An alarm shall be triggered only if it is a valid alarm for the current time period.
  - 3. Set the priority level of an alarm and its reactivation threshold.



4. Define whether to display live or recorded video, still frames or a mix once the alarm is triggered.
  5. Provide the ability to display live and recorded video within the same video tile using picture-in-picture (PiP) mode.
  6. Provide the ability to group alarms by source and by type.
  7. Define the time period after which the alarm is automatically acknowledged.
  8. Define the recipients of an alarm. Alarm notifications shall be routed to one or more recipients. Recipients shall be assigned a priority level that prioritizes the order of reception of an alarm.
  9. Define the alarm broadcast mode. Alarm notifications shall be sent using either a sequential or an all-at-once broadcast mode.
  10. Define whether to display the source of the alarm, one or more entities, or an HTML page.
  11. Specify whether an incident report is mandatory during acknowledgment.
- B. The workflows to create, modify, add instructions and procedures, and acknowledge an alarm shall be consistent for access control and video alarms.
  - C. Alarms shall be federated, allowing global alarm management across multiple independent USP, ACS, and VMS systems.
  - D. The USP shall also support alarm notification to an email address or any device using the SMTP protocol.
  - E. The ability to create alarm-related instructions shall be supported through the display of one or more HTML pages following an alarm event. The HTML pages shall be user-defined and can be interlinked.
  - F. Alarm unpacking and packing shall be supported where all the entities associated to an alarm can be display in the Monitoring UI with the single click of a button.
  - G. The user shall have the ability to acknowledge alarms, create an incident upon alarm acknowledgement, and put an alarm to snooze.
  - H. The user shall be able to spontaneously trigger alarms based on something he or she sees in the system.
  - I. An alarm shall be configured in such a way that it remains visible until the source condition has been acknowledged.
  - J. The user shall be able to investigate an alarm without acknowledging it.

## 2.05 USP Threat Levels

- A. The USP shall support Threat Levels to dynamically change the system behavior to respond to critical events.
- B. Threat Levels shall be activated and deactivated by the CSA operator with the right privilege.
- C. Threat Levels shall be set on an area or on the entire system.
- D. Threat Levels shall affect the system behavior by executing any action available in the USP such as: trigger output, start recording, block camera, override recording quality, arm zone, set a door in maintenance mode, and more.
- E. The following specific actions shall be available with Threat Level:
  - 1. Set minimum security clearance to restrict or permit access to cardholders on specific areas on top of the restrictions imposed by the access rules.
  - 2. Set minimum user level to automatically log out user from the USP.
  - 3. Set reader mode to change how the doors are accessed (for example card and PIN, or card or PIN).
- F. A visible notification shall be displayed in all operator CSA when a Threat Level is activated.

## 2.06 USP Advanced Task Management

- A. USP shall support an infrastructure for managing Monitoring UI tasks used for live monitoring, day-to-day activities, and reporting.
- B. Administrators shall be able to assign tasks and lock the operator's workspace. The user management of their workspace shall be limited by their assigned privileges.
- C. Operators shall be able save their tasks as either Public tasks or Private tasks and in a specific partition. Public tasks shall be available to all users. Private tasks shall only be available to the owner of the task.
- D. Operators shall be able to share their tasks by sending them to one or more online users. Recipients shall have the option to accept the sent task.
- E. Operators shall be able to duplicate a task.

## 2.07 USP Reporting

- A. The USP shall support report generation (database reporting) for access control and video, and intrusion.
- B. Each and every report in the system shall be a USP task, each associated with its own privilege. A user shall have access to a specific report task if they have the appropriate privilege.

- C. The workflows to create, modify, and run a report shall be consistent for access control and video reports.
- D. Reports shall be federated, allowing global consolidated reporting across multiple independent USP, ACS, VMS systems.
- E. Access control and reports shall support cardholder pictures and license plate pictures, respectively.
- F. The USP shall support the following types of reports:
  - 1. Alarm reports
  - 2. Video-specific reports (archive, bookmark, motion, and more)
  - 3. Configuration reports (cardholders, credentials, units, access rules, readers/inputs/outputs, and more)
  - 4. Activity reports (cardholder, cardholder group, visitor, credential, door, unit, area, zone, elevator, and more)
  - 5. Health activity and health statistics reports
  - 6. Other types of reports, including visitor reports, audit trail reports, incident reports, and time and attendance reports
- G. Generic Reports, Custom Reports and Report Templates:
  - 1. The user shall have the option of generating generic reports from an existing list, generating reports from a list of user-defined templates, or creating a new report or report template.
  - 2. The user shall be able to customize the predefined reports and save them as new report templates. There shall be no need for an external reporting tool to create custom reports and report templates. Customization options shall include setting filters, report lengths, and timeout period. The user shall also be able to set which columns shall be visible in a report. The sorting of reported data shall be available by clicking on the appropriate column and selecting a sort order (ascending or descending).
  - 3. All report templates shall be created within the Monitoring UI.
  - 4. These templates can be used to generate reports on a schedule in PDF or Excel formats.
  - 5. An unrestricted number of custom reports and templates shall be supported.
- H. A reporting task layout shall consist of panes with settings (report length, filters, go and reset commands, etc.), the actual report data in column format, and a pane with display tiles. The user shall be able to drag and drop individual records in a report onto one or more display tiles to view a cardholder's picture ID, playback a video sequence event.
- I. The USP shall support comprehensive data filtering for most reports based on entity type, event type, event timestamp, custom fields, and more.

- J. The reporting task shall have the ability to display results through graphics such as line charts, bar charts, stacked bar charts, doughnut charts, and pie charts.
- K. The user shall be able to click on an entity within an existing report to generate additional reports from the Monitoring UI.
- L. The USP shall support the following actions on a report: print report, export report to a PDF/Microsoft Excel/CSV file, export the graphics chart in JPG/PNG, and automatically email a report based on a schedule and a list of one or more recipients.

## 2.08 USP Dashboards

- A. The USP shall support the ability to create dashboards.
- B. Operators shall be allowed to view dashboards if they are granted the appropriate privilege. Modification to the dashboards should also be allowed to users granted the appropriate privilege.
- C. Dashboards in the system shall be a USP task. A user shall have access to a specific dashboard task if they have the appropriate privilege.
- D. Dashboards shall be shared either in a private folder or a public folder.
- E. A dashboard shall consist of a canvas with various widgets displayed on the canvas. All widgets should offer the ability to specify location and size to the widget, a title to the widget, a background color to the widget, and the ability to refresh periodically the content of the widget.
- F. Dashboard widget types shall be:
  - 1. Image: provides the ability to display an image (JPG, PNG, GIF, BMP) on a dashboard.
  - 2. Text: provides the ability to display a text on a dashboard. The text style shall be configurable, so font, size, color, and alignment can be specified by the user.
  - 3. Tile: provides the ability to display any entity of the USP inside of a tile.
  - 4. Web page: provides the ability to display a URL on a dashboard.
  - 5. Entity Count: provides the ability to display the total number of a specific entity type in the USP.
  - 6. Reports: provides the ability to display the results of any saved reports in the system. The results shall be displayed either by showing the total number of results in the report, a set of top results from the report, or a visual graph from the data returned by the report.
- G. It shall be possible to extend the widgets of a dashboard using the SDK. This will provide the ability to develop custom widgets to the system.

- H. The USP shall support the following actions on a dashboard: print dashboard, export dashboard to PNG file, and automatically email a report based on a schedule and a list of one or more recipients.

#### 2.09 USP Federation feature: Monitoring of Remote Systems

- A. The USP shall support the concept of a Federation feature for access control and video.
- B. The Federation feature shall allow multiple independent USP systems (Federated systems) to be unified into a larger virtual system (the Federation feature). This shall facilitate the global monitoring of multiple independent USP systems.
- C. The Federation feature shall support the unification of multiple independent video surveillance systems or VMS.
- D. The Federation feature shall support the unification of multiple independent access control systems or ACS.
- E. The Federation feature shall support the unification of multiple independent license plate recognition systems.
- F. Entities that shall federated and monitored centrally from the Federation feature shall include: alarms, areas, cameras, cardholders and cardholder groups, credentials, doors, elevators and zones (monitored inputs).
- G. The Federation feature shall support a cloud-based deployment, whereby the service and infrastructure will be updated automatically and provisioned by the service provider, without need for on-site hardware.
- H. The Federation feature shall support Global Alarm Management from the Monitoring UI for access control, video.
- I. The Federation feature shall support Global Report Generation from the Monitoring UI for access control, video.
- J. The Federation feature shall support dozens of operator actions on remote (federated) entities from the Monitoring UI (for example generating a global report taking into account events from multiple independent sites or acknowledging remote alarms).

#### 2.10 USP Zone Management

- A. The USP shall support the configuration and management of zones for input point monitoring via the Zone Manager Role. A user shall be able to add, delete, or modify a zone if they have the appropriate privileges.
- B. A zone shall monitor the status of one or more inputs points. Zone monitoring or input point monitoring shall be possible through the use of a controller and one or more input modules. Inputs from video cameras or video encoders shall also be accessible via a zone.

- C. Depending on the hardware installed, supervised inputs shall be supported. Depending on the input module used, both 3-state and 4-state supervision shall be available.
- D. A schedule shall be defined for a zone, indicating when the zone will be monitored.
- E. Custom Events shall provide full flexibility in creating custom events tailored to a zone. Users shall be able to associate custom events to state changes in monitored inputs.
- F. The ACS shall support one or more cameras per zone. Video shall then be associated to zone state changes.
- G. Input/Output (IO) Linking
  - 1. Zone management shall support Input/Output (IO) Linking. I/O Linking shall allow one or more inputs to trigger one or more outputs.
  - 2. I/O Linking shall be available in offline mode when communication between the server and hardware is not available.
  - 3. Custom Output Behaviors shall provide full flexibility in creating a variety of complex output signal patterns: simple pulses, periodic pulses, variable duty-cycle pulses, and state changes.
  - 4. Through the “trigger an output” action, the ACS shall support the triggering of outputs with custom output behaviors.

#### 2.11 USP User and User Group Security, Partitions, and Privileges Management

- A. The USP shall support the configuration and management of users and user groups. A user shall be able to add, delete, or modify a user or user group if they have the appropriate privileges.
- B. The USP shall support user authentication with claims-based authentication using external providers. External providers shall include:
  - 1. ADFS (Active Directory Federation Services)
- C. Common access rights and privileges shared by multiple users shall be defined as User Groups. Individual group members shall inherit the rights and privileges from their parent user groups. User group nesting shall be allowed.
- D. User privileges shall be extensive in the USP. All configurable entities for the USP, including access control, video shall have associated privileges.
- E. Specific entities, such as cardholders, cardholder groups, and credentials shall include a more granular set of privileges, such as the right to access custom fields and change the activation or profile status of an entity.
- F. Partitions:

1. The USP shall limit what users can view in the configuration database via security partitions (database segments). The administrator, who has all rights and privileges, shall be allowed to segment a system into multiple security partitions.
  2. All entities that are part of the USP can be assigned to one or more partitions.
  3. A user who is given access to a specific partition shall only be able to view entities (components) within the partition to which they have been assigned. Access is given by assigning the user as an accepted user to view the entities that are members of a particular partition.
  4. A user or user group can be assigned administrator rights over the partition.
- G. It shall be possible to specify user and user group privileges on a per partition basis.
- H. Advanced logon options shall be available such as dual logon and more.
- I. It shall be possible to specify an inactive period for the Monitoring UI after which time the application shall automatically lock, while still preserving access to currently displayed camera feeds.
- J. It shall be possible to review used permissions and determine:
1. For any entity in the system, which user group or user can view or modify it.
  2. For any user group or user in the system, what are its privileges.
  3. For any privilege in the system, which user group or user is allowed to perform the underlying action.

#### 2.12 USP Event/Action Management

- A. The USP shall support the configuration and management of events for video. A user shall be able to add, delete, or modify an action tied to an event if he has the appropriate privileges.
- B. The USP shall receive all incoming events from one or more ACS and VMS. The USP shall take the appropriate actions based on user-define event/action relationships.
- C. The USP shall receive and log the following events:
1. System-wide events
  2. Application events (clients and servers)
  3. Cardholder and credential events
  4. Unit events
  5. Zone events
  6. Alarm events

7. First Person In and Last Person Out events and antipassback events
  8. Intrusion events
  9. Asset management events
  10. Health monitoring events.
- D. The USP shall allow the creation of custom events.
  - E. The USP shall have the capability to execute an action in response to an access control, video event.
  - F. The USP shall allow a schedule to be associated with an action. The action shall be executed only if it is an appropriate action for the current time period.
- 2.13 USP Schedules and Scheduled Tasks
- A. Schedules
    1. The USP shall support the configuration and management of complex schedules. A user shall be able to add, delete, or modify a schedule if they have the appropriate privileges.
    2. The USP shall provide full flexibility and granularity in creating a schedule. The user shall be able to define a schedule in 1-minute or 15-minute increments.
    3. Daily, weekly, ordinal, and specific schedules shall be supported.
  - B. Scheduled Tasks
    1. The USP shall support scheduled tasks for access control, video.
    2. Scheduled tasks shall be executed on a user-defined schedule at a specific day and time. Recurring or periodic scheduled tasks shall also be supported.
    3. Scheduled tasks shall support all standard actions available within the USP, such as sending an email or emailing a report.
- 2.14 USP Macros and Custom Scripts
- A. The USP shall enable users to automate and extend the functionalities of the system through the use of macros or custom scripts for access control, and video.
  - B. Custom macros shall be created with the USP Software Development Kit (SDK).
  - C. A macro shall be executed either automatically or manually.
  - D. In the Monitoring UI, a macro shall be launched through hot actions.
- 2.15 USP Dynamic Graphical Maps (DGM)
- A. The USP shall support mapping functionality for access control, video surveillance, intrusion detection and external applications.



- B. The USP shall provide a map centric interface with the ability to command and control all the USP capabilities from a full screen map interface.
- C. It shall be possible to span the map over all screens of the USP client station. In the scenario where the map is spanned over all the screens of the USP client station it shall be possible to navigate the map including pan and zoom, and the map's moves shall be synchronized between all screens. Spanning the map over multiple screen must provide the same command and control capabilities than in a single screen display.
- D. The DGM shall support the following file format and protocol for importing map background:
  - 1. PDF
  - 2. JPG
  - 3. PNG
  - 4. Web Tile Map Service (WMTS) and Web Map Service (WMS) defined by the Open Geospatial Consortium (OGC)
  - 5. BeNomad
  - 6. AutoCAD (DWG & DXF)
- E. The DGM shall provide the following online map providers for use as map background and provide the ability to manage their service license if they require one:
  - 1. Google Map, aerial, terrain (Licensed)
  - 2. Bing Map, aerial, satellite, hybrid (Licensed)
  - 3. ESRI ArcGIS (Licensed)
  - 4. OpenStreet Map aerial (Licensed)
  - 5. OVI hybrid
- F. It shall be possible to configure a mixed set of maps made of GIS, online providers and private imported files and link them together.
- G. The DGM shall provide the ability to display all native entities of the USP including:
  - 1. Cameras, fix, and PTZ
  - 2. Doors
  - 3. Camera sequences
  - 4. Areas
  - 5. Intrusion areas
  - 6. Intrusion zones

7. License Plate Recognition cameras
  8. Digital inputs
  9. Digital outputs
  10. Intercoms
  11. Alarms
  12. Macros
  13. Police Car Patrollers
- H. The DGM shall provide the ability to draw and display information over the map in the form of:
1. Vectoral shapes: line, rectangles, polygons, ellipse
  2. Pictures
  3. Text
- I. The DGM shall provide the ability to display any type of third party entities integrated through an SDK.
- J. The DGM shall provide the ability to display layer of information in Keyhole Markup Language (KML) format.
- K. The DGM shall provide the ability to the operator to manage layers of entities displayed over the map, being able to turn them on and off and changing the superposition order.
- L. The DGM shall provide the ability to import data layers from one or more ESRI ArcGIS servers.
- M. The DGM shall provide the operators with the ability to manage layers that are imported from ESRI ArcGIS. The operators shall be able to turn the layers on and off, as well as sort the layers.
- N. The DGM shall offer built-in map data backup and restore for both map backgrounds and layers of entities.
- O. The DGM shall offer failover capabilities.
- P. The DGM shall scale up to several thousands of entities on a single map and hundreds of maps.
- Q. The DGM shall provide a means to update a map background without affecting the map object configuration.
- R. The DGM shall offer a user-friendly graphical map designer to configure the maps.
- S. The DGM shall provide user friendly and intuitive navigation that includes:

1. The ability to create hierarchies of maps to facilitate navigation within and between various sites and buildings.
  2. The ability to define favorites for recurrent position recall.
  3. The possibility to create links between maps. The map links shall allow the link from one map to multiple maps representing the floors of a building. Navigating between floors of a building shall keep the level of the map.
  4. A common user experience regarding navigation into the map for both GIS and private maps.
- T. It shall be possible to monitor the state of entities on the map. It shall be possible to customize the icons of any entities represented on the map.
- U. The DGM shall offer the ability to optionally set a graphical display notification of the motion detection.
- V. The DGM shall offer a smart selection tool to access the video. By clicking the location the user wants to see, the DGM will automatically select the cameras that can see this location and move the PTZ towards that location. This smart selection tool shall take obstacles into consideration and not display cameras that cannot see the location because of a wall.
- W. It shall be possible to select a location by drawing a zone of interest on the DGM, and to display all the entities that are part of that zone of interest at once.
- X. The user shall be able to select and display the content of multiple USP entities on the map in pop-up windows.
- Y. The user shall be able to move, resize, and pin the USP entity pop-up windows to the map.
- Z. It shall be possible to access live and playback video from the map.
- AA. It shall be possible to monitor all entity event notifications from the DGM. Users shall be able to turn notifications on and off per entity.
- BB. The DGM shall offer the ability to fully operate alarm monitoring. It shall be possible to:
1. Center the map on entities related to the alarm.
  2. Visualize the Alarm notifications on the map and access the related videos from the map.
  3. Trigger and receive alarms.
  4. Act on the alarm from the DGM, including acknowledgements, forwarding, and investigation.
  5. Visualize that an alarm occurred in an underlying linked map.
- CC. The DGM shall provide the following search capabilities:

1. Search and center by entity name.
  2. From the Display of an entity in the USP, locate the entity on the map and offer the ability to select another one close-by.
- DD. Any update of map content by an administrator shall be immediately and dynamically pushed to all DGM users.
- EE. The DGM shall support the use of GIS maps or private maps or a combination of both for map background.
- FF. The DGM shall be compatible with any GIS compliant maps with the OGC and supporting WMTS and WMS. This includes, but is not limited to, ESRI maps. The DGM shall allow the selection of the appropriate GIS layers.
- GG. The DGM shall provide an intuitive built-in map designer for entity positioning on the map using drag and drop. Any configuration shall be graphic.
- HH. It shall be possible to edit and configure multiple map objects at once.
- II. All map design modifications shall be logged in an audit trail.
- JJ. Various actions shall be available within maps for execution through simple and intuitive double-click, right-click, or drag-and-drop functionality. Examples of actions available through maps shall include unlocking a door and acknowledging an alarm.
- KK. Through the following functionality, the DGM shall allow the management of USP alarms from the map:
1. Locate on the map entities related to the alarm.
  2. Display entities of the alarm with a specific icon, color, transparency level, and blinking rate.
  3. List, select, and locate alarms.
  4. Auto center the map on the highest priority alarm.
  5. Handle the alarm from the map, including acknowledgement, forwarding, and investigation.
  6. All map containers, such as hotspots or map links shall reflect the alarm status of the contained entities.
- LL. It shall be possible to add advanced functionality to maps object using the SDK. Any functionality available through the USP SDK shall be available within maps.
- MM. The DGM shall offer lasso tools for:
1. Displaying entities at one location through a single action.
  2. Triggering an action on all entities at one a location in a single click.

3. Editing multiple entities at one location simultaneously.

NN. The DGM shall allow the display of USP entities selected from the map on a remote monitor (video wall).

OO. The DGM shall provide the ability to search within the map by entity name.

PP. The DGM shall allow the use of KML overlay map information for both GIS and private maps. Movable objects shall be supported using KML.

QQ. The Contractor shall provide licenses for each entity that is required to be shown on the graphical maps.

2.16 USP Audit and User Activity Trails (Logs)

- A. The USP shall support the generation of audit trails. Audit trails shall consist of logs of operator/administrator additions, deletions, and modifications.
- B. Audit trails shall be generated as reports. They shall be able to track changes made within specific time periods. Querying on specific users, changes, affected entities, and time periods shall also be possible.
- C. For entity configuration changes, the audit trail report shall include detailed information of the value before and after the changes.
- D. The USP shall support the generation of user activity trails. User activity trails shall consist of logs of operator activity on the USP such as login, camera viewed, badge printing, video export, and more.
- E. The ACS shall support the following actions on an audit and activity trail report: print report and export report to a PDF/ Microsoft Excel/CSV file.

2.17 USP Incident Reports

- A. Incident reports shall allow the security operator to create reports on incidents that occurred during a shift. Both video-related and access control-related incident reports shall be supported.
- B. The operator shall be able to create standalone incident reports or incident reports tied to alarms.
- C. The operator shall be able to link multiple video sequences to an incident, access them in an incident report, and change the date or time of the sequences later on.
- D. It shall be possible to create a list of Incident categories, tag a category to an incident, and filter the search with the category as a parameter.
- E. Incident reports shall allow the creation of a custom form on which to input information on an incident.

- F. Incident reports shall allow entities, events, and alarms to be added to support at the report's conclusions.
- G. Incident reports shall allow the use of a custom logo, the default Mission Control logo or no logo at all.

#### 2.18 USP Third Party Integration

##### A. Microsoft Active Directory Integration:

1. The USP shall support a direct connection to one or multiple Microsoft Active Directory server via the Active Directory Role(s). Active Directory integration shall enable the synchronization of information from the Active Directory server to the USP.
2. Active Directory integration shall permit the central management of the USP users, user groups, cardholders, and cardholder groups.
3. The USP shall support ADFS for user login.
4. The USP shall be able to connect to and synchronize data from multiple Active Directory servers (up to 10).
5. The USP shall support Azure AD for cardholder synchronization.
6. The USP shall support synchronizing Active Directory Universal Groups as well as security groups belonging to other domains within the same forest.
7. The USP shall support Microsoft Active Directory encryption using LDAP SSL.
8. When enabled, Active Directory shall manage user logon to the USP client applications through the user's Windows credentials. Logging on to the USP shall utilize native Active Directory password management and authentication features.
9. It shall be possible to synchronize the following USP entities and their information from Active Directory with the USP:
  - a. Users (username, first and last names, email address, and more)
  - b. User groups (user group name, description, and group email address)
  - c. Cardholders (first and last names, description, email, picture and more)
  - d. Cardholder groups (cardholder group name, description, and group email address)
  - e. Active Directory attributes to USP custom fields
10. When enabled, the addition, removal, or suspension of a user's Windows account in Active Directory shall result in the creation, deletion, or disabling of the equivalent user account in the USP.
11. When enabled, the addition, removal, or suspension of a user's Windows account in Active Directory shall result in the creation, deletion, or disabling of the equivalent cardholder account in the USP.

12. Supported synchronization methods for additions, modification, and deletions of synchronized entities shall include: on first logon (users only), manual synchronization, and scheduled synchronization.
13. The USP shall support user connections across independent organizations by connecting to an external ADFS (Active Directory Federation Services) service using claims-based authentication.

B. Intrusion Detection Integration:

1. The USP shall integrate with third party intrusion panels and devices via an Intrusion SDK. The Intrusion Manager Role shall manage communications with the intrusion panels. Communications with intrusion devices shall be over serial communications and/or an IP network.
2. Integration with intrusion panels shall be possible outside the release cycle of the USP. It shall be possible to add new integrations at any point in time.
3. Functionality available via the integration of intrusion devices with the USP shall include the following (where supported by the intrusion panel):
  - a. Arm and disarm intrusion devices (manually, on schedule, or following a USP event)
  - b. Activate or trigger intrusion device outputs
  - c. View intrusion events and alarms
  - d. Monitor the status, including arming status, of the intrusion devices
  - e. Video verification of intrusion events and alarms with video panels
  - f. Create USP zones using intrusion device inputs
4. Currently supported intrusion panels include:
  - a. Bosch G Series panels
  - b. DSC Power Series panels
  - c. DMP XR Series panels
  - d. Honeywell Galaxy Dimension and Flex panels
  - e. Vanderbilt SPC
  - f. UTC Advisor Master and Advanced

C. Third Party Access Control Systems:

1. The USP shall integrate with third party access control software via the SDK. Communications with access control software shall be over an IP network, and should not support administrative tasks such as cardholder management.

2. Integration with access control software shall be possible outside the release cycle of the USP. It shall be possible to add new integrations at any point in time.
  3. Functionality available via the integration of access control software with the USP shall include the following (where supported by the access control solution):
    - a. Synchronize access control entities and receive associated events and states within the USP, including:
      - i. Cardholders and access rights
      - ii. Visitors
      - iii. Readers and doors
      - iv. Alarms
      - v. Inputs and outputs
    - b. Monitor access control events
    - c. Monitor and acknowledge access control alarms
    - d. Trigger actions and outputs in the access control software using hot actions and event-to-actions
    - e. Lock and unlock doors in the access control software
    - f. Video verification of access control events and alarms
    - g. Configure event-to-actions using the access control events and alarms
    - h. Generate Security Center reports using the access control data
    - i. View and monitor states of door entities in the USP maps
  4. Currently supported access control manufacturers include:
    - a. Tyco Software CCURE
    - b. UTC Lenel Onguard
    - c. Amag Symmetry
    - d. Siemens Sipass
    - e. AssaAbloy ARX
- D. Asset Management Integration:
1. The USP shall integrate with third party asset management systems via the Asset Management Role.
  2. Communications with asset management solutions shall be over an IP network (via software communications).



3. Functionality available via the integration of asset management systems with the USP shall include the following (where supported by the asset management systems):
    - a. Synchronize asset management system assets with USP asset entities.
    - b. Live monitoring of asset-related activity events, health events, and activity (asset online, asset offline, asset moves, or low battery).
    - c. Synchronization of asset management alarms with Security Center alarms.
    - d. Viewing video tied to asset-related activity and alerts within monitoring and reporting tasks.
    - e. Acknowledging alarms in Security Center which acknowledges alerts in the asset management system and vice versa.
    - f. Real-time tracking of asset locations on a per area basis.
    - g. Asset Management Inventory reporting task that details the current location (area) of an asset.
    - h. Asset Activity reporting task that provides a historical review of asset-related events and activity.
  4. Currently supported asset management systems include:
    - a. RF Code Asset Manager
    - b. Deister Key management
    - c. Morsewatchmans
    - d. TRAKA
- E. Additional Third Party Integrations
1. The USP shall support multiple approaches to integrating third party systems. These shall include: Software Development Kits (SDKs), REST-based Web Service SDKs, RTSP Service SDKs, and more.
  2. The USP architecture shall support the addition of new connectors to integrate to third party system integration, such as:
    - a. Third party video systems
    - b. Third party access control systems
    - c. Building management systems
    - d. Access Control ecosystem (such as IDscanner, card synchronization, Gardtour)
    - e. Transaction monitoring (POS, Barcode scanning, ATM)
    - f. Data protocols (modbus, BacNet, OPC, SNMP)

g. Videowall

h. Human resource management systems (HRMS)

2.19 USP Software Development Kit (SDK)

- A. A USP SDK shall be available to support custom development for the platform.
- B. The SDK shall include functionalities specific to the embedded access control (ACS), and video (VMS) systems.
- C. Integration with external applications and databases shall be possible with the SDK.
- D. The SDK shall enable end-users to develop new functionality (user interface, standalone applications or services) to link the USP to third party business systems and applications, such as Badging Systems, Human Resources Management Systems (HRMS), and Enterprise Resource Planning (ERP) systems.
- E. The SDK shall be based on the .NET framework.
- F. The SDK shall support dynamic or transactional updates to the USP configuration. It shall also support change notification of USP entity configuration.
- G. The SDK shall provide an extensive list of programming functions to view and/or configure core entities such as: users and user groups, alarms, custom events, and schedules, and more.
- H. The SDK shall provide an extensive list of programming functions to view and configure, ACS and VMS.
- I. The SDK shall be able to receive real time events from the following USP entities: users and user groups, areas, zones, cameras, video units, doors, door controllers (units), elevators, cardholders, cardholder groups, and credentials.
- J. The SDK shall be able to query the history of events for areas, cameras, zones, alarms, cardholders, credentials, visitors, doors, query license plate read events, license plate hit events, generate a license plate hits report, generate a license plate reads report.
- K. The SDK shall support the following alarm functions: view alarms in real time, acknowledge alarms, change priority, and change recipient.

Part 3 - General Client Software Requirements

3.01 The Client Software Applications (CSA) shall provide the user interface for USP configuration and monitoring over any network and be accessible locally or from a remote connection.

- A. The CSA shall consist of the Configuration UI for system configuration and the Monitoring UI for monitoring. The CSA shall be Windows-based and provide an easy-to-use graphical user interface (UI).

- B. The CSA for monitoring shall support running in 64-bit mode.
- C. The Server Administrator shall be used to configure the server database(s). It shall be web-based and accessible locally on the SSM or across the network.
- D. The USP shall use the latest user interface (UI) development and programming technologies such as Microsoft WPF (Windows Presentation Foundation), the XAML markup language, and the .NET software framework.
- E. All applications shall provide an authentication mechanism, which verifies the validity of the user. As such, the administrator (who has all rights and privileges) can define specific access rights and privileges for each user in the system.
- F. Logging on to a CSA shall be done either through locally stored USP user accounts and passwords or using the operator's Windows credentials when Active Directory integration is enabled.
- G. When integrated with Microsoft's Active Directory, the CSA and USP shall authenticate users using their Windows credentials. As a result, the USP will benefit from Active Directory password authentication and strong security features.
- H. The CSA shall support multiple languages, including but not limited to the following: English, French, Arabic, Czech, Dutch, German, Hebrew, Hungarian, Italian, Japanese, Korean, Norwegian, Persian (Farsi), Polish, Portuguese (Brazilian), Simplified and Traditional Chinese, Russian, Spanish, Swedish, Thai, Turkish, and Vietnamese.
- I. To enhance usability and operator efficiency, the Configuration UI and Monitoring UI shall support many of the latest UI such as:
  - 1. A customizable Home Page that includes favorite and recently used tasks.
  - 2. Task-oriented approach for administrator/operator activities where each type of activity (surveillance, visitor management, individual reports, and more) is an operator task.
  - 3. Consolidated and consistent workflows for video and access control.
  - 4. Single click functionality for reporting and tracking. The Monitoring UI shall support both single-click reporting for access control and video, as well as single-click tracking of areas, cameras, doors, zones, cardholders, elevators and more. Single-click reporting or tracking shall create a new task with the selected entities to report on or track.
- J. Configuration UI and Monitoring UI Home Page and Tasks
  - 1. The Configuration UI and Monitoring UI shall be task-oriented.
  - 2. A task shall be user interface design patterns whose goal is to simplify the user interface by grouping related features from different systems such as video and access, in the same display window. Features shall be grouped together in a task based on their shared ability to help the user perform a specific task.

3. Tasks shall be accessible via the Home Page of either the Configuration or the Surveillance CSA.
  4. Newly created tasks shall be accessible via the Configuration UI or the Monitoring UI taskbar.
  5. Similar tasks shall be grouped into the following categories:
    - a. Operation: Access control management, LRP management, and more.
    - b. Investigation: access control activity reports, visitor activity reports, alarm reports, and more.
    - c. Maintenance: Access control and, troubleshooters, audit trails, health-related reports, and more.
  6. An operator shall be able to launch a specific task only if they have the appropriate privileges.
  7. The Home Page content shall be customizable through the use of privileges to hide tasks that an operator should not have access to and through a list of favorite and recently used tasks. In addition, editing a USP XML file to add new tasks on the fly shall also be possible.
- K. The Contractor shall provide up to XX number of simultaneous Clients.

### 3.02 Configuration User Interface (UI)

#### A. General

1. The Configuration UI application shall allow the administrator or users with appropriate privileges to change the system configuration. The Configuration UI shall provide decentralized configuration and administration of the USP system from anywhere on the IP network.
2. The configuration of all embedded ACS, VMS systems shall be accessible via the Configuration UI.
3. The Configuration UI shall have a home page with single-click access to various tasks.
4. The Configuration UI shall include a variety of tools such as troubleshooting utilities, import tools, and a unit discover tool, amongst many more.
5. The Configuration UI shall include a static reporting interface to:
  - a. View historical events based on entity activity. The user shall be able to perform such actions as printing a report and troubleshooting a specific access event from the reporting view.
  - b. View audit trails that show a history of user/administrator changes to an entity.
6. Common entities such as users, schedules, alarms, and many more, can be reused by all embedded systems (ACS, VMS).

### 3.03 ACS Client User Interface (UI)

- A. The Monitoring UI shall fulfill the role of a Unified Security Interface that is able to monitor video and access control events and alarms, as well as view live and recorded video.
- B. The Monitoring UI shall provide a graphical user interface to control and monitor the USP over any IP network. It shall allow administrators and operators with appropriate privileges to monitor their unified security platform, run reports, and manage alarms.
- C. To enhance usability and operator efficiency, the Monitoring UI shall support the following UI concepts:
  1. Dynamically adaptive interface that adjusts in real-time to what the operator is doing.
  2. Dynamic controls loaded with entity-specific widgets (for example, door and camera widgets).
  3. Use of transparent overlays that can display multiple types of data in a seamless fashion.
  4. Display tile menus and quick commands.
  5. Consolidated and consistent workflows.
  6. Tile menus and quick commands easily accessible within every display tile of the user workspace.
  7. Single click functionality for reporting and tracking. The Monitoring UI shall support both single-click reporting for access control and video, as well as single-click tracking of areas, cameras, doors, zones, cardholders, elevators and more. Single-click reporting or tracking shall create a new task with the selected entities to report on or to track.
- D. Monitoring UI Home Page and Tasks
  1. Similar tasks shall be grouped into the following categories:
    - a. Operation: Access control/LRP/video surveillance, visitor management, mustering, access control and video alarm monitoring, and more.
    - b. Investigation: Video bookmark/motion/archive reports, access control activity reports, visitor activity reports, alarm reports and more.
    - c. Maintenance: Access control and video configuration reports, troubleshooters, audit trails, and more.
- E. Dynamically Adaptive UI, Controls section, and Widgets
  1. The Monitoring UI shall dynamically adapt to what the operator is doing. This shall be accomplished through the concept of widgets that are grouped in the Monitoring UI Controls section.

2. Widgets shall be mini-applications or mini-groupings in the Monitoring UI Controls section that let the operator perform common tasks and provide them with fast access to information and actions.
  3. With a single click on an entity (for example, door or camera) the specific widgets associated to that entity appear and other non-relevant widgets disappear dynamically (instantly). Widgets shall bring the operator information such as door status and camera stream information, as well as user actions, such as door unlock, PTZ controls, and more.
  4. Specific widgets include those for a door, camera, alarm, zone, display tile, video stream (statistics), PTZ camera, and more.
- F. Operator Workflows
1. A workflow shall be a sequence of operations an operator or administrator shall execute to complete an activity. The “flow” relates to a clearly defined timeline or sequence for executing the activity.
  2. The Monitoring UI shall be equipped with consistent workflows for the access control systems that it unifies.
  3. Generating or printing a report, setting up or acknowledging an alarm, or creating an incident report shall follow the same process (workflow) whether the operator is working with video and or access control, or with both video and access control.
- G. Each task within the Monitoring UI shall consist of one or more of the following items:
1. Event list.
  2. Logical tree. Doors, cameras, zones, elevators shall be grouped under Areas in a hierarchical fashion.
  3. Entities list of all entities being tracked.
  4. Display tiles with various patterns (1 x 1, 2 x 2, and more).
  5. Display tile menu with various commands related to cameras, doors, PTZ, and tile controls.
  6. Control section with widgets.
- H. The Monitoring UI shall support multiple event lists and display tile patterns, including:
1. Event/alarm list layout only
  2. Display tile layout only
  3. Display tile and alarm/event list combination
- I. User workspace customization

1. The user shall have full control over the user workspace through a variety of user-selectable customization options. Administrators shall also be able to limit what users and operators can modify in their workspace through privileges.
  2. Once customized, the user shall be able to save their workspace.
  3. The user workspace shall be accessible by a specific user from any client application on the network.
  4. Display tile patterns shall be customizable.
  5. Event or alarm lists shall span anywhere from a portion of the screen up to the entire screen and shall be resizable by the user. The length of event or alarm lists shall be user-defined. Scroll bars shall enable the user to navigate through lengthy lists of events and alarms.
  6. The Monitoring UI shall support multiple display tile patterns (e.g. 1 display tile (1x1 matrix), 16 tiles (8x8 matrix), and multiple additional variations).
  7. The Monitoring UI shall support as many monitors as the PC video adapters and Windows Operating System are capable of accepting.
  8. Additional customization options include: show/hide window panes, show/hide menus/toolbars, show/hide overlaid information on video, resize different window panes, and choice of tile display pattern on a per task basis.
- J. The Monitoring UI shall provide an interface to support the following tasks and activities common to access control and video:
1. Monitoring the events from a live security system (ACS and/or VMS).
  2. Generating reports, including custom reports.
  3. Monitoring and acknowledging alarms.
  4. Creating and editing incidents and generating incident reports.
  5. Displaying dynamic graphical maps and floor plans, as well as executing actions from dynamic graphical maps and floor plans.
  6. Management and execution of hot actions and macros.
- K. The Monitoring UI shall be able to monitor the activity of the following entities in real-time: areas, doors, elevators, cameras, cardholders, cardholder groups, zones (input points), and more. The Monitoring UI shall provide an interface to support the following access control tasks and capabilities:
1. Monitoring and management of access events and alarms.
  2. Viewing of cardholder picture or badge IDs.
  3. Verification of cardholder picture IDs against live video.

4. Visitor management.
  5. People counting or mustering, including resetting the people count in an area.
  6. Door control, including remotely unlocking doors, overriding a door's unlocking schedules, and enabling door maintenance mode.
  7. Forgiving antipassback.
  8. Generation of ACS configuration and activity reports.
  9. Viewing of HTML files including alarm instructions.
- L. Entity Monitoring
1. The USP shall permit the user to select multiple entities to monitor from the Monitoring UI by adding the entities one by one to the tracking list.
  2. The Monitoring UI shall provide the option to filter which events shall be displayed in the display tile layout, event list layout, or both.
  3. It shall be possible to lock a Monitoring UI display tile so that it only tracks the activity of a specific entity (for example, a specific door or camera).
  4. The user shall be able to drag and drop an event from an event list (or an alarm from an alarm list) onto a display tile to view a license plate read, cardholder picture ID, badge ID, or live/archived video, among other options.
  5. Event, alarm, monitoring/tracking, and report lists shall contain cardholder pictures where applicable.
  6. The user shall be permitted to start or pause the viewing of events within each display tile.
- M. Display Tile Packing and Unpacking
1. The Monitoring UI shall support single-click unpacking and packing for, areas, doors, zones, and alarms.
  2. The packing and unpacking of entities shall allow operators to quickly obtain additional information and camera views of a specific entity.
  3. The unpacking of an entity shall display associated entities. For example, unpacking a door with multiple associated cameras shall display all cameras associated with that door. Unpacking shall reconfigure the display tiles to be able to display all associated entities. For example, unpacking a door (or a zone or alarm) that is currently in a 1 x 1 tile configuration and that has 3 cameras tied to it will create a 1 x 3 display tile arrangement for viewing all associated entities.
  4. Packing will return the display to the original tile pattern.
- N. The following additional tools or utilities shall be available from the Monitoring UI: create credentials, create cardholders, and access control troubleshooter.



### 3.04 Server Administrator User Interface Requirements

- A. The Server Administrator shall be used to configure the SSM and the Directory Role (main configuration) and its database(s), to apply the license, and more.
- B. The Server Administrator shall be a web-based application. Through the Server Administrator, it shall be possible to access the SSM across the network or locally on the server.
- C. Access to the Server Administrator shall be protected via login name, password, and encrypted communications.
- D. The Server Administrator shall allow the administrator (user) to perform the following functions:
  - 1. Manage the system license.
  - 2. Configure the database(s) and database server for the Directory Role.
  - 3. Activate/Deactivate the Directory Role.
  - 4. Manually back up the Directory Role database(s) and/or restore the server database(s), as well as configure scheduled backups of the databases.
  - 5. Define the client-to-server communications security settings.
  - 6. Configure the network communications hardware, including connection addresses and ports.

### 3.05 Unified Web Client (UWC) General Requirements

- A. The USP shall support a unified web client (UWC) for access control.
- B. The UWC shall be a truly thin client with no download required other than an internet web browser or standard web browser plugins.
- C. The UWC shall be platform independent and run within Microsoft Internet Explorer, Firefox, Safari, and Google Chrome.
- D. The UWC shall be designed as an HTML5 application.
- E. The UWC shall support display on tablet format.
- F. The UWC will support native H.264 video in the web client.
- G. Web pages for the web client shall be managed and pushed by the Web Client Server. Microsoft IIS or any other web hosting service shall not be required given that all the web pages shall be hosted by the Mobile Server.
- H. The Web Client Server shall provide the ability to define a unique URL to access the web client, to ensure the security of the application.

- I. The UWC shall provide the ability to configure, save, and reload camera layouts.
- J. The UWC shall provide the ability to control PTZ cameras.
- K. Functionalities:
  - 1. Log in using name and password or Active Directory support shall be available.
  - 2. Ability for user to change its password.
  - 3. Encrypted communications for all transactions.
  - 4. Print reports and export to CSV file.
  - 5. Access Control.
    - a. Cardholder and group (add/modify/delete)
    - b. Credential management (modify/delete)
    - c. Visitor management (check-in/modify/check-out)
    - d. Unlock door
    - e. Override the unlocking schedule on a door
    - f. Door Activities report
  - 6. Alarms.
    - a. Alarm report
  - 7. Threat Level management.

### 3.06 Smartphone and Tablet App General Requirements

- A. The USP shall support mobile apps for various off-the-shelf devices. The mobile apps shall communicate with the USP over any Wi-Fi or cellular network connection.
- B. Mobile apps shall communicate with the USP via a Mobile Server Role (MSR). All communication between the mobile apps and MSR shall be based on standard TCP/IP protocol and shall use the TLS encryption with digital certificates to secure the communication channel.
- C. Supported device manufacturers shall include (refer to Mobile App specifications for latest compatibility list):
  - 1. Apple devices running iOS 11.0 or later
  - 2. Android devices 6.0 or later
- D. It shall be possible to download the mobile apps from the Central application store (Apple iTunes App Store, Google Play).
- E. Functionalities

1. Core
  - a. Ability to logon/logoff the UPS using an authorized use profile of the system.
  - b. Ability to change the picture or the password of the user of the mobile app.
  - c. Ability to view the current Threat Level of the system.
  - d. Ability to change the current Threat Level of the system.
  - e. Ability to execute hot actions configured in the user profile.
  - f. Ability to view entities from the USP:
    - i. Cameras
    - ii. Doors
    - iii. Web Tile Plugins
    - iv. Layouts
    - v. Camera Sequences
    - vi. Macros
    - vii. Maps (geographical maps only)
  - g. Ability to navigate the system hierarchical view of the entities and search entities in the system.
2. Video
  - a. Ability to view live and recorded video from the cameras of the USP. A maximum of four cameras shall be displayed.
  - b. Ability to display live and recorded video side-by-side for a specific camera.
  - c. Ability to perform digital zoom on cameras.
  - d. Ability to perform actions on cameras, such as add a bookmark, control a PTZ, control the iris/focus function, save a snapshot, and start/stop recording.
  - e. Ability to view camera layouts.
  - f. Ability to view camera sequences.
  - g. Ability to run a camera events report.
  - h. Ability to change the video quality on the cameras displayed on the mobile app.
  - i. Ability to use the camera of the smartphone and stream a live video feed to a video recorder in the system
3. Access Control
  - a. Ability to view the door state and the door lock state.

- b. Ability to perform actions on a door such as unlock the door, set the door in maintenance mode, and override the door unlocking schedule.
    - 4. Alarm Management
      - a. Ability to receive push notifications to notify mobile operators that an alarm was received.
      - b. Ability to view all active alarms assigned to the mobile operator.
      - c. Ability to perform action on an alarm such as acknowledge, forward, or alternate-acknowledge an active alarm.
      - d. Ability to view entities attached to the alarm.
    - 5. Map
      - a. Ability to display a geographical map with USP entities geo-located on the map.
      - b. Ability to view any entity configured on the map.
      - c. Ability to search for entities or locations on the map.
  - F. It shall be possible to send a message from the client user interface to a mobile operator.
  - G. It shall be possible to send a live or playback video sequence from the client UI to a mobile operator.
  - H. It shall be possible to view mobile operators who enabled location tracking on a map in the system. The location of the mobile operator should be updated in real time.
- 3.07 Health Monitor
- A. The USP shall monitor the health of the system, log health-related events, and calculate statistics.
  - B. USP services, roles, agents, units, and client apps will trigger health events.
  - C. The USP shall populate the Windows Event Log with health events related to USP roles, services, and client apps.
  - D. A dedicated role, the Health Monitoring Role, shall perform the following actions:
    - 1. Monitor the health of the entire system and log events.
    - 2. Calculate statistics within a specified time frame (hours, days, months).
    - 3. Calculates availability for clients, servers and video/access/ units.
  - E. A Health Monitoring task and Health History reporting task shall be available for live and historical reporting.

- F. A Health Monitoring dashboard task shall be available in the client application user interface to provide a live display, such as pie charts and event lists, for quick visual assessment on the general health of the system.
- G. A web-based, centralized health dashboard shall be available to remotely view unit and role health events of the USP.
- H. Detailed system care statistics will be available through a web-based dashboard providing health metrics of USP entities and roles, including Uptime and mean-time-between-failures.
- I. All health events raised in the system can be used for automating the USP event/action management.
- J. Health events shall be accessible via the SDK (can be used to create SNMP traps).

#### Part 4 - Electronic Access Control System General Requirements

- 4.01 The ACS shall be an enterprise class IP access control software solution. It shall be fully embedded within a Unified Security Platform (USP). The USP shall allow the seamless unification of the ACS with an IP video management system (VMS).
- A. The ACS shall be highly scalable to support configurations consisting of thousands of doors with facilities spanning multiple geographic areas.
  - B. The ACS shall support an unrestricted number of logs and historical transactions (events and alarms) with the maximum allowed being limited by the amount of hard disk space available.
  - C. The ACS shall support a variety of access control functionalities, including but not limited to:
    - 1. Controller (Unit) management, door management, elevator management, and area management.
    - 2. Cardholder and cardholder group management, credential management, and access rule management.
    - 3. Badge printing and template creation.
    - 4. Visitor Management.
    - 5. People counting, area presence tracking, and mustering.
    - 6. Offering a framework for third party hardware integration such as card and signature scanner.
  - D. Manufacturer:
    - 1. Genetec Security Center:
      - a. Synergis Enterprise
  - E. Certification

1. The ACS shall be certified
  - a. UL-294
  - b. ULC-S319
  - c. EN-60839-11-1
  - d. CSPN

#### 4.02 Failover and Standby Requirements

- A. The USP shall support native and off-the-shelf failover options.
- B. Failover Directory
  1. The Standby Directory shall act as a replacement SSM on hot standby, ready to take over as the acting Directory in case the primary Directory fails. The failover shall occur in less than 1 minute. No action from the user shall be required.
  2. The USP shall support up to five (5) Directories on standby, lined up to take over as the acting Directory in a cascading fashion.
  3. The Standby Directory shall keep its configuration database synchronized with the primary Directory.
  4. The Standby Directory shall support disaster recovery scenarios where a server can be located in another geographic area (or building) and only take over if all other Directories become offline.
  5. The Standby Directory shall support synchronization of the configuration databases using a backup and restore mechanism. The synchronization period shall be configurable from 15 minutes to 1 week.
  6. The Standby Directory shall support real-time synchronization of the configuration databases using SQL Mirroring or SQL Always On.
- C. Off-the-shelf standby/failover options (excluding the VMS Archiver) shall include:
  1. Native role failover across multiple servers
  2. Windows Clustering
  3. NEC ExpressCluster X LAN

#### 4.03 ACS Access Management

- A. The ACS shall be based on an open architecture able to support multiple access control hardware manufacturers. The ACS shall be able to integrate with multiple non-proprietary interface modules and controllers, access readers, and other third party applications.
- B. The ACS shall be an IP enabled solution. All communication between the ACS and hardware controllers shall be based on standard TCP/IP protocol.

C. Access Manager Role

1. The Access Manager Role shall be the server that synchronizes all access control hardware units under its control, such as door controllers and I/Omodules. It shall also be able to validate and log all access activities and events when the door controllers and I/Omodules are online.
  2. The Access Manager Role shall maintain the communication link with the hardware controllers under its control. It shall also continuously monitor whether the controllers are online or offline.
  3. Synchronization of hardware units shall be automated and transparent to users and shall occur in the background. It shall also be possible to manually synchronize units or to synchronize units on a schedule.
  4. The Access Manager Role shall support doors and controllers located within one or more facilities. The Access Server shall support a minimum of 200 readers and up to 2000 readers per computer.
- D. The Access Server shall store all access events associated with the doors, areas, hardware zones (hardware input points), elevators, and controllers under its direct control.

4.04 ACS Global Cardholder Management

- A. The ACS shall support global cardholder management and synchronization between a central independent site and remote independent sites, all of which can have their own Directory and databases.
- B. It shall be possible to synchronize the following entities and their configuration data:
  1. Cardholders (incl. custom fields)
  2. Cardholder groups
  3. Credentials
  4. Badge templates
- C. Cardholders and other synchronized entities can be added centrally and synchronized to remote sites for central cardholder management.
- D. Cardholders and other synchronized entities can be added at remote sites and synchronized to the central site and other remote sites.
- E. The ACS shall support the assignment of a single card per cardholder across all of an organization's sites.
- F. Manual and scheduled synchronization shall be supported.
- G. The ACS shall support Manufacturer OSDP command.

#### 4.05 ACS Hardware Compatibility List

- A. The ACS shall have an open architecture that supports the integration of third party IP-based door controllers and I/O modules. The ACS shall simultaneously support mixed configurations of access control hardware from multiple vendors.
- B. The ACS shall support SAM onboard to hold Desfire encryption keys.
- C. The ACS shall support 802.1x authentication.
- D. The ACS shall support embedded certificate validation engine.
- E. The ACS shall support the use of TLS 1.2 and certificates.
- F. The ACS shall support OSDP transparent reader mode to read Desfire credentials.
- G. The ACS shall support multiple types of hardware devices: single-reader controllers, 2-reader controllers, 1- to 64-reader controllers, integrated readers and door controllers, and Power-over-Ethernet (PoE) enabled door controllers.
- H. The ACS shall support most industry standard card readers that output card data using the Wiegand protocol and Clock-and-Data.
- I. The ACS shall support the following IP-enabled controllers. For a description of the capabilities of the controller, refer to the specific controller's A&E specifications and design:
  - 1. Synergis Cloud Link G2
  - 2. Synergis Cloud Link
  - 3. Synergis IX
  - 4. SharpV
  - 5. HID VertX
  - 6. HID VertX EVO
  - 7. HID Edge
  - 8. HID Edge EVO
  - 9. PW6000 controllers
  - 10. Mercury EP controllers
  - 11. Mercury LP controllers
  - 12. Mercury SIO module
  - 13. Mercury M5 Bridge
  - 14. Mercury MS Bridge



15. Assa Abloy Aperio RS485 8 to 1 hub
  16. Assa Aperio AH40 (IP) hub
  17. Assa Abloy IP Locks (no DSR required)
    - a. Corbin Russwin
    - b. Sargent Passport
    - c. Sargent Profile
    - d. IN220
  18. Salto Sallis RS485 and PoE routers
  19. Schlage AD-300 and AD-400 electronic locks
  20. Schlage Control wireless lock
  21. Schlage LE Networked wireless Mortise lock
  22. Schlage NDE Networked wireless lock
  23. Axis A1001
  24. Axis A1601
  25. STid RS485 readers
  26. DDS AS34/TPL4
  27. SimonsVoss Smart Intego
- J. The following USB enrollment readers shall be supported:
1. RF Ideas pcProx HID USB reader for enrolling proximity cards
  2. RF Ideas AIR ID Enroll iCLASS ID# USB reader for enrolling HID iCLASS cards
  3. RF Ideas AIR ID Enroll 14443/15693 CSN USB reader for enrolling a MIFARE card using the CSN (card serial number)
  4. RF Idea AIR ID Enroll pcProx Plus w/iCLASS reader for enrolling proximity and iCLASS cards
  5. STid STR-W35-E/PH5-5AA
  6. HID Omnikey 5x2x USB readers
- 4.06 Seamless Unification with VMS
- A. Through the USP, the ACS shall support integration with an IP Video Surveillance System or MVS. Integration with an IP video surveillance system shall permit the user to view live and recorded video.

- B. Users shall be able to associate one or more video cameras to the following entity types: doors, elevator and hardware zones (input points), and more.
- C. The Monitoring UI shall present a true Unified Security Interface for access control and video surveillance. Advanced live video viewing and playback of archived video shall be available through the Monitoring UI.
- D. It shall be possible to view video associated with access control events when viewing a report.

#### 4.07 ACS Controller (Unit) Management

- A. The ACS shall support the discovery, configuration, and management of IP enabled controllers and I/O modules (hardware units). A user shall be permitted to add, delete, or modify a controller if they have the appropriate privileges.
- B. The ACS shall support unit configuration through a preconfigured door template.
- C. The ACS shall support automatic unit discovery. The user shall establish the settings for discovery ports and for the types of unit discovery and the ACS shall automatically detect all connected devices.
- D. The ACS shall support a unit swap utility for swapping out an existing controller with a new controller. The unit swap utility shall avoid the reprogramming of the system whenever a unit is replaced. All logs and events from the old unit shall be maintained.
- E. The ACS shall support pre-configuration of the system prior to the physical hardware installation.
- F. The ACS shall support Firmware upgrade in bulk from the application.

#### 4.08 ACS Cardholder and Cardholder Group Management

- A. The ACS shall support the configuration and management of cardholders and cardholder groups. A user shall be able to add, delete, or modify a cardholder or cardholder group if they have the appropriate privileges.
- B. Custom fields shall be supported for both cardholders and cardholder groups.
- C. The ACS shall permit the following activation/expiration options for a cardholder's profile: delayed activation of a cardholder's profile, expiration based on the date of first use of credentials, or expiration on a user-defined date.
- D. It shall be possible to set a start date and expiration date for the association of a cardholder and an access rule for temporary access.
- E. It shall be possible to associate a picture to a cardholder's profile. The picture shall be imported from a file, captured with a digital camera, or captured from a video surveillance camera. When a cardholder event occurs, the picture of the cardholder shall be displayed in the Monitoring UI. The ACS shall support multiple standard picture formats.

- F. Cardholder groups shall enable the grouping of cardholders to facilitate mass changes to system settings. It shall be possible to assign cardholder groups to access rules, thus avoiding the assignment of one cardholder at a time.
- G. It shall be possible to search by picture association, custom fields, names, and credential codes.
- H. It shall be possible to select multiple cardholders for immediate deactivation or reactivation.
- I. The ACS shall support the synchronization of cardholders and cardholders group through Active Directory including the credentials and pictures of the cardholders. It shall be possible to import cardholders from Azure AD.
- J. It shall support the ability to track unused credentials for x days.

#### 4.09 ACS Credential Management

- A. The ACS shall support the configuration and management of credentials, for example access cards and keypad PIN numbers. A user shall be able to add, delete, or modify a credential if the user has the appropriate privileges.
- B. The ACS shall support reader transparent mode.
- C. Users shall be able to add Custom Fields (user-defined fields) to credentials. Creating a new credential shall be accomplished either manually or automatically.
- D. Automatic creation shall allow the user to create a credential entity by presenting a credential to a selected reader. The ACS shall read the card data and associate it to the credential entity. It shall be possible to automatically enroll any card format.
- E. The ACS shall support high assurance credentials using validation of a certificate.
- F. The ACS shall support multiple credentials per cardholder without necessitating duplicate cardholder information. The ACS shall automatically detect and prevent attempts to register an already-registered credential.
- G. It shall be possible to natively encode Desfire credentials from the user interface using customer's own keys and configuration.
- H. Batch enrollment of credentials shall be supported.
- I. The ACS shall provide a workflow for badge issuance and card requests.
- J. It shall be possible to support natively PIV credential in the system.
- K. The ACS shall support the use of license plates as a credential.
- L. The ACS shall support duress pin.
- M. The ACS shall natively support the creation and management of mobile IDs in the same way as other credentials.

#### 4.10 ACS Custom Card Formats

- A. A custom card format feature shall allow the administrator to add additional custom card formats using an intuitive tool within the Configuration UI. The custom card format tool shall be flexible in the following ways:
  - 1. Once enrolled, new custom card formats shall appear in the card format lists for manual card enrollment.
  - 2. An unrestricted number of additional custom card formats can be added.
  - 3. Shall support credential with up to 256 bits.
  - 4. The administrator shall be able to set the following options when defining a new format:
    - a. The order in which card fields appear in the user interface or CSA.
    - b. Whether a field is hidden from or visible to an operator.
    - c. Whether a field is read only or modifiable by an operator.
    - d. Complex parity checking schemes.
    - e. The order and location of a field's data. Location can be defined on a bit-by-bit basis.
    - f. Application ID and keys for Desfire EV1 credentials.

#### 4.11 ACS Badge Designer

- A. The badge designer shall allow the creation of badge templates that define the content and presentation format of a cardholder badge to be printed.
- B. Badge production shall consist of selecting the credential, the badge template, and clicking print.
- C. Batch printing of cards shall be available.
- D. The contents of a badge template can include: cardholder's first and last name, picture, custom fields, bitmap graphics, lines, ovals, rectangles, dynamic text labels linked to custom fields and static text labels, and barcodes (Interleaved 2 of 5, Extended Code 39).
- E. Copy and paste of badge template objects shall be available.
- F. It shall be possible to set the border thickness and color, the fill color of badge objects (content), and the color of text labels.
- G. Settings, such as object transparency, text orientation, and auto-sizing of text shall be available or transparent to the user.
- H. Supported badge formats shall be (portrait and landscape): CR70 (2.875" x 2.125"), CR80 (3.37" x 2.125"), CR90 (3.63" x 2.37"), CR100 (3.88" x 2.63"), and custom card sizes.

- I. Dual-sided badges shall be supported.
- J. A badge template import and export function shall be available to allow the sharing of badge templates between distinct or independent ACS.
- K. Chromakey shall be supported.

#### 4.12 ACS Door Management

- A. The ACS shall support the configuration and management of doors. A user shall be able to add, delete, or modify a door if they have the appropriate privileges.
- B. The ACS shall permit multiple access rules to be associated to a door.
- C. It shall be possible to unlock all doors from an area at once.
- D. The ACS shall support the following forms of authentication: Card Only, Card or Keypad (PIN), or Card and Keypad (PIN). It shall be possible to define a schedule for when Card Only or Card and Keypad authentication modes shall be required.
- E. It shall be possible to set an extended grant time on a per-door basis (in addition to the standard grant time). Cardholder properties shall include the option of using the extended grant time. When flagged cardholders are granted access, the door shall be unlocked for the duration of the extended grant time instead of the standard grant time.
- F. The ACS shall allow the configuration of the relocking mode on doors such as on door open, after a definite time, or on door close.
- G. The ACS shall support the ability to enforce the use of two valid reads from different cardholders to grant access to an area.
- H. The ACS shall support the ability to enable access rules for other cardholders once a supervisor has accessed an area.
- I. The ACS shall support the ability to enable unlocking schedule on a door once an employee has entered the facility.
- J. Readerless doors.
  - 1. The ACS shall support doors configured solely with a lock, a REX, and a door contact but without readers.
  - 2. The implementation of a readerless door shall be possible with the use of standard access hardware IO modules. External hardware, such as timers, shall not be required.
  - 3. Unlocking schedules shall be programmable for readerless doors.
  - 4. Standard door activity reports shall also be possible with readerless doors.
- K. Unlocking schedules and exceptions to unlocking schedules shall be associated with a door. An unlocking schedule shall determine when a door should be automatically unlocked. The

ACS shall also support the use of a specific offline unlocking schedule. Exceptions to unlocking schedules shall be used to define time periods during which unlocking schedules shall not be applied, such as during statutory holidays.

- L. The ACS shall support one or more cameras per door. Video shall then be associated to door access events, such as access grant or access denied.

#### 4.13 ACS Elevator Management

- A. The ACS shall support the configuration and management of elevators. A user shall be able to add, delete, or modify an elevator if they have the appropriate privileges.
- B. The ACS shall be able to control access to specific floors using a reader within the elevator cab. Control shall be available through the use of a controller with an interface to a reader and to multiple output modules with relays.
- C. Elevator floor selections shall be tracked using a controller with an interface to multiple input modules. Floor tracking shall be available within an elevator activity report.
- D. The elevator control module shall continue to function in offline mode should communication between the ACS and the controller fail.
- E. The ACS shall support one or more cameras per elevator cab. Video shall then be associated to elevator access events, such as access granted or access denied.

#### 4.14 ACS Visitor Management

- A. The ACS shall support the configuration and management of visitors. A user shall be able to enroll or remove a visitor if they have the appropriate privileges. The ACS shall support the check-in and check-out of visitors from the Monitoring UI.
- B. A visitor check-in wizard shall facilitate the enrollment process, allowing a user to specify the visitor's specific information.
- C. It shall be possible to set a host leading a group of visitors and a trailing host walking behind visitors, triggering alert if a visitor is not following the delegation.
- D. The ACS shall permit the following credential options during visitor check-in:
  - 1. Use an existing credential.
  - 2. Automatically create a new credential.
  - 3. Manually create a new credential.
- E. The ACS shall support the creation of a pool of visitor credentials in advance. Existing visitor credentials shall be assigned to visitors during the check-in process.
- F. The ACS shall permit cardholder groups to be designated as "available for visitors". Users shall be able to define the access privileges for the cardholder groups (visitor cardholder groups) in advance. During visitor check-in, the user shall select the appropriate visitor

cardholder group to associate with a visitor. All of the visitor cardholder group access privileges shall be automatically transferred to the visitor. This feature shall permit the creation of multiple types of visitor groups and associated privileges, such as for contractors, VIPs, and day visitors. Visitors added to a visitor cardholder group in the Monitoring UI shall be automatically updated in the Configuration UI cardholder group screen.

- G. A visitor's profile shall support the real-time modification of visitor information after a visitor has checked-in.
- H. The ACS shall also provide comprehensive visitor tracking and visitor reporting. Through the real-time tracking feature, the ACS shall generate a real-time and historical visitor activity listing in the Monitoring UI. The ACS shall also generate visitor-specific reports that provide comprehensive listings of visitors as well as full details on their movement.
- I. It shall be possible to exempt a visitor from any antipassback rules in effect.
- J. The operator shall be able to print visitor badges during the check-in process. The printing of both paper badges (visitor without an assigned credential) and actual credentials shall be supported.
- K. Visitor management and reporting shall be available through the Web Client as well.
- L. It shall be possible to locate a visitor's information or profile by swiping the visitor's credential (card) at a USB reader.
- M. It shall be possible to tag the person visited to the visitor's profile.
- N. It shall be possible to require that the visitor must have an escort to enter an area and that the escort must badge-in to confirm the access of the visitor.
- O. The ACS system shall support third party visitor management solutions

#### 4.15 ACS People Counting & Area Presence Tracking (Mustering)

- A. The ACS shall support people counting (or area presence tracking). The ACS shall be able to monitor and report the number of cardholders in an area in real-time and for all areas. Monitoring shall be based on the entire access control infrastructure, for both local areas and those in remote geographic locations. People counting can also be used to perform mustering.
- B. It shall be possible to control the maximum occupancy of an area by setting a threshold and user notification when reaching the limit.
- C. The ACS shall report area presence counts in the UI. Area presence tracks shall dynamically track the total number of cardholders in an area. Displayed data shall be updated dynamically.
- D. The ACS shall support mustering through the use of mobile readers (requires additional software and hardware from third-party).

- E. The ACS shall provide a native dedicated mustering task using a USB, mobile, or wall reader.
- F. The ACS shall be able to generate an area presence report listing the cardholders located in one or more areas, accessible through the Monitoring UI. It shall be possible to filter the report by area and time period. The report shall also include activity from sub-areas (nested areas).
- G. Through people counting, the ACS shall be able to generate First Person In and Last Person Out events. The First Person In event shall detect when the first cardholder enters an empty area. The Last Person Out event shall detect when the last cardholder leaves an area. It shall be possible to trigger actions from both events such as sending a message or triggering an alarm.
- H. The ACS shall be able to determine the entry of a cardholder based on a dedicated sensor.

#### 4.16 ACS Custom Fields (User-Defined Fields)

- A. The ACS shall permit the creation of custom fields. Up to 1,000 custom fields shall be supported.
- B. Custom fields shall be supported for the following entities: cardholders, cardholder groups, credentials, and visitors.
- C. Supported custom fields shall include: text, integers, decimal numbers, dates, Boolean, and images (graphics).
- D. Users shall be able to define a default value for a custom field.
- E. The creation of new custom field types shall be possible. New custom field types shall be based on the standard custom fields supported. They shall support user-defined values from which an operator must make a selection.
- F. Administrators have the ability to define which users can view and modify specific custom fields. This shall limit the access to custom field data to users with pre-defined privileges. The ACS shall support querying and report generation using custom fields.
- G. Custom fields can be grouped and ordered within these groups as defined by the user.
- H. Values for custom fields can be imported using the Import Tool.

#### 4.17 ACS Import Tool

- A. The ACS shall support an integrated Import Tool to facilitate the import of existing cardholder and credential data. The import of data shall be through the use of the CSV file format. The tool shall be available from the Configuration UI.
- B. The Import Tool shall also support the ability to manually import data that has been exported from a third party database if it is in CSV format.
- C. The import tool shall permit the import of the following data:



1. Cardholder name, descriptions, picture, email, and status.
  2. Cardholder group information.
  3. Credential name, status, format, and card number (including credentials with custom formats).
  4. Partition information.
  5. Custom fields.
  6. Activation date and expiration date.
  7. Update cardholder group association.
- D. Full flexibility in selecting the fields to be imported during an import session shall be available.
- E. The option to use a custom and unique cardholder key shall be specified during the import process to ensure that cardholders with duplicate names will not have their data overwritten. Cardholder key generation shall be automated. The end user shall have the option to select which fields will be used to create this unique key, for example credential number, custom fields, or cardholder name.
- F. The ACS shall also support re-importing a CSV file containing new information to update existing information in the ACS database. Re-importing shall enable bulk amendments to existing access control data.

#### Part 5 - VMS General Requirements

- 5.01 The VMS shall be based on a true open architecture that shall allow the use of non-proprietary workstation and server hardware, non-proprietary network infrastructure, and non-proprietary storage.
- A. The VMS shall offer a complete and scalable video surveillance solution that shall allow cameras to be added on a unit-by-unit basis.
  - B. The VMS shall interface with analog-to-digital video encoders and IP cameras and with digital-to-analog video decoders, hereafter referred to as digital video servers (DVS). The VMS shall support DVS from various manufacturers.
  - C. The VMS shall integrate DVS using the DVS native SDK or using the following industry standards to interface to the DVS:
    1. ONVIF
  - D. All video streams supplied from analog cameras or IP cameras shall be digitally encoded in H.265, H.264, MPEG-4, MPEG-2, MJPEG, MxPEG, Wavelet, or JPEG2000 compression formats and recorded simultaneously in real time.

- E. All audio streams supplied from IP video servers shall be digitally encoded in g711 (u-law), g721, g723, or AAC compression formats and recorded simultaneously in real time.
- F. Each camera's bit rate, frame rate, and resolution shall be set independently from other cameras in the system and altering these settings shall not affect the recording and display settings of other cameras.
- G. The VMS shall be able to use multiple CCTV keyboards to operate the entire set of cameras throughout the system, including brands of cameras from various manufacturers and including their PTZ functionalities (i.e. Pelco keyboard controls Panasonic dome or vice-versa).
- H. The VMS shall be able to retrieve and set the current position of PTZ cameras using XYZ coordinates.
- I. The VMS shall support PTZ camera protocols from multiple manufacturers, including analog and IP protocols.
- J. The VMS shall arbitrate the user conflict on PTZ usage based on user levels per camera.
- K. The VMS shall support the following list of CCTV keyboard:
  - 1. American Dynamics 2078 ASCII, and American Dynamics 2088 ASCII
  - 2. Bosch Autodome, Bosch Intuikey
  - 3. DVTel
  - 4. GE ImpactNet
  - 5. Panasonic, Pelco ASCII, Pelco KBD-300, Pelco 9760, and Pelco P.
  - 6. Radionics
  - 7. Hanwha Techwin SSC-100, SPC-600, SPC-2010, SPC-6000, and SPC-7000.
  - 8. Videoalarm
  - 9. Sony RM-NS1000
  - 10. Panasonic WV-CU161C
  - 11. Panasonic WV-CU950 Ethernet keyboard
- L. The VMS shall support the following list of joysticks:
  - 1. Axis 295
  - 2. Axis T8310, T8311, T8312, T8313 Video Surveillance Control Board
  - 3. Any USB joystick detected as a Windows Game Controller

- M. The VMS shall allow for the configuration of a time zone for each camera connected to a DVS. For playback review, users shall have the ability to search for video based on the following options:
  - 1. Local time of the camera
  - 2. Local time of the SSM
  - 3. Local time of user's workstation
  - 4. GMT Time
  - 5. Other time zone
- N. Audio and Video storage configuration for the SSM shall either be:
  - 1. Internal or external IDE/SATA/SAS organized or not in a RAID configuration.
  - 2. Internal or external SCSI/iSCSI/Fiber Channel organized or not in a RAID configuration.
  - 3. Within the overall storage system, it shall be possible to include disks located on:
    - a. External PCs on a LAN or WAN
    - b. Network Attached Servers (NAS) on a LAN or WAN
    - c. Storage Area Networks (SAN)
- O. The SSM shall not limit the actual storage capacity configured per server.
- P. Manufacturer:
  - 1. Genetec Security Center:
    - a. Omnicast Enterprise

## 5.02 Archiving

- A. The Archiver (role) shall use an event and timestamp database for the advanced search of audio/video archives. This database shall use Microsoft SQL.
- B. The Archiver shall protect archived audio/video files and the system database against network access and non-administrative user access.
- C. The Archiver shall digitally sign recorded video using 248-bit RSA public/private key cryptography.
- D. The Archiver shall offer a plug and play type hardware discovery service with the following functionalities:
  - 1. Automatically discover DVS units as they are attached to the network.
  - 2. Discover DVS units on different network segments, including the Internet, and across routers with or without network address translation (NAT) capabilities.

- E. The Archiver shall have the capacity to configure the key frame interval (I-frame) in seconds or number of frames.
- F. The Archiver shall provide a pre-alarm and post-alarm recording option that can be set between one second and 5 minutes on a per camera basis.
- G. The Archiver shall provide the functionality of storing of video and audio streams based on triggering events, such as:
  - 1. Digital motion detection
  - 2. Digital input activation
  - 3. Macros
  - 4. Through SDK application recording
- H. The Archiver shall perform video motion detection on each individual camera based on a grid of 1320 motion detection blocks. All of the video motion detection settings are configurable on schedule. A global sensitivity threshold is available to reduce motion detection sensitivity when the video signal is noisy or when a lot of false hits are incurred. Video motion detection itself can be set into four different modes:
  - 1. Full Screen: All 1320 blocks on screen are activated, and a general threshold for the overall motion in the entire image can be set, and when it is reached, it can trigger recording and a motion event or a custom event.
  - 2. Full Screen Unit: This is the same as the Full Screen but the motion detection takes place in the DVS.
  - 3. Detection Zone: Six overlapping zones can be defined in the 1320 blocks on screen with each of these zones having its own threshold, and, when that threshold is reached, each one of them can trigger recording and a motion event or a custom event. Each zone triggering its own event allows for the configuration of directional motion detection events and other complex motion detection logic.
  - 4. Detection Zone Unit: This is the same as the Detection Zone, but the motion detection takes place in the DVS and only one zone is supported.
  - 5. Disabled: No motion detection is performed on this camera.
- I. The Archiver shall be able to detect motion in video within 200 milliseconds and not only on key frames.
- J. The Archiver shall allow for multiple recording schedules to be assigned to a single camera. Each schedule shall be created with the following parameters:
  - 1. Recording mode:
    - a. Continuous
    - b. On Motion/Manual

- c. Manual
    - d. Disabled
  - 2. Recurrence pattern:
    - a. Once on specific days
    - b. Specific days on a yearly basis
    - c. Specific days on a monthly basis
    - d. Specific days on a weekly basis
    - e. Daily
- K. Time coverage:
  - a. All day.
  - b. Specific time range(s).
  - c. Daytime or nighttime based on the times of sunrise and sunset that are automatically calculated from the time of year and a geographical location. Provision shall be given to offset the calculated sunrise or sunset time by plus or minus 3 hours.
- L. The Archiver shall allow each camera (video source) to be encoded multiple times in the same or different video formats (H.265, H.264, MPEG-4, MPEG-2, MJPEG, MxPEG, Wavelet, or JPEG2000), limited only by the capabilities of each DVS.
- M. Whenever multiple video streams are available from the same camera, users shall be free to use any one of them based on their assigned usage. The standard video stream usages are:
  - 1. Live
  - 2. Recording
  - 3. Remote
  - 4. Low resolution
  - 5. High resolution
- N. The Archiver shall allow the video quality to vary according to predefined schedules. Such schedules shall have the same configuration flexibility as the recording schedules mentioned earlier. The video quality shall be based on, but not limited to, the following parameters:
  - 1. Maximum bit rate
  - 2. Maximum frame rate
  - 3. Image quality
  - 4. Key frame interval

- O. The Archiver shall have the ability to dynamically boost the quality of the "recording stream" (see previous bullet) based on specific events:
  - 1. When recording is started manually by a user.
  - 2. When recording is triggered by a macro, an alarm or detected motion.
- P. The Archiver shall have the capacity to communicate with the DVS using 128 bits SSL encryption.
- Q. The Archiver shall have the capacity to communicate with the DVS using HTTPS secure protocol.
- R. The Archiver shall have the capacity to receive multicast UDP streams directly from the DVS.
- S. For network topologies that restrict the DVS from sending multicast UDP streams, the Archiver shall redirect audio/video streams to active viewing clients on the network using multicast UDP.
- T. The Archiver shall have the capacity to redirect audio/video streams to active viewing clients on the network using unicast UDP or TCP.
- U. The Archiver shall empower the administrator with a full range of disk management options:
  - 1. The Archiver shall allow the administrator to choose which disks to use for archiving and to set a maximum quota for each.
  - 2. The Archiver shall allow the administrator to spread the archiving of different cameras on different disk groups (groups of disks controlled by the same controller) so that archiving could be carried out in parallel on multiple disks.
  - 3. The Archiver shall have the capacity to move video archives to the Azure Cloud. The archives will be moved after a preset number of days.
- V. The Archiver shall offer the following options to clean up old archives, on a camera by camera basis:
  - 1. After a preset number of days.
  - 2. Deleting oldest archives first when disks run out of space.
  - 3. Stop archiving when disks are full.
- W. The Archiver shall allow important video sequences to be protected against normal disk cleanup routines.
- X. Users shall have the following options when protecting a video sequence:
  - 1. Until a specified date
  - 2. For a specified number of days
  - 3. Indefinitely (until the protection is explicitly removed)

- Y. The Archiver shall allow the administrator to put a cap on the percentage of storage space occupied by protected video.
- Z. The Archiver shall keep a log and compile statistics on disk space usage.
  - 1. The statistics shall be available by disk group or for the whole Archiver.
  - 2. The statistics shall show the percentage of protected video over the total used disk space.
- AA. The Archiver shall have the capacity to down-sample video streams for storage saving purposes. The down-sampling options available are the following:
  - 1. For H.264, MPEG-4, and H.265, streams the down-sampling options are: all key frames, 1 fps, 2 sec./frame, 5 sec./frame, 10 sec./frame, 15 sec./frame, 30 sec./frame, 60 sec./frame, 120 sec./frame.
  - 2. For MJPEG streams the down-sampling options are: 15 fps, 10 fps, 5 fps, 2 fps, 1 fps, 2 sec./frame, 5 sec./frame, 10 sec./frame, 15 sec./frame, 30 sec./frame, 60 sec./frame, 120 sec./frame.
- BB. The Archiver shall support DVS with edge recording capabilities and offer the following capacity:
  - 1. The ability to playback the video recorded on the DVS at different speeds.
  - 2. The ability to offload (video trickling) the video recorded on the DVS on schedule, on event, or manually to store it on the Archiver.
  - 3. It shall be possible to filter the video that is being offloaded using one or multiple of the following filters:
    - a. Time interval
    - b. Playback request
    - c. Video analytic events
    - d. Motion events
    - e. Bookmarks
    - f. Alarms
    - g. Input pin events
    - h. Unit offline events
- CC. The Archiver shall be provided with proven performance and scalability figures:
  - 1. The Archiver's performance shall be guaranteed during the rebuild of a disk from a raid 5 disk group. The rebuild process shall not affect the recording and playback capabilities.

2. The recommended server specification from the Genetec Security Center Hardware Requirement shall allow Archiver to perform up to 300 cameras or 300Mbs throughput first limit reached.
  3. The high-performance archiver specification from the Genetec Security Center Hardware Requirement shall allow Archiver to perform:
    - a. Up to 500 cameras or 500Mbs throughput first limit reached with a 1Gbps NIC.
    - b. Up to 700 cameras or 1300Mbs throughput first limit reached with a 10Gbps NIC.
- DD. The Archiver shall provide the ability to encrypt the media stream coming from the DVS including the video, audio and metadata:
1. Media encryption shall be optional and can be activated on a per DVS basis.
  2. Media encryption shall be performed with AES 128-bits.
  3. Media encryption shall encrypt all video, audio and metadata at rest and in transit. Once media encryption is turned on for a DVS all media stored or redirected by the Archiver shall be encrypted and shall require the private key to be decoded.
  4. It shall be possible to export the encrypted media into a non-encrypted ASF file.

#### 5.03 Auxiliary Archiver

- A. The Auxiliary Archiver shall be used to produce redundant archives (video, events, or bookmarks) for any camera in the system, on a case by case basis.
- B. The Auxiliary Archiver shall have the ability to record a camera on a different schedule than the Archiver.
- C. The Auxiliary Archiver shall have the ability to archive any of the standard video streams for archiving. The standard video stream usages are: Live, Recording, Remote, Low Resolution, and High Resolution.
- D. The Auxiliary archiver shall have the capacity to move video archives to the Azure Cloud.

#### 5.04 Standby Archiver

- A. The Standby Archiver shall act as a replacement Archiver role on hot standby, ready to take over the functions of the primary Archiver role. The failover will occur in less than 1 minute. No action from the user will be required.
- B. The Standby Archiver assigned to an Archiver role entity shall automatically provide protection for all DVS connected to that Archiver role.
- C. The Standby Archiver shall protect the primary Archiver role against the following failures:
  1. Server failure (hardware or software).



2. Storage failure, such as Archiver Role detects that it cannot read or write to any of its allocated disks.
- D. It shall be possible for a single USP server to act as the standby server of multiple Archiver roles.
  1. Each Archiver role shall have priority value if multiple Archiver Roles fail at the same time on the same standby server.
- E. It shall be possible for any Archiver role in the system to be designated as another's standby and vice-versa.
- F. For each Archiver role it shall be possible to set up to 2 standby Archiver so that if the first failover Archiver fails the failover will automatically occur to a third server.
- G. The Standby Archiver shall have the ability to act as a Redundant Archiver.
- H. It shall be possible to set a different retention period for the Archiver and the Redundant Archiver.
- I. The Redundant Archiver shall maintain an exact copy of everything recorded by the default Archiver, i.e. audio/video archives, events, and bookmarks.
- J. Redundancy shall be configured on a camera by camera basis.
- K. The Redundant Archiver shall have to ability to use a multicast video stream from the DVS and shall not require an additional connection to any DVS.

#### 5.05 Cloud Archiving

- A. The VMS shall support the automatic transfer of video recorded on the Archiver to the cloud, based on the age of the video.
- B. The Archiver shall encrypt recordings using AES-256 prior to transferring video to the cloud and maintain encryption keys local to the user's system.
- C. The VMS shall support TLS encryption between the on-premises Archiver and the cloud.
- D. The VMS shall allow users to search video stored in the cloud through the same functionality used when querying video that is stored locally.
- E. The VMS will maintain a local cache of video downloaded from the cloud, to playback recordings without requiring an additional transfer.

#### 5.06 VMS Media Streaming

- A. The Media Router Role shall be responsible for routing video and audio streams across local and wide area networks from the source (for example DVS) to the destination (for example CSA).

- B. The Media Router Role shall support multiple transport protocols, such as unicast TCP, unicast UDP, and multicast UDP.
- C. The Media Router shall support IGMP (Internet Group Management Protocol) to establish multicast group memberships:
  - 1. IGMP v3, including SSM (Source-Specific Multicast) shall be supported.
- D. The Media Router Role using Redirector Agents shall be responsible for redirecting a stream from a source IP endpoint to a destination IP endpoint.
- E. The Redirector Agents shall be capable of converting a stream from and to any supported transport protocols:
  - 1. Multicast UDP to Unicast TCP
  - 2. Multicast UDP to Unicast UDP
  - 3. Unicast TCP to Multicast UDP
  - 4. Unicast UDP to Multicast UDP
- F. It shall be possible to limit the number of concurrent live and playback video redirections for each Redirector Agent in order to better control the bandwidth across multiple sites.
- G. It shall be possible to limit the bandwidth consumed by live and playback video from the CSA to better control the bandwidth across multiple sites. The SSM shall be able to prioritize video streaming to the CSA based on user level.
- H. It shall be possible to protect the Media Router Role against hardware or software unavailability by configuring another Media Router Role to act as a hot standby server.
- I. Multiple Redirector Agents shall be used on a large VMS installation to increase the service availability and to provide automatic load balancing.

#### 5.07 VMS Video Archives Transfer capabilities

- A. Archive transfer shall provide the ability to:
  - 1. Transfer video from a server to another server in the same system.
  - 2. Transfer video from a federated server to another server.
  - 3. Transfer video from camera storage to a server.
- B. It shall be possible to program video transfers either on a recurrent schedule, or to trigger them manually or upon connection.
- C. It shall be possible to filter the video of interest for a transfer. The video of interest shall be defined with the following filters:
  - 1. All archives when the camera was offline.

2. Alarms.
  3. Playback request from the edge.
  4. Video analytics events.
  5. Motion events.
  6. Bookmarks.
  7. Input triggers.
  8. Time range.
- D. It shall be possible to define the length of video before and after the event used as a filter to determine the video of interest.
- E. The USP shall offer an interface for displaying all video archive transfer requests. This interface shall display all the current, requested and scheduled video transfer requests. It shall be possible to edit, trigger, and cancel video archive transfers from this interface.

#### 5.08 Security Video Analytics

- A. The analytics shall be completely unified with the Video Management System.
- B. Configuration shall natively be performed in the configuration interface of the Video Management System.
- C. The analytics shall feature dedicated configuration possibilities for the following scenarios:
1. Perimeter protection
  2. Area protection
  3. Direction control
  4. Object detection
  5. Stopped vehicle detection
  6. Tailgating Detection
- D. Each of the scenarios shall trigger events in the Video Management System, which correspond to their functionality.
- E. Additional to these scenarios, the analytics shall allow to configure custom intrusion detection and object detection scenarios as well as allow to import settings to allow maximum flexibility.
- F. The analytics license shall allow to configure any one of these scenarios per camera.
- G. The analytics shall allow at least two different detection variants:

- a. Trigger an alarm if a motion pattern moves from zone A (source) through zone B into zone C (sink).
- b. Trigger an alarm if a motion pattern moves anywhere inside a specified zone.
- H. The analytics shall support an unlimited number of detection areas.
- I. The analytics feature rain-filters to filter out disturbances.
- J. The analytics shall feature live configuration to immediately see the effects of parameter changes in the configuration interface without prior saving new configurations.
- K. The configuration of the analytics shall be possible on recorded video streams.
- L. The analytics shall offer the possibility to configure object movement paths.
- M. The analytics shall not employ tripwires or cross-lines.
- N. Areas and the scenes perspective (near & far object size) shall be configured on-screen using a point-and-click interface.
- O. The analytics shall feature filters for movement speed, distance, and direction to detect events.
- P. The analytics shall feature options to separately show or hide areas, area names, and detection overlays.
- Q. The analytics shall be fully server-based, with no calculation on cameras necessary.
- R. The analytics shall operate with color, thermal, and infrared cameras.
- S. The accuracy of the analytics shall be evaluated and approved by the CPNI Video Analytics Assessment Programme and shall be listed in the CPNI Catalogue of Security Equipment (CSE).

#### 5.09 Camera Integrity Monitor

- A. Description:
  - 1. Automatically checks camera feeds to detect if cameras have been tampered with.
  - 2. Can be used for near-real-time alerting of tampering events or as a maintenance tool.
  - 3. Reports can be run on detected tampering events.
- B. Details:
  - 1. It shall be completely unified with the Video Management System.
  - 2. It shall be possible to set the detection sensitivity per camera stream between low, medium, and high.
  - 3. It shall be possible to choose on which servers the analytics shall run.

4. The camera stream used for analytics shall be configurable.
5. It shall be possible to define how many cameras are being analyzed at the same time.
6. To utilize minimum hardware resources, it shall be definable how often camera streams are analyzed.
7. There shall be an overview over which cameras are configured to be analyzed.

#### 5.10 Privacy Protector

##### A. Description:

1. Automatically obscures all movement in surveillance videos in real-time.
2. Live privacy masking of moving objects (such as people and vehicles).
3. Completely unified with the video management system.
4. Native configuration in the configuration interface of the video management system.

##### B. Details:

1. Certified with a valid EuroPriSe certification seal.
2. Indoor / outdoor modes using flexible background modeling:
  - a. Indoor: Learning model with up to 10 different illumination states – this allows to adapt to fast lighting changes such as lights switching on and off.
  - b. Outdoor: Foreground detection based on edge detection rather than color – this allows to adapt to heavily changing lighting conditions such as clouds temporarily blocking sunlight.
3. Detects movements using an absolute difference image, calculated by subtracting the current frame from a calculated background model.
4. Masks movements using blocks, thus obscuring the outline of an object or person.
5. Three different scrambling methods: Pixelation, Colorize, and Transparency.
6. Masking grids can be configured in a point-and-click interface.
7. Past preview mode to see configuration changes in the configuration interface without necessity to save the configuration.
8. Zones can be freely definable polygons with a point-and-click interface.
9. Option to set analysis resolution to optimize performance.
10. No calculation on the camera necessary, completely server-based.
11. Option to define zones, which should always or never be pixelated.

12. Option to choose input stream and output stream parameters, including resolutions, frame rate, and encoding.

13. Utilizes server-side hardware acceleration to maximize the amount of cameras analyzed per server.

#### 5.11 People Counter

##### A. Description:

1. Automatically counts people in a camera's field of view.
2. Provides live dashboard widgets dedicated for people counting.
3. Completely unified in the video management system.
4. Native configuration in the configuration interface of the video management system.

##### B. Details:

1. Based on deep-learning models trained on person detection to exclude non-human objects.
2. Dedicated dashboard widgets for people counting with the following features:
  - a. Charts: visualization of counts in line- or bar-charts
  - b. Throughput: Show number of persons in given time-frame.
  - c. Occupancy: Show how many people are in an area (IN minus OUT)
3. Counts adults and children.
4. Counts persons in wheel-chairs.
5. Supports top-down camera views.
6. Supports bi-directional counting.
7. Supports tilted camera views.
8. Option to show/hide overlays with detected persons and counting line.
9. No GPU required to run.
10. The occupancy widget support resetting the count at a defined timeOption to define zones, which should always or never be pixelated.
11. Supports organizing cameras into areas and show these areas in widgets.
12. Utilizes server-side hardware acceleration to maximize the amount of cameras analyzed per server.
13. Counts can be integrated to external systems using CSV exports and a .NET SDK

## Part 6 - Execution

### 6.01 Warranty

- A. The product shall perform in all material respects in accordance with the accompanying user manual, and the media on which the Software Product resides will be free from defects in materials and workmanship under normal use. Software defects are covered through Service Releases and Cumulative Updates which are available for a period of 1 year from the date of the software purchase.
- B. Extended warranty, up to 5 years, shall be available through the purchase of the Genetec Advantage support service which includes the following additional services over the standard warranty:
  - 1. Access to phone support and online chat for technical assistance
  - 2. Online case management
  - 3. Online system availability monitor
  - 4. Access to Major and Minor Release Upgrades
  - 5. 24/7 pager support and dedicated support specialist

### 6.02 Deployment Services and System Commissioning

- A. General Requirements:
  - 1. The contractor shall engage the services of the USP vendor to assist in the management of the deployment of the USP at the end-user site on projects that involve:
    - a. Multiple contractors or subcontractors that will be responsible for deploying the USP at multiple client sites in different geographical regions.
    - b. Complex enterprise installations involving advanced functionality (for example The Federation feature, failover, plugins) and/or multiple systems (for example access control, video, ALPR) and/or third party integrations.
    - c. Extensive use of customized solutions/plugins developed by the vendor that will be integrated into the USP.
  - 2. The USP vendor services shall include Deployment Management and System Configuration and Commissioning.
- B. Deployment Management Service:
  - 1. The Deployment Management service from the vendor shall include a Project Manager acting as the single point of contact for all communications between the contractor and the vendor organization and who will be responsible for:
    - a. Conducting a Risk Assessment of the impact of potential risk factors on the operation of the vendor's USP.

- b. Providing a project plan for the deployment of the vendor's USP.
  - c. Managing the development and deployment of the custom solution components that will be integrated into the vendor's USP (if applicable).
  - d. Providing a scope of work detailing the services to be provided by the vendor to assist in the deployment of the vendor's USP.
  - e. Coordinating and scheduling the vendor field services with the contractor to assist with the deployment of the vendor's USP.
  - f. Providing regular project status updates to the contractor regarding the development of custom solutions (if applicable) and the deployment of the vendor's USP.
- C. Solution Architect Service:
- 1. The Solution Architect service from the vendor shall include a Solutions Architect Engineer acting as a single technical point of contact throughout the deployment of the USP, and who will be responsible for:
    - a. Assisting the contractor/subcontractor with the design and architecture of the vendor's USP.
    - b. Conducting technical consultation activities that may include fit/gap analysis, system design reviews, device compatibility assessments, functional and technical design reviews, as well as performance reviews of the vendor's USP.
    - c. Conducting a system assessment and ensuring best practices of the vendor's USP are followed.
    - d. Providing upgrade and migration strategy for the vendor's USP where applicable.
    - e. Providing documentation regarding the system architecture, system design, hardware specifications and compatibility requirements, camera bandwidth calculations, and best practices as they relate to the vendor's USP.
- D. System Configuration and Commissioning Service:
- 1. The System Configuration and Commissioning service from the vendor shall include a Field Engineer who will be responsible for:
    - a. Assisting the contractor's or subcontractor's onsite/remote technicians with the configuration and commissioning of the vendor's USP at the client site.
    - b. Conducting a test of the USP following the deployment of the system using real-world operator scenarios to ensure optimal system performance.
    - c. Providing the contractor with a Service Report detailing the tasks completed during the deployment of the USP at the client site, as well as any recommendations for improving the performance of the USP that must be implemented by the contractor.



- d. Providing a knowledge transfer of the vendor's USP to the contractor following the deployment of the USP at the client site.

6.03 Manufacturer End User Operator Training

- A. The contractor shall engage the services of the USP vendor to assist in the end user training of the USP at the end-user site.

END OF SECTION 28 13 00

## SECTION 28 16 00- INTRUSION DETECTION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Intrusion detection with hard-wired, modular, microprocessor-based controls, intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.
  - 2. Responsibility for integrating electronic and electrical systems and equipment is specified in the following Sections, with Work specified in this Section:
    - a. Division 2 Section "Chain-Link Fences and Gates."
    - b. Division 8 Section "Door Hardware."
    - c. Division 8 Section "Detention Door Hardware."
    - d. Division 26 Section "Lighting Controls."
    - e. Division 28 Section "Fire Alarm."
    - f. Division 14 Section "Electric Traction Elevators."
    - g. Division 14 Section "Hydraulic Elevators."
    - h. Division 26 Section "Lighting Control Devices."

- i. Division 26 Section "Intercommunication Equipment."
  - j. Division 26 Section "Public Address and Music Equipment."
- B. Intrusion detection system shall be integrated with detention monitoring and control system specified in Division 13 Section "Detention Monitoring and Control (PLC Based)," which also defines systems integration.
- C. Related Sections include the following:
  - 1. Division 28 Section "Perimeter Security" for outdoor intrusion detection devices.
  - 2. Division 28 Section "Video Surveillance" for closed-circuit television cameras that are used as devices for video motion detection.
  - 3. Division 26 Section "Voice and Data Communication Cabling" for cabling between central-station control units and field-mounted devices and controllers.

### 1.3 DEFINITIONS

- A. LCD: Liquid-crystal display.
- B. LED: Light-emitting diode.
- C. PIR: Passive infrared.
- D. RFI: Radio-frequency interference.
- E. UPS: Uninterruptible power supply.
- F. Protected or Protection Zone: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any

interface equipment between sensors and communication link to central-station control unit.

- G. Standard Intruder: A person who weighs 100 lb (45 kg) or less and whose height is 60 inches (1525 mm) or less; dressed in a long-sleeved shirt, slacks, and shoes unless environmental conditions at the site require protective clothing.
- H. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.

#### 1.4 SUBMITTALS

- A. Product Data: Components for sensing, detecting, [systems integration], and control, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.
  - 1. Functional Block Diagram: Show single-line interconnections between components including interconnections between components specified in this Section and those furnished under other Sections. Indicate methods used to achieve systems integration. Indicate control, signal, and data communication paths and identify networks and control interface devices and media to be used. Describe characteristics of network and other data communication lines.
  - 2. Raceway Riser Diagrams: Detail raceway runs required for intrusion detection and for systems integration. Include designation of devices connected by raceway, raceway type, and size, and type and size of wire and cable fill for each raceway run.

3. UPS: Sizing calculations.
  4. Site and Floor Plans: Indicate final outlet and device locations, routing of raceways, and cables inside and outside the building.[ Include room layout for central-station control-unit console, terminal cabinet, and racks.
  5. Central-Station Control-Unit Console Layout: At [1/8" = 1'-0"] scale, showing required artwork and device identification.
  6. Device Address List: Coordinate with final system programming.
  7. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.
  8. Details of surge-protection devices and their installation.
  9. Sensor detection patterns and adjustment ranges.
- C. Equipment and System Operation Description: Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are not acceptable.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Samples for Verification: For each type of exposed finish required.
- F. Qualification Data: For intrusion detection systems integrator and testing agency.
- G. Field quality-control test reports.

- H. Operation and Maintenance Data: For intrusion detection system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
  - 1. Data for each type of product, including features and operating sequences, both automatic and manual.
  - 2. Central-station control-unit hardware and software data.
- I. Warranty: Special warranty specified in this Section.
- J. Other Information Submittals:
  - 1. Test Plan and Schedule: Test plan defining all tests required to ensure that system meets technical, operational, and performance specifications within 30 days of date of Contract award.
  - 2. Examination reports documenting inspections of substrates, areas, and conditions.
  - 3. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. An employer of workers, at least one of whom is a technician certified by the National Burglar & Fire Alarm Association.
  - 2. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Intrusion Detection Systems Integrator Qualifications: An experienced intrusion detection

equipment supplier and Installer who has completed systems integration work for installations 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.

- C. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the National Burglar & Fire Alarm Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to Owner's insurance underwriter.
  - 1. Testing Agency's Field Supervisor: Person currently certified as an advanced alarm technician by the National Burglar & Fire Alarm Association to supervise on-site testing specified in Part 3.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of detection devices and central-station control units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- E. 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.
- F. FMG Compliance: FMG-approved and -labeled intrusion detection devices and equipment.
- G. Comply with NFPA 70.

## 1.6 PROJECT CONDITIONS

- A. Environmental Conditions: Capable of withstanding the following environmental conditions

without mechanical or electrical damage or degradation of operating capability:

1. Altitude: Sea level to 4000 feet (1220 m).
2. Central-Station Control Unit: Rated for continuous operation in an ambient of 60 to 85 deg F (16 to 29 deg C) and a relative humidity of 20 to 80 percent, noncondensing.
3. Interior, Controlled Environment: System components, except central-station control unit, installed in air-conditioned interior environments shall be rated for continuous operation in ambients of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.
4. Interior, Uncontrolled Environment: System components installed in non-air-conditioned interior environments shall be rated for continuous operation in ambients of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.
5. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambients of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Comply with UL 294 and UL 639 for outdoor-use equipment. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) 24 inches (610 mm) thick.
6. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings shall be rated, listed, and installed according to NFPA 70.



## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of intrusion detection devices and equipment that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

## 1.8 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.
  - 1. Intrusion Detection Devices: Furnish quantity equal to five percent of the number of units of each type installed, but no fewer than one of each type.
  - 2. Fuses: Three of each kind and size.
  - 3. Tool Kit: Provide six sets of tools for use with security fasteners, each packaged in a compartmented kit configured for easy handling and storage.
  - 4. Security Fasteners: Furnish no fewer than 1 box for every 50 boxes or fraction thereof, of each type and size of security fastener installed.

## 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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2.
  - a. ADEMCO (Vista 128B)

## 2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. Supervision: System components shall be continuously monitored for normal, alarm, supervisory, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.
  1. Alarm Signal: Display at central-station control unit and actuate audible and visual alarm devices.
  2. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or controller failure.
  3. Supervisory Condition Signal: Distinct from other signals, indicating an abnormal condition as specified for the particular device or controller.
- B. System Control: Central-station control unit shall directly monitor intrusion detection units and connecting wiring.
- C. System Control: Central-station control unit shall directly monitor intrusion detection devices and connecting wiring in a multiplexed distributed control system or as part of a network.

- D. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.
- E. Operator Commands:
1. Help with System Operation: Display all commands available to operator. Help command, followed by a specific command, shall produce a short explanation of the purpose, use, and system reaction to that command.
  2. Acknowledge Alarm: To indicate that alarm message has been observed by operator.
  3. Place Protected Zone in Access: Disable all intrusion-alarm circuits of a specific protected zone. Tamper circuits may not be disabled by operator.
  4. Place Protected Zone in Secure: Activate all intrusion-alarm circuits of a protected zone.
  5. Protected Zone Test: Initiate operational test of a specific protected zone.
  6. System Test: Initiate system-wide operational test.
  7. Print Reports.
- F. Timed Control at Central-Station Control Unit: Allow automatically timed "secure" and "access" functions of selected protected zones.
- G. Automatic Control of Related Systems: Alarm or supervisory signals from certain intrusion detection devices control the following functions in related systems:
1. Switch selected lights.
  2. Shift elevator control to a different mode.
  3. Open a signal path between certain intercommunication stations.
  4. Shift sound system to "listening mode" and open a signal path to certain system speakers.

5. Switch signal to selected monitor from closed-circuit television camera in vicinity of sensor signaling an alarm.
  
- H. Printed Record of Events: Print a record of alarm, supervisory, and trouble events on system printer. Sort and report by protected zone, device, and function. When central-station control unit receives a signal, print a report of alarm, supervisory, or trouble condition. Report type of signal (alarm, supervisory, or trouble), protected zone description, date, and time of occurrence. Differentiate alarm signals from other indications. When system is reset, report reset event with the same information concerning device, location, date, and time. Commands shall initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.
  
- I. Response Time: Two seconds between actuation of any alarm and its indication at central-station control unit.
  
- J. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from central-station control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at central-station control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.
  
- K. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially

scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.

- L. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

### 2.3 SYSTEM COMPONENT REQUIREMENTS

- A. Compatibility: Detection devices and their communication features, connecting wiring, and central-station control unit shall be selected and configured with accessories for full compatibility with the following equipment:
  - 1. Access control Section 13730.
- B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
  - 1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Division 26 Section "Transient Voltage Suppression."
  - 2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Comply with requirements in Division 26 Section "Transient Voltage Suppression" as recommended by manufacturer for type of line being protected.
- C. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V RMS injected into power supply lines at 10 to 10,000 MHz.

- D. Tamper Protection: Tamper switches on detection devices, controllers, annunciators, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled and when entering conductors are cut or disconnected. Central-station control-unit alarm display shall identify tamper alarms and indicate locations.
- E. Self-Testing Devices: Automatically test themselves periodically, but not less than once per hour, to verify normal device functioning and alarm initiation capability. Devices transmit test failure to central-station control unit.
- F. Antimasking Devices: Automatically check operation continuously or at intervals of a minute or less, and use signal-processing logic to detect blocking, masking, jamming, tampering, or other operational dysfunction. Devices transmit detection of operational dysfunction to central-station control unit as an alarm signal.
- G. Addressable Devices: Transmitter and receivers shall communicate unique device identification and status reports to central-station control unit.
- H. Remote-Controlled Devices: Individually and remotely adjustable for sensitivity and individually monitored at central-station control unit for calibration, sensitivity, and alarm condition.

## 2.4 ENCLOSURES

- A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.

- B. Interior Electronics: NEMA 250, Type 12.
- C. Exterior Electronics: NEMA 250, Type 4X fiberglass.
- D. Corrosion Resistant: NEMA 250, Type 4X stainless steel.
- E. Screw Covers: Where enclosures are accessible to inmates, secure with security fasteners of type appropriate for enclosure.

## 2.5 SECURE AND ACCESS DEVICES

- A. Manufacturers:
  - 1. ADEMCO Group; Pittway Corporation.
  - 2. Honeywell International Inc.
  - 3.
  - 4.
- B. Keypad and Display Module: Arranged for entering and executing commands for system-status changes and for displaying system-status and command-related data.
- C. Key-Operated Switch: Change protected zone between secure and access conditions.

## 2.6 DOOR AND WINDOW SWITCHES

- A. Available Manufacturers:
  - 1. ADEMCO Group; Pittway Corporation.
  - 2. Aleph International Corporation.

3. Amseco; Division of Kobishi America, Inc.
4. FBII; Pittway Corporation.
5. GE Interlogix; General Electric Company.
6. George Risk Industries.
7. Honeywell International Inc.
8. Optex.
9. Ultrak, Inc.; a division of Ademco Video Systems.

- B. Description: Balanced-magnetic switch, complying with UL 634, installed on frame with integral overcurrent device to limit current to 80 percent of switch capacity. Bias magnet and minimum of [two] [three] encapsulated reed switches shall resist compromise from introduction of foreign magnetic fields.
- C. Flush-Mounted Switches: Unobtrusive and flush with surface of door and window frame.
- D. Overhead Door Switch: Balanced-magnetic type, listed for outdoor locations, and having door-mounting magnet and floor-mounting switch unit.
- E. Remote Test: Simulate movement of actuating magnet from central-station control unit.

## 2.7 PIR SENSORS

- A. Manufacturers:
1. ADEMCO Group; Pittway Corporation.
  2. Aleph International Corporation.



3. Crow Electronic Engineering, Inc.
4. Digital Security Controls, Ltd.
5. FBI; Pittway Corporation.
6. Honeywell International Inc.
7. NAPCO Security Systems, Inc.
8. Optex.
9. Richardson Electronics, Ltd.
10. Visonic Inc.

B. Description: Sensors detect intrusion by monitoring infrared wavelengths emitted from a human body within their protected zone and by being insensitive to general thermal variations.

1. Wall-Mounting Unit Maximum Detection Range: 125 percent of indicated distance for individual units and not less than 50 feet (15 m).[ Provide adjustable coverage pattern.]
2. Ceiling-Mounting Unit Spot-Detection Pattern: Full 360-degree conical.
3. Ceiling-Mounting Unit Pattern Size: 84-inch (2135-mm) diameter at floor level for units mounted 96 inches (2440 mm) above floor; 18-foot (5.5-m) diameter at floor level for units mounted 25 feet (7.6 m) above floor.

C. Device Performance:

1. Sensitivity: Adjustable pattern coverage to detect a change in temperature of 2 deg F (1deg C) or less, and standard-intruder movement within sensor's detection patterns at any speed between 0.3 to 7.5 fps (0.09 to 2.3 m/s) across 2 adjacent segments of

detector's field of view.

2. Test Indicator: LED test indicator that is not visible during normal operation. When visible, indicator shall light when sensor detects an intruder. Locate test enabling switch under sensor housing cover.
3. Remote Test: When initiated by central-station control unit, start a test sequence for each detector element that simulates standard-intruder movement within sensor's detection patterns, causing an alarm.

## 2.8 MICROWAVE INTRUSION DETECTORS (INTERIOR)

### A. Available Manufacturers:

1. ADEMCO Group; Pittway Corporation
2. GE Interlogix; General Electric Company.
3. Visonic Inc.

### B. Device Performance: Microwave transmitter establishes an electromagnetic field in an adjustable detection pattern and detects intrusion by monitoring changes in that pattern.

1. Sensitivity: Adjustable, able to detect standard-intruder movement within sensor's detection pattern at any speed between 0.3 to 7.5 fps (0.09 to 2.3 m/s). Sensor sensitivity adjustments shall be accessible only when sensor housing is removed, and sensors shall comply with 47 CFR 15.
2. Activation Indicator: LED indicator shall not be visible during normal operation. Indicator shall light when sensor detects a standard intruder. Locate test-enabling

switch under sensor housing cover.

3. Remote Test: When initiated by central-station control unit, start a test sequence for each detector element that simulates standard-intruder movement within sensor's detection patterns, causing an alarm.

## 2.9 ACOUSTIC-TYPE, GLASS-BREAK SENSORS

### A. Manufacturers:

1. ADEMCO Group; Pittway Corporation.
2. Crow Electronic Engineering, Inc.
3. Digital Security Controls, Ltd.
4. GE Interlogix; General Electric Company.
5. FBI; Pittway Corporation.
6. Honeywell International Inc.
7. International Electronics Inc.
8. NAPCO Security Systems, Inc.
9. Visonic Inc.

### B. Device Performance: Detect unique, airborne acoustic energy spectrum caused by breaking glass.

1. Sensor Element: Microprocessor-based, digital device to detect breakage of plate, laminate, tempered, and wired glass while rejecting common causes of false alarms. Detection pattern shall be at least a 20-foot (6-m) range.

2. Hookup Cable: Factory installed, not less than 72 inches (1830 mm).
3. Activation Indicator: LED on sensor housing that lights when responding to vibrations, remaining on until manually reset at sensor controller[ or at central-station control unit].
4. Controller: Integral with sensor housing or in a separate assembly, locally adjustable by control under housing cover.
5. Glass-Break Simulator: A device to induce frequencies into protected glass pane that simulate breaking glass without causing damage to glass.

#### 2.10 PIEZOELECTRIC-TYPE, GLASS-BREAK SENSORS

##### A. Available Manufacturers:

1. ADEMCO Group; Pittway Corporation.
2. Honeywell International Inc.
3. GE Interlogix; General Electric Company.
4. NAPCO Security Systems, Inc.
5. Visonic Inc.

##### B. Device Performance: Detect unique, high-frequency vibrations caused by breaking glass.

1. Sensor Element: Piezoelectric crystals in a housing designed to mount directly to glass surface with adhesive provided by element manufacturer. Circular detection pattern, with at least a 60-inch (1525-mm) radius on a continuous glass pane. Sensor element shall not be larger than 4 sq. in. (25.80 sq. cm).

2. Hookup Cable: Factory installed, not less than 72 inches (1830 mm).
3. Activation Indicator: LED on sensor housing that lights when responding to vibrations, remaining on until manually reset at sensor controller or at central-station control unit.
4. Controller: Integral with sensor housing or in a separate assembly, locally adjustable by control under housing cover.
5. Glass-Break Simulator: A device to induce frequencies into protected glass pane that simulate breaking glass without causing damage to glass.

## 2.11 VIBRATION SENSORS

### A. Available Manufacturers:

1. ADEMCO Group; Pittway Corporation.
2. Honeywell International Inc.
3. Potter Electric Signal.
4. PULNiX America, Inc.

### B. Description: A sensor controller and piezoelectric crystal sensor elements that are designed to be rigidly mounted to structure being protected.

### C. Device Performance: Detects high-frequency vibrations generated by use of such tools as oxyacetylene torches, oxygen lances, high-speed drills and saws, and explosives that penetrate a structure while not responding to any other mechanical vibration.

1. Circular detection pattern, with at least a 72-inch (1830-mm) radius on protected structure.

2. Hookup Cable: Factory installed, not less than 72 inches (1830 mm).
3. Controller: Integral with sensor housing or in a separate assembly, locally adjustable by control under housing cover.
4. Glass-Break Simulator: A device to induce frequencies to protected glass pane that simulate breaking glass without causing damage to glass.

## 2.12 PHOTOELECTRIC SENSORS

### A. Available Manufacturers:

1. ADEMCO Group; Pittway Corporation.
2. Honeywell International Inc.
3. Aleph International Corporation.
4. Amseco; Division of Kobishi America, Inc.
5. Optex.
6. Protex International Corp.
7. PULNiX America, Inc.
8. Richardson Electronics, Ltd.

### B. Device Performance: Detect an interruption of a pulsed, infrared, light beam that links transmitter and receiver.

1. Sensitivity: Detect standard-intruder movement within sensor's detection patterns at any speed of less than 7.5 fps (2.3 m/s) though the beam. Allow installation of multiple sensors within same protected zone that will not interfere with each other.

2. Activation Indicator: LED indicator shall not be visible during normal operation. Indicator shall light when sensor detects a standard intruder. Locate test enabling switch under sensor housing cover.
3. Remote Test: When initiated by central-station control unit, start a test sequence for each detector element that simulates standard-intruder movement within sensor's detection patterns, causing an alarm.

#### 2.13 MICROWAVE-PIR DUAL-TECHNOLOGY MOTION SENSORS

A. Available Manufacturers:

1. ADEMCO Group; Pittway Corporation.
2. Honeywell International Inc.
3. Aleph International Corporation.
4. GE Interlogix; General Electric Company.
5. NAPCO Security Systems, Inc.
6. Richardson Electronics, Ltd.
7. Visonic Inc.

B. Description: Single unit combining a sensor that detects changes in microwave signals and a PIR sensor that detects changes in ambient level of infrared emissions caused by standard-intruder movement within detection pattern.

C. Device Performance: An alarm is transmitted when either sensor detects a standard intruder within a period of three to eight seconds from when the other sensor detects a standard

intruder.

1. Minimum Detection Pattern: A room 20 by 30 feet (6 by 9 m).
2. PIR Sensor Sensitivity: Adjustable pattern coverage to detect a change in temperature of 2 deg F (1 deg C) or less, and standard-intruder movement within sensor's detection patterns at any speed between 0.3 to 7.5 fps (0.09 to 2.3 m/s) across 2 adjacent segments of detector's field of view.
3. Microwave Sensor Sensitivity: Adjustable, able to detect standard-intruder movement within sensor's detection pattern at any speed between 0.3 to 7.5 fps (0.09 to 2.3 m/s). Sensor sensitivity adjustments shall be accessible only when sensor housing is removed, and sensors shall comply with 47 CFR 15.
4. Activation Indicator: LED indicator shall not be visible during normal operation. Indicator shall light when sensor detects a standard intruder. Locate test enabling switch under sensor housing cover.
5. Remote Test: When initiated by central-station control unit, start a test sequence for each detector element that simulates standard-intruder movement within sensor's detection patterns, causing an alarm.

#### 2.14 DURESS-ALARM SWITCHES

- A. Available Manufacturers:
1. ADEMCO Group; Pittway Corporation.
  2. Honeywell International Inc.
  3. GE Interlogix; General Electric Company.
  4. NAPCO Security Systems, Inc.



5. Visonic Inc.

B. Description: A switch with a shroud over the activating lever that allows an individual to covertly send a duress signal to central-station control unit, with no visible or audible indication when activated. Switch shall lock in activated position until reset with a key.

1. Minimum Switch Rating: 50,000 operations.
2. Foot Rail: Foot activated, floor mounting.
3. Push Button: Finger activated, suitable for mounting on horizontal or vertical surface.

#### 2.15 VIDEO MOTION SENSOR (INTERIOR)

A. Available Manufacturers:

1. ADEMCO GROUP; PITTMAY CORPORATION.
2. Aleph International Corporation.
3. AXCESS Inc.
4. Diebold, Incorporated.
5. GE Interlogix; General Electric Company.
6. ICU Security, Inc.
7. NAPCO Security Systems, Inc.
8. Richardson Electronics, Ltd.
9. Visonic Inc.

B. Device Performance: Detect changes in video signal within a user-defined protected zone.

Video inputs shall be composite video as defined in EIA 170. Provide an alarm output for each video input.

1. Detect movement within protected zone of standard intruders wearing clothing with a reflectivity that differs from that of background scene by a factor of 2. Reject all other changes in video signal.
2. Modular design that allows for expansion or modification of number of inputs.
3. Controls:
  - a. Number of detection zones.
  - b. Size of detection zones.
  - c. Sensitivity of detection of each protected zone.
4. Mounting: Standard 19-inch (480-mm) rack as described in EIA 310.

## 2.16 CENTRAL-STATION CONTROL UNITS

### A. Available Manufacturers:

1. ADEMCO Group; Pittway Corporation.
2. Amseco; Division of Kobishi America, Inc.
3. DAQ Electronics, Inc.
4. Diebold, Incorporated.
5. FBII; Pittway Corporation.
6. GE Interlogix; General Electric Company.
7. Honeywell International Inc.
8. Magal Security Systems Ltd.
9. NAPCO Security Systems, Inc.

10. Perimeter Products, Inc.
  11. Richardson Electronics, Ltd.
  12. Visonic Inc.
- B. Description: Panel shall provide supervision of sensors and detection subsystems and their connecting communication links, status control (secure or access) of sensors and detector subsystems, activation of alarms and supervisory and trouble signals, and other indicated functions.
- C. Construction: Modular, with separate and independent alarm and supervisory system modules. Alarm-initiating protected zone boards shall be plug-in cards. Arrangements that require removal of field wiring for module replacement are not acceptable.
- D. Comply with UL 609 UL 1023 UL 1076.
- E. Alarm Indication: Audible signal sounds and an LED lights at central-station control unit identifying protected zone originating the alarm. Annunciator panel displays a common alarm light and an audible tone.
- F. Alarm Indication: Audible signal sounds and a plain-language identification of protected zone originating the alarm appears on LED display at central-station control unit. Annunciator panel displays a common alarm light and an audible tone.
- G. Alarm Indication: Audible signal sounds and a plain-language identification of protected zone originating the alarm appears on LED or LCD display at central-station control

unit. Annunciator panel alarm light and audible tone identify protected zone signaling an alarm.

1. Alarm activation sounds a bell or siren and strobe.

H. Operator Controls: Manual switches and push-to-test buttons that do not require a key to operate. Include the following:

1. Acknowledge alarm.
2. Silence alarm.
3. System reset.
4. LED test.

I. Resetting Controls: Prevent resetting of alarm, supervisory, or trouble signals while alarm or trouble condition persists.

J. Timing Unit: Solid state, programmable, 365 days.

1. Astronomic Control: For automatic control of light switching at dawn and dusk.
2. Confirmation: Relays, contactors, and other control devices shall have auxiliary contacts that provide confirmation signals to system for their on or off status. Software shall interpret such signals, display equipment status, and initiate failure signals.
3. Override Capability: Programmed shutdown of lighting and other items shall be overridden by using override push buttons or by entering commands over telephone data links.

K. Alphanumeric Display and System Controls: Arranged for interface between operator and addressable system components, including annunciation and supervision. Display alarm,

supervisory, component status messages, and programming and control menu.

1. Display: LCD, 80 characters, minimum.
  2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- L. Alphanumeric Display and System Controls: Arranged for interface between operator at central-station control unit and addressable system components, including annunciation, supervision, and test.
1. Display: A minimum of 80 characters; alarm, supervisory, and component status messages; and indicate control commands to be entered into system for testing of sensors.
  2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- M. Protected Zones: Quantity of alarm and supervisory zones as indicated, with capacity for expanding number of protected zones by a minimum of 25 percent.
- N. Power Supply Circuits: Central-station control units shall provide power for remote power-consuming detection devices. Circuit capacity shall be adequate for at least a 25 percent increase in load.
- O. Cabinet: Lockable, steel enclosure arranged so operations required for testing, normal operation, and maintenance are performed from front of enclosure. If more than a single cabinet is required to form a complete control unit, provide exactly matching modular enclosures. Accommodate all components and allow ample gutter space for field wiring.

Identify each enclosure by an engraved, laminated, phenolic-resin nameplate. Lettering on enclosure nameplate shall not be less than 1 inch (25 mm) high. Identify, with permanent labels, individual components and modules within cabinets.

## 2.17 ANNUNCIATOR

### A. Manufacturers:

1. ADEMCO Group; Pittway Corporation.
2. Amseco; Division of Kobishi America, Inc.
3. DAQ Electronics, Inc.
4. Diebold, Incorporated.
5. FBII; Pittway Corporation.
6. GE Interlogix; General Electric Company.
7. Honeywell International Inc.
8. Magal Security Systems Ltd.
9. NAPCO Security Systems, Inc.
10. Perimeter Products, Inc.
11. Richardson Electronics, Ltd.
12. Visonic Inc.
- 13.

### B. Power and Signal Inputs: From central-station control unit.

### C. Visual Displays: Modular-lighted type with displays as indicated and engraved legend for each protected zone annunciated.

- D. Light Source: Duplicate LEDs for "alarm signals," visible at a distance of 30 feet (9.2 m).
- E. Signals Annunciated: "Secure," "access," and "alarm" shall be distinctly indicated for each protected zone by green, yellow, and red displays, respectively. Annunciate alarm condition by flashing light and steady alarm tone until silence-reset switch is operated.
- F. Audible Alarm: Unit mounted within annunciator cabinet; sounds for alarm conditions and is silenced by silence-reset switch on unit. Alarm shall sound again when condition is normalized until silence-reset switch is reset.
- G. Silence-Reset Switch: Resets annunciator to normal condition after alarm condition is restored.
- H. Test Switch: Tests annunciator LEDs.
- I. Cabinet: Two hinged doors, one behind the other. Metal outer door frame with minimum 1/4-inch- (6-mm-) thick, clear acrylic vision lite. Steel inner door with mounting surface for annunciator modules. Both doors shall have flush tumbler locks and tamper switches. Comply with Division 26 Section "Raceways and Boxes."
  - 1. Graphics: Integrate LED displays with graphic display panel to form a graphic annunciator.
- J. Electrical Power: Annunciator shall be powered by UPS of central-station control unit.

## 2.18 AUDIBLE AND VISUAL ALARM DEVICES

- A. Available Manufacturers:

1. ADEMCO Group; Pittway Corporation.
  2. Honeywell International Inc.
  3. Alarm Controls Corporation.
  4. Amseco; Division of Kobishi America, Inc.
  5. Edwards Signaling.
  6. Gentex Corporation; Fire Protection Group.
  7. Potter Electric Signal.
  8. Richardson Electronics, Ltd.
  9. Wheelock, Inc.
  - 10.
- B. Bell: Central-station control unit 10 inches (254 mm) in diameter, rated to produce a minimum sound output of 84 dB at 10 feet (3 m) from central-station control unit.
1. Enclosure: Weather-resistant steel box equipped with tamper switches on cover and on back of box.
- C. Klaxon Weatherproof Motor-Driven Hooter: UL listed, rated to produce a minimum sound output of 120 dB at 3 feet (1 m), plus or minus 3 dB, at a frequency of 470 Hz. Rated for intermittent use: two minutes on and five minutes off.
1. Designed for use in industrial areas and in high noise, severe weather marine environments.
- D. Siren: 30-W speaker with siren driver, rated to produce a minimum sound output of 103 dB at 10 feet (3 m) from central-station control unit.
1. Enclosure: Weather-resistant steel box with tamper switches on cover and on back of



box.

- E. Strobe: Xenon light complying with UL 1638, with a clear polycarbonate lens.
  - 1. Light Output: 115 cd, minimum.
  - 2. Flash Rate: 60 per minute.

#### 2.19 SECURITY FASTENERS

- A. Operable only by tools produced for use on specific type of fastener by fastener manufacturer or other licensed fabricator. Drive system type, head style, material, and protective coating as required for assembly, installation, and strength.
- B. Manufacturers:
  - 1. Camcar Textron Inc.
  - 2. Holo-Krome; a Danaher Corporation.
  - 3. Safety Socket Screw Corporation.
  - 4. Tamper-Pruf Screws, Inc.
- C. Drive System Types: Pinned Torx-Plus.
- D. Socket Flat Countersunk Head Fasteners:
  - 1. Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).
  - 2. Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.
- E. Socket Button Head Fasteners:
  - 1. Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).
  - 2. Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.

F. Socket Head Cap Fasteners:

1. Heat-treated alloy steel, ASTM A 574 (ASTM A 574M).
2. Stainless steel, ASTM F 837 (ASTM F 837M), Group 1 CW.

G. Protective Coatings for Heat-Treated Alloy Steel:

1. Zinc chromate, ASTM F 1135, Grade 3 or 4; for exterior applications and interior applications where indicated.
2. Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide, unless otherwise indicated.

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 intrusion detection.
1. Examine roughing-in for embedded and built-in anchors to verify actual locations of intrusion detection connections before intrusion detection installation.
  2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of intrusion detection.
- B. Inspect built-in and cast-in anchor installations, before installing intrusion detection, to verify that anchor installations comply with requirements. Prepare inspection reports.
1. Remove and replace anchors where inspections indicate that they do not comply with

requirements. Reinspect after repairs or replacements are made.

2. Perform additional inspections to determine compliance of replaced or additional anchor installations. Prepare inspection reports.

C. For material whose orientation is critical for its performance as a ballistic barrier, verify installation orientation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SYSTEM INSTALLATION

A. Comply with UL 681 UL 1641.

B. Security Fasteners: Where accessible to inmates, install intrusion detection components using security fasteners with head style appropriate for fabrication requirements, strength, and finish of adjacent materials except that a maximum of two different sets of tools shall be required to operate security fasteners for Project. Provide stainless-steel security fasteners in stainless-steel materials.

### 3.3 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceways according to Division 26 Section "Raceways and Boxes." Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be 1/2 inch (13 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.

B. Wiring Method: Install wiring in raceways except in accessible indoor ceiling spaces and in

interior hollow gypsum board partitions where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 1/2 inch (13 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.

- C. Wiring Method: Cable, concealed in accessible ceilings, walls, and floors when possible.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Wires and Cables:
  - 1. Conductors: Size as recommended in writing by system manufacturer, unless otherwise indicated.
  - 2. 120-V Power Wiring: Install according to Division 26 Section "Conductors and Cables," unless otherwise indicated.
  - 3. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable, unless otherwise indicated or if manufacturer recommends shielded cable, according to Division 26 Section "Voice and Data Communication Cabling."
  - 4. Computer and Data-Processing Cables: Install according to Division 26 Section "Voice and Data Communication Cabling."

5. Television Signal Transmission Cables: Install according to Division 26 Section "Voice and Data Communication Cabling."

F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

G. Install power supplies and other auxiliary components for detection devices at controllers, unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.

H. Identify components with engraved, laminated-plastic or metal nameplate for central-station control unit and each terminal cabinet, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Electrical Identification."

### 3.4 GROUNDING

A. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding. Provide 5 -ohm ground. Measure, record, and report ground resistance.

C. Install grounding electrodes of type, size, location, and quantity indicated. Comply with installation requirements in Division 26 Section "Grounding and Bonding."

### 3.5 FIELD QUALITY CONTROL

- A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
  - 1. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.
  
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
  
- C. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
  
- D. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
  
- E. Perform the following field tests and inspections and prepare reports:
  - 1. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
  - 2. Operational Tests: Schedule tests after pretesting has been successfully completed. Test all modes of system operation and intrusion detection at each detection device.

Test for detection of intrusion and for false alarms in each protected zone. Test for false alarms by simulating activities outside indicated detection patterns.

3. Electrical Tests: Comply with NFPA 72, Section A-7. Minimum required tests are as follows:

- a. Verify the absence of unwanted voltages between circuit conductors and ground.
- b. Test all conductors for short circuits using an insulation-testing device.
- c. With each circuit pair, short circuit at the far end of circuit and measure circuit resistance with an ohmmeter. Record circuit resistance of each circuit on Record Drawings.
- d. Verify that each controller is in normal condition as detailed in manufacturer's operation and maintenance manual.
- e. Test signal and data transmission circuits complying with requirements in Division 26 Section "Voice and Data Communication Cabling" for proper signal transmission under open-circuit conditions. One connection each should be opened at not less than 10 percent of initiating and indicating devices. Observe proper signal transmission according to class of wiring used.
- f. Verify that transient surge-protection devices are installed according to manufacturer's written instructions.
- g. Test each initiating and indicating device for alarm operation and proper response at central-station control unit.
- h. Test both primary and secondary power. Verify, by test, that UPS is capable of operating the system for period and in manner specified.

F. Report of Tests and Inspections: Prepare a written record of tests, inspections, and detailed

test results in the form of a test log.

- G. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain intrusion detection. Refer to Division 1 Section "Demonstration and Training."

### 3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose. Visits for this purpose shall be in addition to any required by warranty.

END OF SECTION 28 16 00



## SECTION 28 31 11 – VOICE EVACUATION FIRE ALARM SYSTEM

### PART 1 - GENERAL

#### 1.1.1.1 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. Related Sections:
  - 1. Division 01 General Requirements
  - 2. Division 07 Thermal and Moisture Protection, Section 078413 Penetration Firestopping
  - 3. Division 08 Openings, Section 087100 Door Hardware
  - 4. Division 21 Fire Suppression
  - 5. Division 23 Heating Ventilating and Air Conditioning Monitoring & Control (HVAC).
  - 6. Division 26 Electrical, Section 260500 Common Work Results for Electrical
  - 7. Division 28 Electronic Safety and Security

#### 1.1.1.2 SUMMARY

- A. Section Includes:
  - 1. This specification describes an addressable Fire Detection and alarm signaling system. The control panel shall be intelligent device addressable, analog detecting, low voltage and modular, with digital communication techniques. The features and capacities described in this specification are required as a minimum for this project and shall be furnished by the successful contractor.
  - 2. All equipment furnished shall be new and the latest state of the art products of a single experienced manufacturer, engaged in the manufacturing and sale of analog fire detection devices.
  - 3. The system specified shall be that of Siemens Cerberus® PRO which meets the project requirements.

#### 1.1.1.3 DEFINITIONS

- A. ASME: American Society of Mechanical Engineers.
- B. Broadcast Media: The speakers, radio, cell phone, and other media that will carry the selected message to the selected audience.
- C. FACP: Fire alarm control panel.
- D. NAC: Notification Appliance Circuit. A circuit used to monitor and activate notification appliances or devices.
- E. FM: FM Global (Factory Mutual).
- F. Furnish: To supply the stated equipment or materials.
- G. Install: To set in position and connect or adjust for use.

- H. LED: Light-emitting diode.
- I. NFPA: National Fire Protection Association. Definitions in NFPA 72 apply to fire alarm terms used in this Section.
- J. NICET: National Institute for Certification in Engineering Technologies.
- K. Provide: To furnish and install the stated equipment or materials.
- L. UL: Underwriters Laboratories.
- M. AHJ: Authority Having Jurisdiction. Local authority (such as a fire marshal), presiding over the occupancy of the building(s).

#### 1.1.1.4 SYSTEM DESCRIPTION

- A. Basic Cerberus® PRO Fire Safety – The system shall be a complete, electrically supervised fire detection and notification system, with a microprocessor based operating system having the following capabilities, features, and capacities:
  - 1. The local system shall provide status indicators and control switches for all of the following functions:
    - 1) Audible and visual notification alarm circuit zone control.
    - 2) Status indicators for sprinkler system water-flow and valve supervisory devices.
    - 3) Any additional status or control functions as indicated on the drawings, including but not limited to; emergency generator functions, fire pump functions, door unlocking and security with bypass capabilities.
- B. Cerberus® PRO Fire Safety Intelligent Voice Communication -- The system shall be complete, electrically supervised evacuation system using one-way communication with microprocessor-based operating system having the following capabilities, features and capacities:
  - 1. Listed for emergency and non-emergency use.
  - 2. Listed for MNS from any control point to 'Request/Grant/Deny' and integrated with FC922-924 and FV922-924 (no separate MNS panel)
  - 3. Ability to support up to two microphones per FV922-924 control panel for one-way paging, and up to 64 microphones in a voice network.
  - 4. Ability to provide manual voice control.
  - 5. Two channel message player supporting 300 messages (38 pre-recorded). The system supports MP3 and WAV files.
  - 6. Three simultaneous audio channels for each networked panel.
  - 7. Amplifiers shall be rated for 25V or 70.7V RMS, 50 watts. Voice amplification shall be supervised and backed up with like amplifiers. Back up shall be one or two per node.

8. Ability to provide separate booster amplifier. Amplifiers shall be rated for 25V or 70.7V RMS, 100 watts.
9. Multiple nodes shall provide peer-to-peer voice capability in order to eliminate a single point of failure.
10. Audio shall be synchronized between nodes in order to take into account common areas.
11. Speakers shall have the ability to play coded audio tones.
12. The system shall provide status indicators and control switches for all of the following functions:
  - 1) Audible and visual notification alarm circuit zone control.
  - 2) Speaker circuit zone control.
  - 3) Status indicators for sprinkler system water flow and valve supervisory devices.
  - 4) Any additional status or control functions as indicated on the drawings, including but not limited to: emergency generator functions, fire pump functions, door unlocking and security with bypass capabilities.

#### 1.1.1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with NFPA 72 and all contract documents and specification requirements.
- B. All interconnections between this system and the monitoring system shall be arranged so that the entire system can be UL-Certificated.
- C. System shall be a complete, supervised, non-coded, addressable multiplex fire alarm system conforming to NFPA 72.
- D. The system shall have Class B circuits for each floor. The system shall operate in the alarm mode upon actuation of any alarm initiating device. The system shall remain in the alarm mode until all initiating device(s) are reset and the fire alarm control panel is manually reset and restored to normal.
- E. The system shall be capable of the following configurations. Both configurations are permitted on the same network.
  1. The system shall support up to 252 addressable devices, which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
  2. The system shall support two loops of 252 addressable devices, each of which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
- F. The system shall support H-series devices and Cerberus® PRO series devices
- G. The system shall have an optional digital alarm communication transmitter.
- H. The system shall provide an off-normal warning prior to reset for all active devices.
- I. The system shall be capable of remote monitoring via Cerberus Remote, a proprietary software system that provides a graphical representation of the fire alarm control panel at a

remote PC when connected via Ethernet to the system. The display will show the exact state of the panel, including blinking LEDs, and with menu buttons for control.

- J. The system shall be capable of being configured via a PC Tool.
- K. The system shall provide the following functions and operating features:
  - 1. The FACP and auxiliary power panels shall provide power, annunciation, supervision and control for the system.
  - 2. Provide Class B initiating device circuits.
  - 3. Provide two Class B notification appliance circuits. Arrange circuits to allow individual, selective, and visual notification by zone. Notification appliance circuits shall be zoned to correspond with the building fire barriers and other building features.
  - 4. NACs shall be synchronized throughout the entire building.
  - 5. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.
- L. The system shall provide a field test function where one person can test the complete system or a specific area while maintaining full operational function of other areas not being tested. Alarms, supervisory signals, trouble signals shall be logged in system history during the walk-test.
- M. Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.
- N. Fire alarm signal initiation shall be by one or more of the following devices:
  - 1. Manual pull station
  - 2. Heat detector
  - 3. Addressable area smoke detectors
  - 4. Projected beam detector
  - 5. Automatic sprinkler system water flow switch.
- O. Activation of any system fire, security, supervisory, trouble, or status initiating device shall cause the following actions and indications at all network Person Machine Interfaces using an LCD display with multiple detail screens.
  - 1. Fire Alarm Condition:
    - 1) Sound an audible alarm and display a custom message defining the building in alarm and the specific alarm point initiating the alarm on an LCD display.
    - 2) Log into the system history archives all activity pertaining to the alarm condition.
    - 3) Sound the ANSI 117-1 signal with synchronized audible notification appliances 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) Activation of any smoke detector in a single elevator lobby or an elevator equipment room shall, in addition to the actions described, cause the recall of that bank of elevators to the 1<sup>st</sup> floor and the lockout of controls. In the event of recall initiation by a detector in the first floor lobby, the recall shall be to the alternate floor as determined by the AHJ.
  - 7) Where indicated on drawings heat detectors in elevator shaft and machine rooms shall activate an elevator power shunt trip breaker. The heat detectors shall be rated at a temperature below the ratings of the sprinkler heads in respective locations to insure that the power shall be shut off before activation of sprinkler system.
  - 8) Door closure devices shall operate by floor or by local requirements.
2. Supervisory Condition:
- 1) Display the origin of the supervisory condition report at the local fire alarm control panel LCD display.
  - 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.
3. Trouble Condition
- 1) Display at the local fire alarm control panel LCD display, 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 conditions that have been restored to normal shall be automatically removed from the trouble display queue and not require operator intervention. This feature shall be software selectable and shall not preclude the logging of trouble events to the historical file.
  - 5) 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.
  - 6) Record within system history, the occurrence of the event, the time of occurrence and the device initiating the event.

- P. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

#### 1.1.1.6 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Complete manufacturer's catalog data including supervisory power usage, alarm power usage, physical dimensions, and finish and mounting requirements.
- B. Power calculations. Battery capacity calculations. Battery size shall be a minimum of 125% of the calculated requirement. Provide the following supporting information:
- C. Shop Drawings: Include plans, elevations, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
  - 2. Complete drawings covering the following shall be submitted by the contractor for the proposed system:
    - a. Floor plans in a CAD compatible format at a scale of 1/8"=1'-0" showing all equipment.
- D. Operation and Maintenance Data: For all fire alarm equipment, to include in operation and maintenance manuals.

#### 1.1.1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: The publications listed below form a part of this publication to the extent referenced. The publications are referenced in the text by the basic designation only. The latest version of each listed publication shall be used as a guide unless the authority having jurisdiction has adopted an earlier version.
  - 1. FM Global (Factory Mutual (FM)):FM Approval Guide
  - 2. National Fire Protection Association (NFPA)
    - 1) NFPA 70 National Electrical Code
    - 2) NFPA 72 National Fire Alarm Code
    - 3) NFPA 90A Standard For The Installation of Air Conditioning and Ventilating Systems
    - 4) NFPA 101 Life Safety Code
  - 3. Underwriters' Laboratories, Inc. (UL) equipment standards, Latest Edition
    - 1) UL Fire Protection Equipment Directory
    - 2) UL Electrical Construction Materials Directory
    - 3) UL 38 – Manually Actuated Signaling Boxes for Use With Fire Protection Signaling Systems
    - 4) UL 228 – Door Holding Devices
    - 5) UL 268 - Smoke Detectors for Fire Protective Signaling Systems
    - 6) UL 464 - Audible Signal Appliances

- 7) UL 497A – Secondary Protectors for Communications Circuits
  - 8) UL 521 - Heat Detectors for Fire Protective Signaling Systems
  - 9) UL 864 - Control Units for Fire Protective Signaling Systems
  - 10) UL 1283 – Electromagnetic Interference Filters
  - 11) UL 1449 - Transient Voltage Surge Suppressors
  - 12) UL 1971 - Signaling Devices for the Hearing Impaired
  - 13) UL 2075 – Gas and Vapor Detectors and Sensors
  - 14) UL 2572 – Mass Notification Systems
4. International Code Council
    - 1) International Building Code
    - 2) International Fire Code.
  5. State and Local Building Codes as adopted and/or amended by The Authority Having Jurisdiction, ADA, and/or State and local equivalency standards as adopted by The Authority Having Jurisdiction.
- B. Installer Qualifications:
1. Before commencing work, submit data showing that the manufacturer has successfully installed fire alarm systems of the same scope, type and design as specified.
  2. The contractor shall submit copies of all required Licenses and Bonds as required in the State having jurisdiction.
  3. The contractor shall employ on staff a minimum of one NICET level III APS.

#### 1.1.1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, and shelf life if applicable.
- B. Store materials inside, under cover, above ground, and kept dry and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.

#### 1.1.1.9 PROJECT CONDITIONS

- A. Installed products or materials shall be free from any damage including, but not limited to, physical insult, dirt and debris, moisture, and mold damage.
- B. Environmental Limitations: Do not deliver or install products or materials until spaces are enclosed and weather-tight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

#### 1.1.1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire alarm equipment that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: 1 year from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1.1.1 MANUFACTURERS

- A. Hochiki

### 2.1.1.2 CONTROL PANEL

- A. The fire alarm control panel shall be microprocessor based using multiple microprocessors throughout the system providing rapid processing of smoke detector and other initiation device information to control system output functions.
- B. There shall be a watchdog circuit, which shall verify the system processors and the software program. Problems with either the processors or the system program the panel shall activate a trouble signal, and reset the panel.
- C. The system modules shall communicate with an RS 485 network communications protocol. All module wiring shall be to terminal blocks.
- D. The Cerberus® PRO Fire Safety FC and FV 922 system shall be capable of the following configurations. Both configurations are permitted on the same network.
  1. The system shall support up to 252 addressable devices, which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
  2. The system shall support two loops of 252 addressable devices, each of which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
- E. The Cerberus® PRO Fire Safety FC and FV 924 system shall be capable of supporting the 252 device configuration listed above, as well as, an additional 252 device circuit. Both configurations are permitted on the same network.
  1. The system shall support up to 504 addressable devices, which includes a second SLC configuration and each may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
  2. The system shall support two loops of 504 addressable devices, each of which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
- F. The system shall be capable of supporting unshielded wiring applications.
- G. System Components:
  1. The System Periphery board shall be capable of 252 intelligent devices distributed between one, two, three, or four Class B SLC circuits. Any trouble on one circuit shall not affect the other circuit. This module controls the signaling from the initiation devices reporting alarms and troubles to the control panel. This module shall also provide the signaling to the field devices for the controlling the output of specific initiation devices. The on board microprocessor provides the periphery board with the ability to function even if the main microprocessor fails. LED's on the board shall provide annunciation for the following; Power, Gnd. Fault, Alarm, Trouble. This board is integral to the system. The board shall be model number FCI2016-U1.



2. The system periphery board shall be capable of supporting two system drivers of 252 intelligent devices distributed between one, two, three, or four Class B SLC circuits for each driver, for a total panel capacity of 504 addressable devices. Any trouble on one circuit shall not affect the other circuit. This module controls the signaling from the initiation devices reporting alarms and troubles to the control panel. This module shall also provide the signaling to the field devices for the controlling the output of specific initiation devices. The on board microprocessor provides the periphery board with the ability to function even if the main microprocessor fails. LED's on the board shall provide annunciation for the following: Power, Gnd. Fault, Alarm, and Trouble. This board is integral to the system. The board shall be model number FCI2017-U1.
3. The voice-system card cage (Model VCA2002-A1) supports the mounting and field wiring for cards used on a Model FV922 / FV924 FACP.
4. The voice system CPU card (Model VCC2001-A1) is a central-processing unit (CPU) card that controls and monitors all modules and functions for Cerberus® PRO Fire Safety intelligent voice-communication FACPs.
5. The In/Out Voice System Card (Model VCC2002-A1) is the Input / Output card for the Cerberus® PRO Fire Safety intelligent voice-communication system.
6. The Voice Amplifier (25 / 70 V) Card used in 'real time', emergency communication, the 50W amplifier card (Model VCI2001-U1) provides AC power between a Model FV922 / FV924 panel and a site's speaker system. Up to four (4) Model VCI2001 amplifiers are supported in a 3-to1 backup, or 1-to-1 backup schematic on a single Cerberus® PRO Fire Safety intelligent voice-communication system: configured as one (1), two (2) or three (3) main amplifiers, and one (1) or two (2) optional backup amplifiers.
7. The Microphone Option Module (Model VTO2004-U3) is used to provide live, non-pre-recorded voice communication on a Cerberus® PRO Fire Safety intelligent voice communication panel. Model VTO2004-U3 can serve either as a main microphone installed in the main-system enclosure, or as a remote microphone in a remote enclosure. Up to two (2) Model VTO2004-U3 microphones are supported for each Model FV922 / FV924 FACP.
8. The Switch Option Module (Model VTO2001-U3) is a series of front-end, illuminated and programmable pushbuttons primarily mounted in the middle inner door of each Cerberus® PRO Fire Safety intelligent voice-communication FACP. Each Model VTO2001-U3 module has 24 group-switches, thus totaling 48 LEDs, and consists of up to 96 multi-color LED-status indicators. Each LED switch-group is assigned specific functionality during the configuration process. Furthermore, a pushbutton [for each affected zone] will illuminate to acknowledge the command has been received at the Voice System CPU Card, Model VCC2001-A1. Additionally, if no microphone is used, up to eight (8) Model VTO2001-U3 switch-option modules can be used in a given three-eight-unit (3HU) enclosure (Model FHD2007-U3/R3).

9. As an option, the Model EBA2004-A1 Booster Amplifier is a main board that allows for expansion of speaker zones for additional power to a Cerberus® PRO Fire Safety intelligent voice communication system.
  10. The Signal Line Circuits (SLC) shall be tested for opens, shorts and communications with all addressable devices installed before connection to the control panel. Systems without this capability shall have a test panel installed for initial testing to eliminate any possible damage short term or long term to the control panel. After initial testing replace the test panel and proceed with complete testing.
  11. The standard Operator Interface shall have the ability to view events, acknowledge, silence, and reset the system and any networked Cerberus® PRO Fire Safety control panels, when configured as a global PMI. The standard operator interface can acknowledge, silence, and reset all panels via Global PMI.
  12. The LED Operator Interface shall have the ability to view events, acknowledge, silence, and reset the system and any networked Cerberus® PRO Fire Safety control panels, when configured as a global PMI. Additionally, the operator interface provides twelve multicolored configurable LEDs for annunciating system status
  13. The System Periphery Board shall contain 2 Class B NAC circuits rated at 3 amps each with power-limited outputs. The zones shall be isolated and independently supervised. There shall be at least 6 unique codes/signals for each circuit based on system logic. These signals shall be Temporal Code 3 (Evacuation), Steady, Temporal Code 4 (for CO alarms), March Time 120ppm, March Time 60ppm, and March Time 30ppm. The card shall have the following LED's to provide trouble shooting and annunciation; Power, Gnd. Fault, Zone Activation or Trouble. This functionality shall be integral to the system. The card shall be model number FCI2016-U1/FCI2017-U1.
  14. The control panel shall be equipped with four Form C relays for alarm, trouble, supervisory, and programmable output. The system shall provide the mounting of all system cards, field wiring, and panel's inter-card wiring. All power limited field wiring shall be separated from all non-power limited internal wiring. The card shall be model number FCI2016-U1/FCI2017-U1.
- H. System response time from alarm to output shall be an average of three (3) seconds.
- I. All system cards and modules shall have Flash memory for downloading the latest module firmware.
- J. Passwords:
1. Technician Level Password - There shall be a 4 character password that a user must enter into the control panel in order to perform such maintenance- and control-related functions at the panel as:
    - a. Arming and disarming devices.
    - b. Activating, deactivating or modifying detector ASD and sensitivity settings.
    - c. Activating and deactivating the History Log function, and deleting obsolete entries.
    - d. Changing the system time and date.

2. Maintenance Level Password - There shall be a 4 character password that a user must enter into the control panel in order to access the panel's reporting functions and walktest functions.
  3. Acknowledge Silenceable Reset Access - There shall be a key required to open a locked cabinet that a system user must use in order to acknowledge events, turn silenceable audibles and visuals on and off, and perform panel resets.
- K. History: The system shall store 2000 events in history. Trouble warnings will occur when the History buffer is full.
- L. Reports:
1. The system shall have the ability to provide configuration, status, queue and history reports.
  2. Configuration reports shall provide the following information:
    - a. Custom Messages
    - b. Database Information
    - c. Entity Type
    - d. Zone usage
    - e. Device Category
    - f. Firmware revision
  3. Status reports shall provide the following information:
    - a. Disarmed cards and devices
    - b. ASD settings
    - c. Sensitivity in %/foot
    - d. Alarm threshold in %/foot
    - e. Temperature in degrees F.
    - f. Walktest
  4. Queue reports shall provide the following information:
    - a. Alarm events with custom message and event time
    - b. Gas alarm events with custom message and event time
    - c. Supervisory events with custom message and event time
    - d. Trouble events with custom message and event time
    - e. Status events with custom message and event time
    - f. Information events

5. History reports shall provide Address, History Type, Description, Time & Date and Custom Message. The following event types shall be reported:
  - a. Alarm events
  - b. Gas alarm events
  - c. Supervisory events
  - d. Status changes
  - e. Alarm verification
  - f. Output activation from logic
  - g. System Reset
  - h. Event Acknowledgements
  - i. Block Acknowledgements
  - j. Audible Silence System Flag Changes
  - k. Sensitivity Changes
  - l. Arm / Disarm Commands
  - m. Arm / Disarm By Logic
  - n. Manual Output Overrides
  - o. Output Overrides By Logic
  - p. Time Changes
  - q. Menu Logins
  - r. ASD Changes
  - s. Walktest
  - t. Device Input to Logic Activations/Deactivations

#### 2.1.1.3 POWER SUPPLY

- A. The system Power Supply shall be a 170 Watt, 6.5-amp that provides 24VDC power for system operation. The power supply shall be filtered and regulated. The power supply provides power for all system operation, including signaling line circuits, notification appliance circuits, auxiliary power, battery charger, and all optional modules. The power supply shall be rated for 120/240 VAC 50/60 Hz. The module shall be model number FP2011-U1
- B. The system Power Supply FP2012-U1 shall be a 300 Watt, 11.5-amp that provides 24 VDC power for system operation. The power supply provides power for all system operation, including signaling line circuits, notification appliance circuits, auxiliary power, battery charger, and all optional modules. The power supply shall be rated for 120/240 VAC 50/60 Hz. The module shall be model number FP2012-U1.
- C. For applications requiring greater than 300W of power, the Model FP2013-U1 power supply can optionally power a Model FV922 or FV924 system. Model FP2013-U1 consists of two (2) power supply units and one (1) interconnection cable, in order to balance the power from

Model FP2013-U1. Consequently, this power-supply configuration can provide up to 600W at 24VDC.

- D. The battery charger shall be able to charge the system batteries up to 100 AH. Battery charging shall be microprocessor controlled and programmed to select battery sizes.
- E. Transfer from AC to battery power shall be instantaneous when AC voltage drops to a point where it is not sufficient for normal operation.

#### 2.1.1.4 SYSTEM ENCLOSURE

- A. Provide the enclosure as specified. Provide the color to comply with local AHJ requirements.
- B. Provide three-height-unit backbox as part of the Cerberus® PRO Fire Safety intelligent - communication system hardware for use with 3HU system enclosures. Specifically, each backbox is used to fasten with a 3HU outer door.

#### 2.1.1.5 REMOTE ANNUNCIATOR

- A. LCD Annunciator Panel: Provide FT2014/FT2015 LCD remote annunciator(s) as indicated on the drawings. The remote annunciator shall provide visual indication of all system status changes including alarm, supervisory, trouble, and system status. Display shall include text descriptions as programmed at the main panel for all device status and system status. The FT2015 remote annunciator shall provide key-lock switch protected functionality including reset, signal silence/un-silence, and acknowledge. The FT2014/FT2015 shall be available in both red and black housings.

#### 2.1.1.6 INTELLIGENT INITIATING DEVICES

- A. General
  - 1. All initiation devices shall be insensitive to initiating loop polarity. Specifically, the devices shall be insensitive to plus/minus voltage connections.
- B. Smoke Detectors – Standard Addressable Detectors:
  - 1. The smoke detectors must provide at least 3 environmental parameter sets to assist in device sensitivity configuration.
  - 2. The detectors shall have a tri-color LED to streamline system maintenance/inspection by plainly indicating detector status as follows: green for normal operation, amber for maintenance required, red for alarm.
  - 3. The detector shall be RoHS-compliant: it shall meet standards for Reduction of Hazardous Substances (RoHS) by reduction in lead content and other restricted substances.
  - 4. The detectors shall be UL listed for operation in a 95% relative humidity (RH) environment.
  - 5. The detectors shall be designed to eliminate calibration errors associated with field cleaning of the chamber.
  - 6. The detectors shall support the use of a relay, or LED remote indicator without requiring an additional software address. Low profile, white case shall not exceed 2.5 inches of extension below the finish ceiling.

7. For the detectors where required, there shall be available a locking kit and detector guard to prevent unauthorized detector removal.

8. Available models:

- 1) OH921. Multi-Criteria incorporating 1 Optical sensor and 1 Thermal sensor with an operating temperature range of 32°F to 100°F. Available in four parameter sets. Polarity insensitive installation wiring. Three color LED.
- 2) OP921. Photoelectric Smoke detector with an operating temperature range of 32°F to 120°F. Available in three parameter sets. Polarity insensitive installation wiring. Three color LED.

C. Heat Detectors – Addressable

1. Thermal Detectors shall be rated at 135 degrees fixed temperature and 15 degrees per minute rate of rise. Detectors shall be constructed to compensate for the thermal lag inherent in conventional type detectors due to the thermal mass, and alarm at the set point of 135 degrees Fahrenheit. The choice of alarm reporting as a fixed temperature detector or a combination of fixed and rate of rise shall be made in system software and be changeable at any time without the necessity of hardware replacement.

2. The detectors furnished shall have a listed spacing for coverage up to 2,500 square feet and shall be installed according to the requirements of NFPA 72 for open area coverage. The thermal detector shall be model number HFPT-11.

3. Model HI921 heat detector shall have the following temperature settings:

- 1) Fixed temperature at 135°F, 145°F, 155°F, 165°F, 174°F
- 2) Rate of Rise at 15°F/ min (8.3°C) at 135°F (57°C)
- 3) Rate of Rise at 15°F/ min (8.3°C) at 174°F (79°C)
- 4) Low temperature warning at 40°F (4.4°C)

D. Detector Bases – Addressable

1. 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.

2. The model number for the standard base shall be DB-11 - 6" Version.

3. The model number for the standard base shall be DB-11E - 4" Version.

E. Manual Pull Stations – Addressable

1. Provide addressable manual stations where shown on the drawings, to be flush or surface mounted as required. Manual stations shall contain the intelligence for reporting address, identity, alarm and trouble to the fire alarm control panel. The manual station communications shall allow the station to provide alarm input to the system and alarm output from the system within less than four (4) seconds.

2. The manual station shall be equipped with terminal strip and pressure style screw terminals for the connection of field wiring. Surface mounted stations where indicated on the drawings shall be mounted using a manufacturer's prescribed matching red enamel outlet box.

3. The double action pull station shall be model number HMS-D.
4. Where required, there shall also be available pull stations with break glass, capable of explosion proof installation, capable of weatherproof installation, reset key operation, and metal housings.

F. Addressable Interface Devices

1. Addressable Interface Devices shall be provided to monitor contacts for such items as water-flow, tamper, and PIV switches connected to the fire alarm system. These interface devices shall be able to monitor a single or dual contacts. An address will be provided for each contact. Where remote supervised relay is required the interface shall be equipped with a SPDT relay rated for 4 amps resistive and 3.5 amps inductive. The addressable interface modules shall be model number HTRI or FDCIO Series.
2. Where needed, a Conventional Zone Module shall connect to the Signal Line Circuit, which will allow the use of conventional initiation devices. This module shall have the ability to support up to 15 conventional smoke detectors and an unlimited number of contact devices. This module shall also be capable of monitoring Linear Beam detectors and conventional Flame detectors. Where required, there shall be an intrinsically safe detection solution for NEMA defined intrinsically safe installations (model DI-3IS with ISI-1) compatible with the conventional zone module. The module shall be model HZM.
3. Single Device Damper Monitoring and Control: A single HTRI switch input shall be able to monitor all 3 states of a damper – open, closed, and in transit. A single HTRI-R shall be able to fully control a damper (through the relay connected to the motor control) while also using its switch input for monitoring all 3 states of the damper.
4. Model HCP addressable control point shall provide remote, independent control of any of the following:
  - 1) A notification appliance circuit (NAC)
  - 2) A telephone zone
  - 3) A speaker zone.

2.1.1.7 DEVICE PROGRAMMING UNIT

- A. Device Programming Unit: The programming tool shall program the intelligent devices with addresses. The unit shall test the device to respond to its address. Dipswitches and rotary switches shall not be acceptable. The programmer shall be model DPU with carrying case.

2.1.1.8 NOTIFICATION APPLIANCES

- A. All notification appliances shall be listed for Special Applications: Strobes are designed to flash at 1-flash-per-second minimum over their "Regulated Input Voltage Range

2.1.1.9 DIGITAL COMMUNICATOR

- A. The Multi-Point Digital Alarm Communicator FCA2015-U1 shall be UL864 listed to provide point identification of alarm, supervisory, security and trouble events to a Central or Remove Receiving Station. The DACT shall support the following:
  1. Ademco Contact ID or SIA protocol

2. Ademco Contact ID selection shall provide the ability to transmit events for up to 999 individual zones
3. SIA selection shall provide the ability to transmit events for up to 10000 individual points
4. Programming of accounts and phone numbers
5. Dual phone line interface
6. Line fault monitoring.
7. Automatic 24-hour test
8. The DACT supports configurable alarm, alarm restoral, trouble, trouble restoral, supervisory, supervisory restoral, and reset events.
9. The DACT supports Ademco Contact ID alarm event codes for general alarm, smoke detector alarm, waterflow alarm, duct alarm, and manual alarm events.
10. Optionally, the DACT can be programmed to report events by event queue only.

### PART 3 - EXECUTION

#### 3.1.1.1 EXAMINATION

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

#### 3.1.1.2 INSTALLATION

- A. Perform work in accordance with the requirements of NFPA 70, NFPA 72 and NECA 1-2006, Standard of Good Workmanship in Electrical Contracting.
- 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, 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.
- D. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
- E. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- F. 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.
- G. Provide primary power for each panel from normal/ emergency panels as indicated on the Electrical Power Plans. Power shall be 120 VAC service, transformed through a two-winding,



isolation type transformer and rectified to low voltage DC for operation of all circuits and devices.

#### 3.1.1.3 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.
- E. "Fire alarm system" decal or silk-screened label shall be applied to all junction box covers.

#### 3.1.1.4 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 minimum 18 AWG twisted.
- D. All splices shall be made using solder-less connectors. All connectors shall be installed in conformance with the manufacturer recommendations.
- E. Wiring within sub panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.

#### 3.1.1.5 DEVICES

- A. All devices and appliances shall be mounted to or in an approved electrical box.

#### 3.1.1.6 IDENTIFICATION

- A. Permanently label or mark each conductor at both ends with permanent alphanumeric wire markers.

#### 3.1.1.7 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

#### 3.1.1.8 ACCEPTANCE TESTING

- A. A written acceptance test procedure (ATP) for testing the fire alarm system components and installation will be prepared 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. The installing contractor prior to the ATP shall prepare a complete listing of all device labels for alphanumeric annunciator displays.

- C. Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are functioning properly. After preliminary testing is complete, the Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.
- D. Final Acceptance Test: Notify the owner in writing when the system is ready for final acceptance testing. Submit request for test at least 7 calendar days prior to the test date. Test the system in accordance with the procedures outlined in NFPA 72.
- E. 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.

#### 3.1.1.9 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.
  - 2. System operation, installation and maintenance manuals.

#### 3.1.1.10 DEMONSTRATION

- A. Instructor: Include in the project the services of an instructor, who shall have received specific training from the manufacturer for the training of other persons regarding the inspection, testing and maintenance of the system provided. The instructor shall train the employees designated by the owner, in the care, adjustment, maintenance, and operation of the fire alarm system.
- B. Training sessions shall cover all aspects of system performance, including system architecture, signaling line circuit configurations, sensor and other initiating device types, locations, and addresses, fire alarm control panel function key operation, and other functions as designated by the owner.

END OF SECTION 28 31 11

## **SECTION 31 05 13 - SOILS FOR EARTHWORK**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Subsoil materials.
  - 2. Topsoil materials.
  
- B. Related Sections:
  - 1. Section 310513 - Aggregates for Earthwork.
  - 2. Section 320516 - Aggregates for Exterior Improvements.
  - 3. Section 312213 - Rough Grading.
  - 4. Section 312323 - Backfill.
  - 5. Section 312317 - Trenching.

#### **1.2 REFERENCES**

- A. American Association of State Highway and Transportation Officials:
  - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
  
- B. ASTM International:
  - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
  - 2. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
  - 3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

### **PART 2 PRODUCTS**

#### **2.1 SOURCE QUALITY CONTROL**

- A. Section 014000 - Quality Requirements: Testing and Inspection Services Testing and analysis of soil material.
  
- B. Testing and Analysis of Subsoil Material: Perform in accordance with ASTM D698.
  
- C. Testing and Analysis of Topsoil Material: Perform in accordance with ASTM D698.
  
- D. When tests indicate materials do not meet specified requirements, change material and retest.
  
- E. Furnish materials of each type from same source throughout the Work.

## **PART 3 EXECUTION**

### **3.1 EXCAVATION**

- A. Excavate subsoil and topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.
- B. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.
- C. Remove excess excavated materials subsoil and topsoil not intended for reuse, from site.
- D. Remove excavated materials not meeting requirements for subsoil materials and topsoil materials from site.

### **3.2 STOCKPILING**

- A. Stockpile materials on site at locations designated by Architect/Engineer.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Prevent intermixing of soil types or contamination.
- E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

### **3.3 STOCKPILE CLEANUP**

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

**END OF SECTION 31 05 13**

## **SECTION #31 10 00 - SITE CLEARING**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Demolition of designated site structures, retaining walls, foundations and removal of materials from site.
- B. Demolition and removal of pavements, curbs and gutters, drainage structures, utilities, signage or landscaping.
- C. Disconnecting and capping or removal of identified utilities.
- D. Filling or removal of underground tanks and piping.
- E. Filling voids in subgrade created as a result of removals or demolition.
- F. Hazardous Material Compliance.
- G. Cleaning site of debris, grass, trees and other plant life in preparation for site or building excavation work.
- H. Protection of existing structures, trees or vegetation indicated on the contract documents to remain.
- I. Stripping topsoil from areas that are to be incorporated into the limits of the project and where so indicated on the construction drawings.
- J. Removal of identified and discovered rock during excavation.
- K. Use of explosives to assist rock removal.
- L. Incorporating removed rock into fills and embankments.

#### **1.2 RELATED SECTIONS**

- A. Section 31 20 00
- B. Construction drawings.
- C. Geotechnical Engineering Report

#### **1.3 PROJECT RECORD DOCUMENTS**

Accurately record actual locations of capped utilities, and subsurface obstructions.

#### **1.4 REGULATORY REQUIREMENTS**

- A. Conform to applicable local code for demolition of structures, safety of adjacent structures, dust control and runoff control.
- B. Obtain required permits and licenses from authorities. Pay associated fees including disposal charges.
- C. Notify affected utility companies before starting work and comply with their requirements.
- D. Do not close or obstruct roadways, sidewalks or hydrants without permits.
- E. Conform to applicable regulatory procedures when discovering hazardous or contaminated materials.
- F. Test soils around buried tanks for contamination.
- G. Construct temporary erosion control systems as shown on the plans or as directed by the engineer to protect adjacent properties and water resources from erosion and sedimentation.
- H. In the event that site work on this project will disturb one (1) or more acres, the contractor shall NOT begin construction without a "National Pollution Discharge Elimination System" (NPDES) permit governing the discharge of storm water from the construction site for the entire construction

period. The permit requires a "Storm Water Pollution Prevention Plan" (SWPPP) to be in place during construction which includes monitoring of storm water flows during construction.

The contractor shall be totally responsible for conducting the storm water management practices in accordance with the NPDES permit and for any enforcement action taken or imposed by Federal or State agencies, including the cost of fines, construction delays and remedial actions resulting from the contractor's failure to comply with all provisions of the NPDES permit.

- I. NFPA 495 – Code for Explosive Materials

## **1.5 JOB CONDITIONS**

- A. Structures to be demolished will be discontinued in use and vacated prior to start of work.
- B. Owner assumes no responsibility for condition of structures to be demolished.
- C. Conditions existing at time of inspection for bidding purposes will be maintained by Owner in so far as practicable. Variations within structures may occur by Owner's removal and salvage operations prior to start of demolition work.
- D. Variations to conditions or discrepancy in actual conditions as they apply to site preparation operations are to be brought to the attention of the owner prior to the commencement of any site work.
- E. Unless otherwise indicated in the Construction Documents or specified by the Owner's representative, all items of salvageable value to Contractor shall be removed from the site and structure. Storage or sale of removed items on site will not be permitted and shall not interfere with any other work specified in the contract documents.
- F. Explosives shall not be brought to site or used without written consent of authorities having jurisdiction. Such written consent will not relieve Contractor of total responsibility for injury to persons or for damage to property due to blasting operations. The performance of any required blasting shall comply with governing regulations.
- G. Any discrepancy with plans and specifications regarding amount and type of rock to be removed shall immediately be brought to the attention of the Owner and the Engineer. A revised removal plan and schedule shall subsequently be provided and followed by the Contractor.

### **1.6.1 ENVIRONMENTAL REQUIREMENTS**

- A. Determine all environmental effects associated with proposed work and safeguard those concerns as regulated by law and all others by reasonable and practiced methods.

## **PART 2 - PRODUCTS**

### **2.1 FILL MATERIALS**

Aggregate materials specified in Section 31 20 00.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Provide, erect, and maintain erosion control devices, temporary barriers and security devices at locations indicated
- B. Protect existing landscaping materials, appurtenances and structures which are not to be demolished. Repair damage caused by demolition operations at no cost to Owner.
- C. Prevent movement or settlement of adjacent structures. Provide bracing and shoring.
- D. Mark location of utilities. Protect and maintain in safe and operable condition the utilities to remain. Prevent interruption of existing utility service to occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during

interruptions to existing utilities as acceptable to governing authorities and the Owner's representative.

### **3.2 DEMOLITION REQUIREMENTS**

- A. Conduct demolition to minimize interference with adjacent structures or pavements.
- B. Cease operations immediately if adjacent structures appear to be in danger. Notify authority having jurisdiction. Do not resume operations until directed.
- C. Conduct operations with minimum interference to public or private access. Maintain access and egress at all times.
- D. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon or limit access to their property.
- E. Sprinkle Work with water to minimize dust. Provide hoses and water connections for this purpose.
- F. Comply with governing regulations pertaining to environmental protection.
- G. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing prior to start of work.

### **3.3 DEMOLITION**

- A. Demolish buildings completely and remove from site using methods as required to complete work within limitations of governing regulations. Small structures may be removed intact when acceptable to owner and authorities having jurisdiction.
- B. Proceed with demolition in systematic manner, from top of structure to ground and complete demolition work above each floor or tier before disturbing supporting members on lower levels.
- C. Locate demolition equipment and remove materials so as to prevent excessive loading to supporting walls, floors, or framing.
- D. Remove structural framing members and lower to ground by hoists, derricks, or other suitable methods.
- E. Demolish concrete and masonry in small sections. Break up concrete slabs-on-grade that are 2 or more feet below proposed subgrade. Remove slabs within 2 feet of proposed subgrade.
- F. Demolish and remove below grade construction and concrete slabs on grade to a minimum depth of two feet below proposed subgrade.

### **3.4 FILLING BASEMENTS AND VOIDS**

- A. Completely fill below grade areas and voids resulting from demolition or removal of structures (underground fuel storage tanks, wells, cisterns, etc.) using approved select fill materials consisting of stone, gravel, and sand free from debris, trash, frozen materials, roots, and other organic matter.
- B. Ensure that areas to be filled are free of standing water, frost, frozen, or unsuitable material, trash, and debris prior to fill placement.
- C. Place fill materials in horizontal layers not exceeding 8" in loose depth and compact each layer at optimum moisture content of fill material to proposed density, unless subsequent excavation for new work is required.
- D. Grade surface to match adjacent grades and to provide flow of surface drainage after fill placement and compaction.

### **3.5 DISPOSAL OF DEMOLISHED MATERIALS**

- A. Remove from site debris, rubbish, and other materials resulting from demolition operations.



- B. No burning of any material, debris, or trash on-site or off-site will be allowed, except when allowed by the appropriate governing authority and the Owner's representative. If allowed as stated above, burning shall be performed in manner prescribed by governing authority. Attend burning materials until fires have burned out or have been extinguished.
- C. Transport materials removed from demolished structures with appropriate vehicles and dispose off-site to areas which are approved for disposal by governing authorities and appropriate property owners.

### **3.6 SITE PREPARATION**

Verify that existing plant life and clearing limits are clearly tagged, identified and marked in such a manner as to insure their safety throughout construction operations.

### **3.7 SITE PROTECTION**

- A. Locate and identify existing utilities that are to remain and protect them from damage.
- B. Protect trees, plant growth and features designated to remain as final landscape.
- C. Conduct operations with minimum interference to public or private accesses and facilities. Maintain access and egress at all times and clean or sweep any roadways daily or as required by the governing authority. At such times as deemed necessary by the owner, dust control shall be provided with sprinkling systems or equipment provided by the contractor.
- D. Protect bench marks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed it shall be referenced by a licensed land surveyor and replaced, as necessary, by the same.
- E. Provide traffic control as required, in accordance with the U.S. Department of Transportation "Manual of Uniform Traffic Control Devices" and the state highway department requirements.

### **3.8 SITE CLEARING**

- A. Clear areas required for access to site and execution of work.
- B. Unless otherwise indicated on the drawings, remove trees, shrubs, grass, other vegetation, improvements, or obstructions interfering with installation of new construction. Removal includes digging out stumps and roots. Depressions caused by clearing and grubbing operations are to be filled to subgrade elevation to avoid water ponding. Satisfactory fill material shall be placed in horizontal layers not exceeding 8" loose depth, and thoroughly compacted per fill requirements of this section. Contractor shall also refer to Geotechnical Report for fill requirements. In the case of discrepancies, the more restrictive of the two shall govern.
- C. Remove grass, trees, plant life, stumps and all other construction debris from the site to a dump site that is suitable for handling such material according to state laws and regulations.
- D. In retention pond footprint, clear all rock and vegetation. Excavate to proposed grade level., reserving some native soil for re-use in pond footprint.

### **3.9 TOPSOIL EXCAVATION**

- A. Strip topsoil from areas that are to be filled, excavated, landscaped or re-graded to such a depth that it prevents intermingling with underlying subsoil or questionable material.
- B. Cut heavy growths of grass from areas before stripping and remove with the rest of the cleared vegetative material.
- C. Topsoil shall consist of organic soil found in depth of not less than 6". Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones and other objects over 2" in diameter, weeds, roots, and other objectionable material.
- D. Stockpile topsoil in storage piles in areas shown or where directed. Construct storage piles to freely drain surface water. Cover storage piles as required to prevent windblown dust. Dispose of unsuitable topsoil as specified for waste material, unless otherwise specified by owner. Excess

topsoil shall be removed from the site by the Contractor unless specifically noted otherwise on the Drawings.

**END OF SECTION #31 10 00**

## **SECTION 31 10 00 - SITE CLEARING**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Removing surface debris.
  - 2. Removing designated trees, shrubs, and other plant life.
  - 3. Removing abandoned utilities.
  - 4. Excavating topsoil.
- B. Related Sections:
  - 1. Section 312213 - Rough Grading.
  - 2. Section 312318 - Rock Removal.

### **PART 2 EXECUTION**

#### **2.1 EXAMINATION**

- A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify existing plant life designated to remain is tagged or identified.
- C. Identify waste area for placing removed materials.

#### **2.2 PREPARATION**

- A. Call Local Utility Line Information not less than three working days before performing Work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.

#### **2.3 PROTECTION**

- A. Locate, identify, and protect utilities indicated to remain, from damage.
- B. Protect trees, plant growth, and features designated to remain, as final landscaping
- C. Protect bench marks, survey control points, and existing structures from damage or displacement.

#### **2.4 CLEARING**

- A. Clear areas required for access to site and execution of Work.
- B. Remove trees and shrubs within marked areas. Remove stumps.
- C. Clear undergrowth and deadwood, without disturbing subsoil.

- D. Apply herbicide to remaining stumps to inhibit growth.

## **2.5 REMOVAL**

- A. Remove debris, rock, and extracted plant life from site.
- B. Remove abandoned utilities. Indicated removal termination point for underground utilities on Record Documents.
- C. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- D. Do not burn or bury materials on site. Leave site in clean condition.

## **2.6 TOPSOIL EXCAVATION**

- A. Excavate topsoil from areas to be further excavated, relandscaped, or regraded, without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site to depth not exceeding 8 feet and protect from erosion.
- D. Remove excess topsoil not intended for reuse, from site.

**END OF SECTION 31 10 00**

## **SECTION #31 14 00 – EARTHWORK**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Protection, modification and/or installation of utilities as sitework progresses paying particular attention to grade changes and any necessary staging of work.
- B. Cutting, filling and grading to required lines, dimensions, contours and proposed elevations for proposed improvements.
- C. Scarifying, compaction, drying and removal of unsuitable material to ensure proper preparation of areas for fills or proposed improvements.

#### **1.2 RELATED SECTIONS**

- A. Section 02 41 00 - Demolition
- B. Section 31 10 00 - Site Preparation
- C. Section 31 23 00 - Excavation, Backfill and Compaction for Utilities
- D. Section 31 22 00 - Excavation, Backfill and Compaction for Pavement
- E. Section 31 20 00 - Aggregate Materials
- F. Section 31 32 00 - Soil Stabilization
- G. Geotechnical Report (if available) for boring locations and findings of subsurface materials and conditions.
- H. Construction Drawings
- I. Architectural Plans and Specifications as they relate specifically to the earthwork beneath the buildings, where the architectural requirements are more stringent than the civil requirements

#### **1.3 REFERENCE STANDARDS**

- A. American Society for Testing and Materials (ASTM) latest edition.
  - D 422 Method for Particle Size Analysis of Soils
  - D 698 Test for Moisture-Density Relations of Soils Using 5.5 lb. (2.5 kg) Rammer and 12-inch (304.8 mm) Drop (Standard Proctor)
  - D 1556 Test for Density of soil in Place by the Sand Cone method
  - D 1557 Test for Moisture-Density Relations of Soils Using 10-lb (4.5 Kg) Rammer and 18-inch (457 mm) Drop (Modified Proctor)
  - D 1559 Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
  - D 2167 Test for Density of Soil in Place by the Rubber Balloon Method
  - D 2216 Laboratory Determination of Moisture content of Soil
  - D 2487 Classification of Soils for Engineering Purposes
  - D 2922 Tests for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth)
  - D 3017 Test for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
  - D 4318 Test for Plastic Limit, Liquid Limit, and Plasticity Index of Soils
  - C 25 Chemical Analysis of Limestone, Quicklime and Hydrate Lime
  - C110 Physical Testing for Quicklime and Hydrated Lime, Wet Sieve Method
  - C618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
  - C977 Quicklime and Hydrated Lime for Soil Stabilization
- B. American Association of State Highway and Transportation Officials (AASHTO) latest edition
  - T88 Mechanical Analysis of Soils

#### **1.4 QUALITY ASSURANCE**

- A. Independent Testing Laboratory selected and paid by owner, shall be retained to perform construction testing on site based on the following:
  - 1. Building Subgrade Areas, including 10' –0" Outside Exterior Building Lines: In cut areas, not less than one compaction test for every 2,500 square feet. In fill areas, same rate of testing for each 8" lift (measured loose).
  - 2. Areas of Construction exclusive of building subgrade: In cut areas, not less than one compaction test for every 10,000 square feet. In fill areas, same rate of testing for each 8" lift (measured loose).
- B. If compaction requirements are not complied with at any time during construction process, remove and recompact deficient areas until proper compaction is obtained at no additional expense to owner.
- C. In all areas to receive pavement, a CBR (or LBR) test shall be performed for each type of material imported from off-site.
- D. The following tests shall be performed on each type of on-site or imported soil material used as compacted fill as part of construction testing requirements.
  - 1. Moisture and Density Relationship: ASTM D 698 or ASTM D1557.
  - 2. Mechanical Analysis: AASHTO T-88
  - 3. Plasticity Index: ASTM D 4318
- E. Field density tests for in-place materials shall be performed according to one of the following standards as part of construction testing requirements.
  - 1. Sand-Cone Method: ASTM D 1556
  - 2. Balloon Method: ASTM D 2167
  - 3. Nuclear method: ASTM D 2922 (Method B-Direct Transmission)
- F. Independent Testing Laboratory shall prepare test reports that indicate test location, elevation data, and test results. Owner, architect, and contractor shall be provided with copies of reports within 96 hours of time test was performed. In event that any test performed fails to meet these Specifications, owner and contractor shall be notified immediately by independent testing laboratory.
- G. All costs related to retesting due to failures shall be paid for by the contractor at no additional expense to owner. Owner reserves the right to employ an Independent Testing Laboratory and to direct any testing that is deemed necessary. Contractor shall provide free access to site for testing activities.

## 1.5 SUBMITTALS

- A. Submit a sample of each type of off-site fill materials that is to be used at the site in an air tight, 10 lb container for the testing laboratory.
- B. Submit the name of each material supplier and specific type and source of each material. Any change in source throughout the job requires approval of the owner or engineer.
- C. For use of fabrics or geogrids, a design shall be submitted for approval by the Owner

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Excavated and re-used material for subsoil fill as specified herein.
- B. Aggregate fill as specified in Section 31 20 00.
- C. Imported subsoil material approved by the owner and specified herein.
- D. Topsoil fill as specified in Section 31 10 00.
- E. Acceptable stabilization fabrics and Geogrids:
  - 1. Mirafi 500X or 600X
  - 2. Phillips 66 Supac 6WS
  - 3. Dupont Typar 3401 and 3601
  - 4. Trevira S1114 and S1120
  - 5. Tensar SS-1 and SS-2

- 6. Exxon GTF-200 or 350
- F. Filter/Drainage Fabrics
  - 1. Mirafi 14ONS
  - 2. Phillips 66 Supac 4NP
  - 3. Dupont Typar 3341

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Identify required lines, levels, contours and datum.
- B. Locate and identify existing utilities that are to remain and protect them from damage.
- C. Notify utility companies to remove and/or relocate any utilities that are in conflict with the proposed improvements.
- D. Protect plant life, lawns, fences, existing structures, sidewalks, paving and curbs from excavating equipment and vehicular traffic.
- E. Protect benchmarks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed it shall be referenced by a licensed land surveyor and replaced, as necessary, by the same.
- F. Remove from site material encountered in grading operations that, in opinion of owner or owners representative, is unsuitable or undesirable for backfilling, subgrade or foundation purposes. Dispose of in a manner satisfactory to owner. Backfill areas with layers of suitable material and compact as specified.
- G. Prior to placing fill in low areas, such as previously existing creeks, ponds, or lakes, perform following procedures:
  - 1. Drain water out by gravity with ditch having flow line lower than lowest elevation in low area. If drainage cannot be performed by gravity ditch, use adequate pump to obtain same results.
  - 2. After drainage of low area is complete, remove mulch, mud, debris, and other unsuitable material by using acceptable equipment and methods that will keep natural soils underlying low areas dry and undisturbed.
  - 3. If proposed for fill, all muck, mud, and other materials removed from above low areas shall be dried on-site by spreading in thin layers for observation by owner or owner's representative. Material shall be inspected and, if found to be suitable for use as fill material, shall be incorporated into lowest elevation of site filling operation, but not under the building area or within all of perimeter of building pad or paving subgrade. If, after observation by owner or owners representative, material is found to be unsuitable, all unsuitable material shall be removed from site.

#### **3.2 EXCAVATION FOR FILLING AND GRADING**

- A. Classification of Excavation: Contractor by submitting bid acknowledges that he has investigated the site to determine type, quantity, quality, and character of excavation work to be performed. Excavation shall be considered unclassified excavation, except as indicated by "Article 4 - Administration of the Contract" in the "Supplementary Conditions" portion of the specification.
- B. Perform excavation using capable, well maintained equipment and methods acceptable to owner and governing agencies.
- C. When performing grading operations during periods of wet weather, provide adequate drainage and ground water management to control moisture of soils.
- D. Shore, brace, and drain excavations as necessary to maintain safe, secure, and free of water at all times.
- E. Excavated material containing rock or stone greater than 6" in largest dimension is unacceptable as fill to within the proposed building and paving area.
- F. Rock or stone less than 6" in largest dimension is acceptable as fill to within 24" of surface of proposed subgrade when mixed with suitable material.
- G. Rock or stone less than 2" in largest dimension and mixed with suitable material is acceptable as fill within the upper 24" of proposed subgrade.

#### **3.3 FILLING AND SUBGRADE PREPARATION**

- A. Fill areas to contours and elevations shown with unfrozen materials.
- B. Place fill in continuous lifts specified herein.
- C. Refer to Section 31 22 00 for filling requirements for pavements.
- D. Areas exposed by excavation or stripping and on which subgrade preparations are to be performed shall be scarified to minimum depth of 8" and compacted to minimum of 95% of optimum density, in accordance with ASTM D 698 (or 92% of optimum density, in accordance with ASTM D 1557), at a moisture content of not less than 1% below and not more than 3% above the optimum moisture content. These areas shall then be proofrolled to detect any areas of insufficient compaction. Proofrolling shall be accomplished by making a minimum of two (2) complete passes with a fully-loaded tandem-axle dump truck, or approved equivalent, in each of the two perpendicular directions under the supervision and direction of a field geotechnical engineer. Areas of failure shall be excavated and recompacted as stated above.
- E. Fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed 8" loose measure and compacted to a minimum density of 95% of optimum density, in accordance with ASTM D 698, (or 92% of the optimum density, in accordance with ASTM D 1557) at a moisture content of not less than it below and not more than 3% above the optimum moisture content.
- F. Material imported from off -site shall have a CBR (California Bearing Ratio) or LBR (Limerock Bearing Ratio) value equal to or above the pavement design subgrade CBR or LBR value indicated on the Drawings.

#### **3.4 MAINTENANCE OF SUBGRADE**

- A. Finished subgrades shall be verified to ensure proper elevation and conditions for construction above subgrade.
- B. Protect subgrade from excessive wheel loading during construction, including concrete trucks and dump trucks.
- B. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in a manner that will comply with compaction requirements by use of material equal to or better than best subgrade material on site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.

#### **3.5 RIP RAP**

- A. Place rip-rap in all areas where indicated on the Drawings. The stone for rip-rap shall consist of field stone or rough unhewn quarry stone as nearly uniform, in section as is practical. The stones shall be dense, resistant to the action of air and water, and suitable in all aspects for the purpose intended. Unless otherwise specified, all stones used as rip-rap shall weigh between 50 and 150 pounds each, and at least 60 percent of the stones shall weigh more than 100 pounds each.
- B. Slopes and other areas to be protected shall be dressed to the line and grade shown on the plans prior to the placing of rip-rap. Contractor shall undercut the areas to receive rip-rap to an elevation equal to the final elevation less the average diameter of the stones before placing the rip-rap.
- C. Filter fabric and bedding stone shall be installed prior to the placement of the stones if so indicated on the drawings. The bedding stone shall be quarried and crushed angular limestone in accordance with Section 31 20 00 and shall be 6" in depth. Filter fabric shall be as specified herein and as detailed on the plans.
- D. Stones shall be placed so that the greater portion of their weight is carried by the earth and not by the adjacent stones. The stones shall be placed in a single layer with close joints. The upright areas of the stone shall make an angle of approximately 90 degree with the embankment slope. The courses shall be placed from the bottom of the embankment upward, the larger stones being placed in the lower courses. Open joints shall be filled with spalls. Stones shall be embedded in the embankment as necessary to present a uniform top surface such that the variation between tops of adjacent stones shall not exceed three inches.

#### **3.6 FINISH GRADING**



- A. Grade all areas where finish grade elevations or contours are indicated on Drawings, other than paved areas and buildings, including excavated areas, filled and transition areas, and landscaped areas. Graded areas shall be uniform and smooth, free from rock, debris, or irregular surface changes. Finished subgrade surface shall not be more than 0.10 feet above or below established finished subgrade elevation, and all ground surfaces shall vary uniformly between indicated elevations. Finish ditches shall be graded to allow for proper drainage without ponding and in a manner that will minimize erosion potential.
- B. Correct all settlement and eroded areas within one year after date of completion at no additional expense to owner. Bring grades to proper elevation. Replant or replace any grass, shrubs, bushes, or other vegetation that appears dead, dying or disturbed by construction activities. Refer to Section 31 35 00 for slope protection and erosion control.
- C. Refer to Section 31 32 00 for soil stabilization using lime, cement, fly ash and geotextile fabric methods for subbase materials.

**END OF SECTION #31 14 00**



## **SECTION #31 20 00 - AGGREGATE MATERIALS**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

Aggregate Materials

#### **1.2 RELATED SECTIONS**

- A.. Section 31 10 00 - Site Preparation
- B. Section 31 14 00 - Earthwork
- C. Section 31 06 00 - Excavation, Backfill and Compaction for Structures
- D. Section 31 23 00 - Excavation, Backfill and Compaction for Utilities
- E. Section 31 22 00 - Excavation, Backfill and Compaction for Pavement
- F. Section 31 32 00 - Soil Stabilization
- G. Section 31 35 00 - Slope Protection and Erosion Control
- H. Construction Drawings

#### **1.3 REFERENCE STANDARDS**

- A. American Society for Testing and Materials (ASTM) latest edition.
  - ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
  - ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
  - ANSI/ASTM D155 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
  - ASTM D2167 - Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
  - ASTM D2487 - Classification of Soils for Engineering Purposes.
  - AS7'M D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  - ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.
  - ASTM D4318 - Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- B. American Association of State Highway and Transportation Officials (AASHTO) latest edition.
  - AASHTO T180 - Moisture-Density Relations of Soils Using a 10-lb (4.54 Kg) Rammer and an 18 inch (457 mm) Drop.
  - AASHTO M147 - Materials for Aggregate and Soil-Aggregate.

#### **1.4 QUALITY ASSURANCE**

Tests and analysis of aggregate material will be performed in accordance with standard ASTM and AASHTO procedures listed herein.

#### **1.5 SUBMITTALS**

- A. Submit in air tight containers a 10 pound sample of each aggregate or mixture that is to be incorporated into the project to the testing laboratory designated by the owner.
- B. Submit the name of each material supplier and specific type and source of each material. Any change in source throughout the job requires approval of the owner and engineer.

- C. Submit materials certificate to on-site independent testing laboratory which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. All construction and materials shall meet or exceed the requirements of this section and any state highway department specification section referred to or noted on the drawings which pertain to paving base course design, materials, preparation, and/or execution. All materials shall be as indicated on Drawings and shall comply with applicable state highway specification regarding source, quality, gradation, liquid limit, plasticity index, and mix proportioning.

## **PART 3 EXECUTION**

### **3.1 STOCKPILING**

Stockpile on-site at locations indicated by the owner in such a manner that there will be no standing water or mixing with other materials.

### **3.2 BORROW SITES**

Upon completion of borrow operations, clean up borrow areas as indicated on the plans in a neat and reasonable manner to the satisfaction of the property owner, the owner and the engineer.

### **3.3 TRANSPORTATION**

Off-site materials shall be transported to the project using well maintained and operating vehicles. Once on the job site, all transporting vehicles shall stay on designated haul roads and shall at no time endanger any of the improvements by rutting, overloading or pumping the haul road.

**END OF SECTION #31 20 00**

## **SECTION #31 21 00 - ROCK REMOVAL**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Removal of identified and discovered rock during excavation.
- B. Use of explosives to assist rock removal.
- C. Incorporating removed rock into fills and embankments.

#### **1.2 RELATED SECTIONS**

- A. Section 31 14 00 – Earthwork
- B. Section 31 06 00 – Excavation, Backfill and Compacting for Structures
- C. Section 31 23 00 – Excavation, Backfill and Compacting for Utilities
- D. Section 31 22 00 – Excavation, Backfill and Compacting for Pavement
- E. Geotechnical report (if available) for boring locations and findings of subsurface materials and conditions.
- F. Construction drawings.

#### **1.3 REFERENCE STANDARDS**

NFPA 495 – Code for Explosive Materials

#### **1.4 ENVIRONMENTAL REQUIREMENTS**

Determine all environmental effects associated with proposed work and safeguard those concerns as regulated by law and all others by reasonable and practiced methods.

#### **1.5 JOB CONDITIONS**

Any discrepancy with plans and specifications regarding amount and type of rock to be removed shall immediately be brought to the attention of the Owner and the Engineer. A revised removal plan and schedule shall subsequently be provided and followed by the Contractor.

#### **1.6 QUALIFICATIONS**

Contractor shall submit records of documented experience to the Owner and the Engineer prior to removal of rock by blasting.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

Explosives, detonator/delay device and blast mat materials shall be the type recommended by the explosive supplier and shall comply with the requirements of this section.

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Verify site conditions and note subsurface conditions affecting work of this section.
- B. Identify required lines, levels and elevations that will determine the extent of the proposed removals.

#### **3.2 ROCK EXCAVATION**

- A. Rock excavation is defined as igneous, metamorphic or sedimentary rock that cannot be removed by rippers or other mechanical methods and; therefore, requires drilling and blasting. Cut rock to form level

- bearing at bottom of footing and trench excavations. In utility trenches, excavate rock to 6" below invert elevation of pipe. Remove shaled layers to provide sound and unshattered base for footings or foundations. Reuse excavated materials on-site in accordance with section 31 14 00, if applicable.
- B. Comply with all laws, rules, and regulations of Federal, State and local authorities and insurer which govern storage, use, manufacture, sale, handling, transportation, licensing, or other disposition of explosives. Take special precautions for proper use of explosives to prevent harm to human life and damage to surface structures, all utility lines, or other subsurface structures. Do not conduct blasting operations until persons in vicinity have had ample notice and have reached positions of safety.
  - C. Contractor shall save harmless the Owner, Architect, Engineer and Owner's representative from any claim growing out of use of such explosives. Removal of materials of any nature by blasting shall be done in such a manner and such time as to avoid damage affecting the integrity of design and to avoid damage to any new or existing structure included in or adjacent to work. It shall be contractor's responsibility to determine method of operation to ensure desired results and integrity of completed work.
  - D. Perform rock excavation in a manner that will produce material of such size as to permit it being placed in embankments in accordance with Section 31 14 00. Remove rock to limits as indicated. Remove loose or shattered rock, overhanging ledges and boulders which might dislodge.
  - E. Use lean concrete or suitable materials to replace rock overblast or over excavation in building area and in expansion area to facilitate placement of utilities and future footings.

**END OF SECTION #31 21 00**

## **SECTION #31 22 00 - EXCAVATION, BACKFILLING AND COMPACTING FOR PAVEMENT**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Excavate to line, grade and configuration as shown in the plans and specifications for proposed and future pavement areas.
- B. Fill to line, grade and configuration as shown in the plans and specifications for proposed and future pavement areas.
- C. Compacting fill materials in an acceptable manner as stated herein.

#### **1.2 RELATED SECTIONS**

- A. Section 31 14 00 - Earthwork
- B. Section 31 20 00- Aggregate Materials
- C. Section 31 32 00 - Soil Stabilization
- D. Section 32 11 00- Paving Base Course
- E. Section 32 12 00 - Asphaltic Concrete Paving
- F. Section 32 13 00 - Portland Cement Concrete
- G. Section 32 16 00 - Curbs and Sidewalks
- H. Geotechnical Report (if available) for Boring Locations and Findings of Subsurface Materials and Conditions.
- I. Construction Drawings

#### **1.3 REFERENCE STANDARDS**

- A. American Society for Testing and Materials (ASTM) latest edition.
  - D 422 Method for Particle Size Analysis of Soils
  - D 698 Test for Moisture-Density Relations of Soils Using 5.5 lb. (2.5 kg) Rammer and 12-inch (304.8 mm) Drop (Standard Proctor)
  - D 1556 Test for Density of soil in Place by the Sand Cone Method
  - D 1557 Test for Moisture-Density Relations of Soils Using 10-lb (4.5 Kg) Rammer and 18-inch (457 mm) Drop (Modified Proctor)
  - D 1559 Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
  - D 2167 Test for Density of Soil in Place by the Rubber Balloon Method
  - D 2216 Laboratory Determination of Moisture content of Soil
  - D 2487 Classification of Soils for Engineering Purposes
  - D 2922 Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
  - D 3017 Test for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
  - D 4318 Test for Plastic Limit, Liquid Limit, and Plasticity Index of Soils
  - C 25 Chemical Analysis of Limestone, Quicklime and Hydrated Lime
  - C110 Physical Testing for Quicklime and Hydrated Lime, Wet Sieve Method
  - C618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
  - C977 Quicklime and Hydrated Lime for Soil Stabilization
- B. American Association of State Highway and Transportation Officials (AASHTO) latest edition
  - T88 Mechanical Analysis of Soils

#### **1.4 QUALITY ASSURANCE**

Independent testing laboratory selected and paid by owner shall be retained to perform construction testing on filling operations and subgrade analysis as specified in Section 31 14 00 and as stated herein.

### **1.5 SUBMITTALS**

- A. Shop drawings or details pertaining to excavating and filling for pavement are not required unless otherwise shown on the drawings or specifications or if contrary procedures to the project documents are proposed.
- B. Submit a sample of each type of off-site fill material that is to be used in backfilling in an air-tight, 10 lb. container for the testing laboratory or submit a gradation and certification of the aggregate material that is to be used to the testing laboratory for review.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. Fill material from on-site as specified in Section 31 14 00 and approved by the owner or owner's representative.
- B. Fill material from off-site as specified in Section 31 14 00 and approved by the owner or owner's representative.
- C. Aggregate material as specified in Section 31 20 00.
- D. Acceptable stabilization fabrics and geogrids:
  - 1. Mirafi 500X or 600X
  - 2. Phillips 66 Supac 6WS
  - 3. Dupont Typar 3401 and 3601
  - 4. Trevira S1114 and S1120
  - 5. Tensar SS-1 and SS-2
  - 6. Exxon GTF-200 or 350

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Identify all lines, elevations and grades necessary to construct pavements, curb and gutter, bases, walkways and roadways as shown in the plans and specifications.
- B. Carefully protect benchmarks, property corners, monuments or other reference points.
- C. Locate and identify all site utilities that have previously been installed and may be in danger of damage by grading operations.
- D. Locate and identify all existing utilities that are to remain and protect them from damage.
- E. Over excavate and properly prepare areas of subgrade that are not capable of supporting the proposed systems. These areas shall be stabilized by using acceptable filter fabrics and/or aggregate material placed and compacted as specified.

### **3.2 EXCAVATION**

- A. Excavate roadway and pavement areas to line and grade as shown in the plans and specifications.
- B. Engage all suitable material into the project fill areas as specified in Section 31 14 00
- C. Unsuitable excavated material is to be disposed of in a manner and location that is acceptable to the owner and local governing agencies.
- D. Perform excavation using capable, well maintained equipment and methods acceptable to the owner and the project document requirements.

### **3.3 FILLING AND SUBGRADE PREPARATION**

- A. Areas exposed by excavation or stripping and on which subgrade preparations for paving are to be performed, including future pavement areas, shall be scarified to minimum depth of 8", and compacted to minimum of 98% of optimum density, in accordance with ASTM D 698, at a moisture content of not less



than 2% below and not more than 2% above the optimum moisture content. These areas shall then be proofrolled to detect any areas of insufficient compaction. Proofrolling shall be accomplished by making a minimum of two (2) complete passes with a fully-loaded tandem-axle dump truck, or approved equivalent, in each of the two perpendicular directions under the supervision and direction of a field geotechnical engineer. Areas of failure shall be excavated and recompacted as stated above.

- B. Fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed 8" loose measure and compacted to a minimum density of 98% of optimum density, in accordance with ASTM D 698, at a moisture content of not less than 2% below and not more than 2% above the optimum moisture content.
- C. The following table stipulates maximum allowable values for plasticity index (PI) and liquid limit (LL) of suitable fill materials to be used in the specified areas, unless specifically stated otherwise on the Drawings:

	<u>PI</u>	<u>LL</u>
*Paving Area, below upper two feet	20	50
*Paving Area, upper two feet	18	40

(\*References to Depth are to Proposed Subgrade Elevations)

- D. Material imported from off-site shall have a CBR (California Bearing Ratio) or LBR (Limerock Bearing Ratio) value equal to or above the pavement design subgrade CBR or LBR value indicated on the Drawings.

### 3.4 COMPACTION

- A. Maintain optimum moisture content of fill materials to attain required compaction density.
- B. All materials shall be tested in accordance with Section 31 14 00
- C. An independent testing laboratory selected and paid by the owner, shall be retained to perform testing on-site.
- D. Compaction test will be as specified in Section 31 14 00 together with the following for paving areas:
  1. In cut areas not less than one compaction test for every 10,000 square feet.
  2. In fill areas, same rate of testing for each 8", lift (measured loose).
- E. If compaction requirements are not complied with at any time during construction process, remove and recompact deficient areas until proper compaction is obtained at no additional expense to owner.

### 3.5 MAINTENANCE OF SUBGRADE

- A. Finished subgrades shall be verified to ensure proper elevation and conditions for construction above subgrade.
- B. Protect subgrade from excessive wheel loading during construction including concrete trucks and dump trucks.
- C. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in a manner that will comply with compaction requirements by use of material equal to or better than best subgrade material on-site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.

### 3.6 FINISH GRADING

- A. Finish grading shall be in accordance with Section 31 14 00 and as more specifically stated herein.
- B. Grading of paving areas shall be checked by string line from grade stakes (blue tops) set at not more than 50' centers. Tolerances of .10 feet, more or less, will be permitted. Contractor to provide engineering and field staking necessary for verification of lines, grades, and elevations.

**END OF SECTION #31 22 00**

Melden & Hunt, Inc.  
PBK Project No. 20217  
Issue for Construction

CTE Barrientes  
Edinburg CISD  
Juen 4, 2024

## SECTION 31 22 13 - ROUGH GRADING

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Excavating topsoil.
  - 2. Excavating subsoil.
  - 3. Cutting, grading, filling, compacting site for site structures, building pads.
  
- B. Related Sections:
  - 1. Section 310513 - Soils for Earthwork: Soils for fill.
  - 2. Section 310516 - Aggregates for Earthwork: Aggregates for fill.
  - 3. Section 311000 - Site Clearing: Excavating topsoil.
  - 4. Section 312316 - Excavation and Fill: Building excavation.
  - 5. Section 312318 - Rock Removal.
  - 6. Section 312323 - Backfill: General building area backfilling.
  - 7. Section 312317 - Trenching: Trenching and backfilling for utilities.

#### 1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
  - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
  
- B. ASTM International:
  - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3  - 3. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
  - 4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3  - 5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
  - 6. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
  - 7. ASTM D2434 - Standard Test Method for Permeability of Granular Soils (Constant Head).
  - 8. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  - 9. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).</sup></sup>

## **PART 2 EXECUTION**

### **2.1 PREPARATION**

- A. Call Local Utility Line Information service not less than three working days before performing Work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Protect utilities indicated to remain from damage.
- D. Protect bench marks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

### **2.2 FILLING**

- A. Fill areas to contours and elevations with unfrozen materials.
- B. Place fill material in continuous layers and compact as required.
- C. Maintain optimum moisture content of fill materials to attain required compaction density.
- D. Slope grade away from building minimum 2 percent slope for minimum distance of 10 ft, unless noted otherwise.
- E. Make grade changes gradual. Blend slope into level areas.

### **2.3 FIELD QUALITY CONTROL**

- A. Perform in place compaction tests in accordance with the following:
  - 1. As required by geotechnical engineer.

**END OF SECTION 31 22 13**

## **SECTION 31 23 00 - EXCAVATION AND FILL**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Soil densification.
  - 2. Excavating for building foundations.
  - 3. Excavating for slabs-on-grade.
  - 4. Excavating for site structures.
  
- B. Related Sections:
  - 1. Section 310513 - Soils for Earthwork: Stockpiling excavated materials.
  - 2. Section 310516 - Aggregates for Earthwork: Stockpiling excavated materials.
  - 3. Section 312213 - Rough Grading: Topsoil and subsoil removal from site surface.
  - 4. Section 312318- Rock Removal: Removal of rock during excavating.
  - 5. Section 312323- Backfill.
  - 6. Section 312317 - Trenching: Excavating for utility trenches.

#### **1.2 REFERENCES**

- A. ASTM International:
  - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
  - 2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
  - 3. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
  - 4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  
- B. Local utility standards when working within 24 inches of utility lines.

### **PART 2 EXECUTION**

#### **2.1 EXCAVATION**

- A. Underpin adjacent structures which may be damaged by excavation work.
- B. Excavate subsoil to accommodate building foundations, slabs-on-grade.
- C. Excavate to working elevation for piling work.
- D. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 02320 and Section 02324.
- E. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- F. Trim excavation. Remove loose matter.

- G. Notify Architect/Engineer of unexpected subsurface conditions.
- H. Correct areas over excavated with structural fill.
- I. Remove excess and unsuitable material from site.
- J. Repair or replace items indicated to remain damaged by excavation.

## **2.2 PROTECTION**

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

**END OF SECTION 31 23 00**

## **SECTION #31 23 00 - EXCAVATION, BACKFILLING AND COMPACTING FOR UTILITIES**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Excavating trenches for the installation of utilities
- B. Backfilling trench with bedding material as specified and indicated and finishing filling trench with suitable material to proposed subgrade.
- C. Compacting backfill materials in an acceptable manner
- D. Borings and casings under roads

#### **1.2 RELATED SECTIONS**

- A. Section 31 14 00 - Earthwork
- B. Section 31 20 00 - Aggregate Materials
- C. Section 33 39 00 - Sewer Structures
- D. Section 33 11 00 - Water Distribution Systems
- E. Section 33 41 00 - Storm Sewer Systems
- F. Section 33 31 00 - Sanitary Sewer Systems
- G. Geotechnical report (if available) for boring locations and findings of subsurface materials and conditions
- H. Construction Drawings

#### **1.3 REFERENCE STANDARDS**

- A. American society for testing and materials (ASTM) Latest Edition
  - D 422 Method for Particle Size Analysis
  - D 698 Test for Moisture-Density Relations of Soils Using 5.5-lb. (2.5 Kg) Rammer and 12-inch (304.8mm) Drop (Standard Proctor)
  - D 1556 Test for Density of Soil in Place by the Sand Cone Method
  - D 1557 Test for Moisture-Density Relations of Soils Using 10-lb. (4.5 Kg) Rammer and 18-inch (457 mm) Drop (Modified Proctor)
  - D 1559 Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
  - D 2216 Laboratory Determination of Moisture Content of Soil
  - D 2487 Classification of Soils for Engineering Purposes
  - D 2922 Tests for Density of Soil and Soil-Aggregate in Place by Nuclear methods (Shallow Depth)
    - D 3017 Test for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
  - D 4318 Test for Plastic Limit, Liquid Limit, & Plasticity Index of Soils
  - C 25 Chemical Analysis of Limestone, Quicklime and Hydrated Lime.
  - C 110 Physical Testing for Quicklime and Hydrated Lime, Wet Sieve Method
  - C 618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
  - C 977 Quicklime and Hydrated Lime for Soil Stabilization
- B. American Association of State Highway and Transportation Officials (AASHTO) latest edition
  - T88 Mechanical Analysis of Soils

#### **1.4 QUALITY ASSURANCE**

Independent testing laboratory selected and paid by owner, shall be retained to perform construction testing on backfilling operations as specified in Section 31 14 00 and as stated herein.

**1.5 SUBMITTALS**

- A. Shop Drawings or details pertaining to Site Utilities are not required unless required by regulatory authorities or unless use of materials, methods, equipment, or procedures are contrary to Drawings or these specifications are proposed. Do not perform work until required shop drawings have been accepted by Owner.
- B. The Contractor shall contact all utility companies and determine if additional easements will be required to complete the project. Contractor shall provide written confirmation of the status of all easements to the Owner's Construction Manager at the time of the preconstruction conference or no later than 90 days prior to the project possession date.
- C. Submit a sample of each type of offsite fill material that is to be used in backfilling in an air-tight, 10 lb container for the testing laboratory or submit a gradation and certification of the aggregate material that is to be used to the testing laboratory for review.

**1.6 PROJECT RECORD DOCUMENTS**

Accurately record actual locations of all subsurface utilities, structures and obstructions encountered.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- A. Bedding Material: Processed sand and gravel free from clay lumps, organic, or other deleterious material, and complying with following gradation requirements:

<u>U. S. Sieve Size</u>	<u>Percent Passing (by weight)</u>
1 Inch	100
3/4 Inch	90-100
3/8 Inch	20- 55
No. 4	0- 10
No. 8	0- 5
- B. Backfill material from site as specified in Section 31 14 00 and approved by the owner or owner's representative.
- C. Backfill material from offsite as specified in Section 31 14 00 and approved by the owner or owner's representative.
- D. Steel Casing Pipe: Comply with AWWA C-201 or C-202, minimum grade B, size and wall thickness as indicated on Drawings.
- E. Acceptable Stabilization Fabrics and Geogrids
  - 1. Mirafi 500X or 600X
  - 2. Phillips 66 Supac 6WS
  - 3. Dupont Typar 3401 and 3601
  - 4. Trevira S1114 and S1120
  - 5. Tensar SS-1 and SS-2
  - 6. Exxon GTF-200 or 350
- F. Filter/Drainage Fabrics
  - 1. Mirafi 140 NS
  - 2. Phillips 66 Supac 4NP
  - 3. Dupont Typar 3341

**PART 3 EXECUTION**

**3.1 PREPARATION**



- A. Set all lines, elevations, and grades for utility and drainage system work and control system for duration of work, including careful maintenance of bench marks, property corners, monuments, or other reference points.
- B. Maintain in operating condition all existing utilities, active utilities and drainage systems encountered in utility installation. Repair any surface or subsurface improvements shown on Drawings.
- C. Verify location, size, elevation, and other pertinent data required to make connections to existing utilities and drainage systems as indicated on Drawings. Contractor shall comply with local codes and regulations.
- D. Over excavate and properly prepare areas of subgrade that are not capable of supporting the proposed systems. These areas shall be stabilized by using acceptable filter fabrics and/or additional bedding material placed and compacted as specified.
- E. Install dewatering systems that will be required to construct the proposed utilities in a manner that is described herein.

### 3.2 EXCAVATION

- A. The local utility companies shall be contacted before excavation shall begin. Dig trench at proper width and depth for laying pipe, conduit, or cable. Cut trench banks vertical if possible and remove stones from bottom of trench as necessary to avoid point-bearing. Over excavate wet or unstable soil, if encountered, from trench bottom as necessary to provide suitable base for continuous and uniform bedding.
- B. All trench excavation side walls greater than 5 feet in depth shall be sloped, shored, sheeted, braced or otherwise supported by means of sufficient strength to protect the workmen within them in accordance with the applicable rules and regulations established for construction by the Department of Labor, Occupational Safety and Health Administration (OSHA), and by local ordinances. Lateral travel distance to an exit ladder or steps shall not be greater than 25 feet in trenches 4 feet or deeper.
- C. Perform excavation as indicated for specified depths. During excavation, stockpile materials suitable for backfilling in orderly manner far enough from bank of trench to avoid overloading, slides, or cave-ins.
- D. Remove excavated materials not required or not suitable for backfill or embankments and waste as specified. Any structures discovered during excavation(s) shall be disposed of as specified.
- E. Prevent surface water from flowing into trenches or other excavations by temporary grading or other methods, as required. Remove accumulated water in trenches or other excavations by pumping or other acceptable methods.
- F. Open cut excavation with trenching machine or backhoe. Where machines other than ladder or wheel-type trenching machines are used, do not use clods for backfill. Dispose of unsuitable material and provide other suitable material at no additional cost to Owner.
- G. Accurately grade trench bottom to provide uniform bearing and support for each section of pipe on bedding material at every point along entire length, except where necessary to excavate for bell holes, proper sealing of pipe joints, or other required connections. Dig bell holes and depressions for joints after trench bottom has been graded. Dig no deeper, longer, or wider than needed to make joint connection properly.
- H. Trench width requirements below the top of the pipe shall not be less than 12" nor more than 18", wider than outside surface of any pipe or conduit that is to be installed to designated elevations and grades. All other trench width requirements for pipe, conduit, or cable shall be the least practical width that will allow for proper compaction of trench backfill.
- I. Trench depth requirements measured from finished grade or paved surface shall meet the following requirements or applicable codes and ordinances:
  - 1. Water Mains: 30" to top of pipe barrel or 6", below the frost line (established by the local building official), whichever is deeper.
  - 2. Sanitary Sewer: Elevations, and grades as indicated on Drawings.
  - 3. Storm Sewer: Depths, elevations, and grades as shown on Drawings.

4. Electrical Conduits: 24" minimum to top of conduit or as required by NEC 300-5, NEC 710-36 codes, or the local utility company requirements, whichever is deeper.
  5. TV Conduits: 18" minimum to top of conduit or as required by the local utility company, whichever is deeper.
  6. Telephone Conduits: 18" minimum to top of conduit, or as required by the local utility company, whichever is deeper.
  7. Gas Mains and Service: 30" minimum to top of pipe, or as required by the local utility company, whichever is deeper.
- J. Provide sheeting and bracing, when necessary, in trenches and other excavations where protection of workmen required. Sheeting may be removed after sufficient backfilling to protect against damaging or injurious caving.

### **3.3 PIPE BEDDING**

- A. Accurately cut trenches for pipe or conduit that is installed to designated elevations 4" below bottom of pipe and to width as specified. Place 40 of bedding material, compact in bottom of trench, and accurately shape to conform to lower portion of pipe barrel. After pipe installation, place backfill as specified and compact in maximum 8" layers measured loose to the top of the trench.
- B. Place geotextile fabric as specified on the plans and specifications.

### **3.4 BACKFILLING**

- A. Criteria: Trenches shall not be backfilled until required tests are performed and the utility systems comply with and are accepted by applicable governing authorities. Backfill trenches as specified. If improperly backfilled, reopen to depth required to obtain proper compaction. Backfill and compact, as specified, to properly correct condition in an acceptable manner.
- B. Backfilling: After pipe or conduit has been installed, bedded, and tested as specified, backfill trench or structure excavation with specified material placed in 8" maximum loose lifts.
- C. Backfill trenches to the contours and elevations shown on the plans with unfrozen materials.
- D. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

### **3.5 COMPACTION**

- A. Exercise proper caution when compacting immediately over top of pipes or conduits. water jetting or flooding is not permitted as a method of compaction.
- B. Maintain optimum moisture content of fill materials to attain required compaction density.
- C. An independent testing laboratory shall perform testing at intervals not exceeding 200' of trench for the first and every other eight-inch (8") lift of compacted trench backfill and furnish copies of test results as specified. Compact to minimum density of 95% of optimum density in accordance with ASTM D 699 or 92% of optimum density in accordance with ASTM D1557.
- D. All materials used for backfill shall comply with the requirements of Section 31 14 00.

### **3.6 BORINGS AND CASINGS UNDER ROADS, HIGHWAYS AND RAILROAD CROSSINGS**

- A. When indicated by Drawings and specifications, all street, road, highway, or railroad crossings for utility mains installed by the jacking and boring method shall be in accordance with area specifications and governing authorities.
- B. Excavation of approach pits and trenches within right- of-way of street, road, highway, or railroad shall be of sufficient distance from paving or railroad tracks to permit traffic to pass without interference. Tamp backfill for approach pits and trenches within right - of -way in layers not greater than 6", thick for entire length and depth of trench or pit. Compact backfill to 95% of maximum density obtained at optimum moisture as determined by AASHTO T 180-57, Method A. Mechanical tampers may be used after cover of 6" has been obtained over top of barrel of pipe.

- C. Accomplish boring operation using commercial type boring rig and hole shall be bored to proper alignment and grade and within 2" of same diameter as largest outside joint diameter of pipe installed. Install pipe in hole immediately after bore has been made, and in no instance shall hole be left open while unattended.
- D. In event subsurface operations result in failure or damage to pavement within one year of construction, Contractor shall make necessary repairs to pavement at no additional cost to Owner. In event paving cracks on either side of pipe line or is otherwise disturbed or broken due to construction operations, Contractor shall repair or replace disturbed or broken area at no additional expense to the Owner.
- E. Clean and prime interior and exterior of casing pipe; and line with two coats of asphalt in accordance with area specifications and governing authorities.
- F. Butt weld steel casing welds shall be full penetration single butt-welds in accordance with AWWA C-205 and AWS D7-0-62.
- G. Install casing and utility pipe with end seals, vent pipe, and other special equipment in accordance with area specifications and governing authorities.

**END OF SECTION #31 23 00**

Melden & Hunt, Inc.  
PBK Project No. 20217  
Issue for Construction

CTE Barrientes  
Edinburg CISD  
June 4, 2024

## **SECTION 31 31 16 - TERMITE CONTROL**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Soil treatment for termite control.
- B. Related Sections:
  - 1. Section 310513 - Soils for Earthwork: Backfill materials.
  - 2. Section 312316 - Excavation and Fill: Subgrade preparation.
  - 3. Section 033000 - Cast-In-Place Concrete: Slabs on grade and foundations placed over treated soil.

#### **1.2 REFERENCES**

- A. Environmental Protection Agency:
  - 1. EPA FIFRA - Federal Insecticide, Fungicide and Rodenticide Act.
- B. National Pest Management Association:
  - 1. NPMA WDO - Wood Destroying Organism Library.

#### **1.3 SUBMITTALS**

- A. Product Data: Submit toxicants to be used, composition by percentage, dilution schedule, intended application rate. Include product label information.
- B. Test Reports: Indicate regulatory agency approval reports.
- C. Manufacturer's Application Instructions: Indicate caution requirements and in accordance with current product label of chosen pesticide.
- D. Certify applications followed NPMA WDO for termite control or other regional location guidance.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Project Record Documents: Record moisture content of soil before application, date and rate of application, areas of application, diary of toxicity meter readings and corresponding soil coverage.
- B. Operation and Maintenance Data: Indicate re-treatment schedule.

#### **1.5 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing the Work of this section and licensed in State of Texas.

## **1.6 SEQUENCING**

- A. Section 011000 - Summary: Work sequence.
- B. Apply toxicant immediately prior to installation of vapor barrier under slabs-on-grade in accordance with product label supplemented by the NPCA's ARP for termiticiding or local requirements.

## **1.7 WARRANTY**

- A. Warranty: Include coverage for damage and repairs to building and building contents caused by termites. Repair damage. Re-treat where required.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. Toxicant Chemical: EPA FIFRA approved; synthetically color dyed to permit visual identification of treated soil.
- B. Diluent: Recommended by toxicant manufacturer.

### **2.2 MIXES**

- A. Mix toxicant to manufacturer's instructions.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.
- C. Verify final grading and excavation are complete.

### **3.2 APPLICATION**

- A. Apply toxicant at locations indicated in Schedule at end of section.
- B. Apply extra treatment to structure penetration surfaces including pipe or ducts, and soil penetrations including grounding rods or posts.
- C. Re-treat disturbed treated soil with same toxicant as original treatment.
- D. When inspection or testing identifies presence of termites, re-treat soil and re-test.

**3.3 PROTECTION OF FINISHED WORK**

- A. Section 017000 - Execution Requirements: Protecting finished Work.
- B. Do not permit soil grading over treated work.

**3.4 SCHEDULES**

- A. Locations:
  - 1. Under Slabs-on-Grade.
  - 2. Both Sides of Foundation Surface.

**END OF SECTION 31 31 16**

## **SECTION #31 32 00 - SOIL STABILIZATION**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Lime Stabilized Subgrade
- B. Cement Stabilized Subgrade
- C. Fly Ash Stabilized Subgrade
- D. Geotextile Fabric Stabilized Subgrade

#### **1.2 RELATED SECTIONS**

- A. Section 31 14 00 - Earthwork
- B. Section 31 22 00 - Excavation, Backfill and Compacting for Pavement
- C. Section 31 20 00 - Aggregate Materials
- D. Construction Drawings
- E. Geotechnical Report (if available) for boring locations and findings of subsurface materials and conditions.

#### **1.3 REFERENCE STANDARDS**

- A. American Society for Testing Materials (ASTM) latest edition.
  - C 150- Portland Cement
  - C 618- Fly Ash for Soil Stabilization
  - C 977- Quicklime and Hydrated Lime for Soil Stabilization
  - D 1633- Test method for compressive strength of molded soil cement cylinders
- B. American Association of State Highway and Transportation Officials (AASHTO) latest edition.
  - M 216 - Lime for Soil Stabilization
- C. National Lime Association (NLA)
  - Bulletin 326 - Lime Stabilization Construction Manual

#### **1.4 ENVIRONMENTAL REQUIREMENTS**

Do not install mixed materials in wind in excess of 10 mph or when temperature is below 40<sup>0</sup> F.

#### **1.5 QUALITY ASSURANCE**

Perform work in accordance with state and local standards in conjunction with requirements specified herein.

#### **1.6 SUBMITTALS**

- A. Submit a sample of each material to be used in a 10 pound air tight container to the testing laboratory.
- B. Submit the name of each materials supplier and specific type and source of each material. Any change in source throughout the job requires approval of the owner or engineer.
- C. Submit mix design and materials mix ratio that will achieve specified requirements for soil stabilization of state and local agencies.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. Quicklime or Hydrated Lime
- B. Portland Cement
- C. Fly Ash
- D. Coarse Aggregate
- E. Fine Aggregate
- F. Subsoil: Existing Reused



- G. Geotextile Fabric for Stabilization
  - 1. Mirafi 500X or 600X
  - 2. Phillips 66 Supac 6WS
  - 3. Dupont Typar 3401 and 3601
  - 4. Trevira S1114 and S1120
  - 5. Tensar SS-1 and SS-2
  - 6. Exxon GTF-200 or 350

## **2.2 EQUIPMENT**

Perform operations using suitable, well maintained equipment capable of excavating subsoil, mixing and placing materials, wetting, consolidation and compaction of material.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Obtain Engineers approval of the mix design before proceeding with the placement.
- B. Do not start stabilization without weather and soil conditions being favorable for the successful application of the proposed material.
- C. Proof roll subgrade to identify areas in need of stabilization.

### **3.2 EXCAVATION**

- A. Excavate subsoil to a depth sufficient to accommodate soil stabilization.
- B. Remove lumped subsoil, boulders and rock that interferes with achieving uniform subsoil conditions.

### **3.3 SOIL TREATMENT AND BACKFILLING**

- A. Lime Stabilized Subgrade: Where indicated on Drawings, treat prepared subgrade with hydrated lime in accordance with applicable state highway specification. Compact to not less than 98% of optimum density as determined by ASTM D 698.
- B. Cement Stabilized Subgrade: where indicated on Drawings, treat prepared subgrade with portland cement in accordance with applicable state highway specification. Compact to not less than 98% of optimum density as determined by ASTM D 698.
- C. Fly Ash Stabilized Subgrade: where indicated on Drawings, treat prepared subgrade with fly ash in accordance with applicable state highway specification. Compact to not less than 98% of optimum density as determined by ASTM D 698.
- D. Maintain optimum moisture of mix materials to attain required stabilization and compaction.
- E. Finish subgrade surface in accordance with Section 31 14 00.

### **3.4 GEOTEXTILE FABRIC**

- A. Place fabric in those areas that are shown on the plans or in those areas that need additional stabilization prior to the placement of the base course.
- B. Place fabric specified in the plans and specifications in accordance with the manufacturers recommendations.

**END OF SECTION #31 32 00**

## **SECTION #31 35 00 - SLOPE PROTECTION AND EROSION CONTROL**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Temporary and permanent erosion control systems.
- B. Slope Protection Systems.

#### **1.2 RELATED SECTIONS**

- A. Section 31 10 00 - Site Preparation
- B. Section 31 14 00 - Earthwork
- C. Erosion Control Plan
- D. Construction Drawings

#### **1.3 ENVIRONMENTAL REQUIREMENTS**

- A. The contractor shall protect adjacent properties and water resources from erosion and sediment damage throughout the life of the contract.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. Quick growing grasses such as wheat, rye or oats.
- B. Hay or straw bales.
- C. Fencing for siltation control as specified on the plans.
- D. Curlex blankets by American Excelsior Company or approved equal.
- E. Bale stakes for each bale shall be a minimum of 4 feet in length and shall be either 2 #4 rebars, 2 steel pickets or 2-2"x2" hardwood stakes driven 1'-6" to 2'-0" into ground.
- F. Temporary mulches such as loose hay, straw, netting, wood cellulose or agricultural silage.
- G. Fence stakes shall be metal stakes a minimum of 8 feet in length.
- H. RipRap (See Section 31 14 00)

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Review site erosion control plan.
- B. Deficiencies or changes in the erosion control plan as it is applied to current conditions will be brought to the attention of the Owner and the Engineer for remedial action.

#### **3.2 EROSION CONTROL AND SLOPE PROTECTION IMPLEMENTATION**

- A. Place erosion control systems in accordance with the erosion control plan.
- B. The Owner has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and embankment operations and to direct the contractor to provide immediate permanent or temporary pollution control measures. The contractor will be required to incorporate all permanent erosion control features into the project at the earliest practical time to minimize the need for temporary controls. Cut slopes shall be permanently seeded and mulched as the excavation proceeds to the extent considered desirable and practical.
- C. The temporary erosion control systems installed by the contractor shall be maintained as directed by the Owner to control siltation at all times during the life of the -contract. The contractor must respond to any maintenance or additional work ordered by the Owner within a 48 hour period.
- D. Any additional material and work required and authorized by the Owner which is beyond the extent of the erosion control plan shall be paid for by the owner.

- E. Slopes that erode easily shall be temporary seeded as the work progresses with a wheat, rye or oats application.

**3.3 STORM WATER POLLUTION PREVENTION PLAN (SWP3)**

- A. Prepare and submit Notice of Intent (NOI) to Texas Commission of Environmental Quality (TCEQ).
- B. The general contractor shall prepare a SWP3 in accordance with all requirements of TXR 150000 and submit to the Architect for review and approval prior to commencing anywork.
- C. The general contractor shall implement the SWP3 through completion of the work.

**END OF SECTION #31 35 00**

## **SECTION #31 36 00 - RETAINAGE SYSTEMS**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Furnishing and installing modular retaining wall units to the lines and grades designated on the construction drawings and as specified herein.
- B. Preparing foundation soil, furnishing and installing leveling pad or footing, unit fill and backfill to the lines and grades designated on the construction drawings.
- C. Furnishing and installing all appurtenant materials required for construction of the retaining wall (s) as shown on the construction drawings.
- D. Submission of the proprietary design information, engineering calculations, materials lists and design certifications as required herein, on the construction drawings or in the Special Conditions to the contract.

#### **1.2 RELATED SECTIONS**

- A. Section 31 10 00 Site Preparation
- B. Section 31 14 00 Earthwork
- C. Section Cast In Place Concrete (See Architectural/Building Specifications)
- D. Construction Drawings

#### **1.3 REFERENCE STANDARDS**

American Society for Testing and Materials (ASTM)  
C 90-85 Hollow Load Bearing Masonry Units  
C140-75 Sampling and Testing Concrete Masonry Units  
C145-85 Solid Load Bearing Concrete Masonry Units

#### **1.4 SUBMITTALS**

- A. Samples of all products used in the work of this section. If units are of such size to make submission impractical, adequate examples of finish and material shall be provided.
- B. Latest edition of manufacturer's specifications for proposed materials, and method of installation and list of materials proposed for use.
- C. Four copies of shop drawings for all walls showing overall dimensions, reinforcing, foundations, soil reinforcement, drainage systems, backfill, appurtenances to be provided and coordination with items not provided as part of the wall system.
- D. Submit required materials and drawings directly to the Owners Consulting Civil Engineer, within fifteen (15) days of the Contract Date, with a copy of the transmittal to the owner's Construction department. Prior to submittal, the design shall be certified by a professional engineer registered in the state where the project is located.  
The design shall incorporate factors of safety for Sliding, Bearing, Overturning, Slope Stability and Design Uncertainties as recommended in the geotechnical investigation unless specifically waived or modified in writing by Owner's Construction Department and the Owner's Consulting Civil Engineer.

#### **1.5 QUALITY ASSURANCE**

- A. Soil testing and associated testing for quality control during earthwork operations will be supplied by the Owner (see Section 31 14 00). Any specific testing or inspection services required by the retaining wall design shall be clearly delineated in the submission.
- B. Construction of a mockup of adequate size to illustrate the finish and construction techniques may be required, at a location acceptable to the Owner, for any wall system with which the Owner is not familiar or for which unique design modifications are proposed.

### **PART 2 PRODUCTS**

## 2.1 MANUFACTURED UNITS

- A. Retaining wall units, reinforcing and accessories shall be supplied as specified in the manufacturer's submissions. Units produced under a license from an approved proprietary system shall be manufactured in a facility meeting all requirements of the licensing system with adequate capacity to supply the product to the site in a timely manner. Materials shall be stored as required to prevent damage and staining.
- B. Acceptable retainage systems which will be allowed based on shop drawings and calculations:  
"Reinforced Earth" retaining wall units - as manufactured by a licensed distribute for The Reinforced Earth Company, Bedford, Texas.  
Keystone Retaining Wall Units as manufactured by a licensed distribute for Keystone Retaining Wall Systems, Inc., Minneapolis, Minnesota.
- C. Geogrids as listed in Section 31 14 00 and specified in the approved shop drawings. Material shall be stored as required to protect from damage until used.

## 2.2 LEVELING PAD

Leveling pad material shall consist of compacted sand, gravel, crushed rock or leveling concrete as shown on the construction drawings and/or shop drawings.

## 2.3 FILL AND BACKFILL

Unit fill (if required) and backfill materials, shall be as specified and shown on the construction drawings and/or shop drawings.

## PART 3 EXECUTION

### 3.1 EXCAVATION

The contractor shall excavate to the lines and grades required. overexcavation and/or recompaction shall be performed as required to produce the specified bearing conditions.

### 3.2 LEVELING PADS

Leveling pads and foundations, unit installation, cap installation, installation of geogrid and/or other anchor materials and installation of accessories and appurtenances shall be carried out according to the manufacturer's recommendations and the approved drawings.

### 3.3 FIELD QUALITY CONTROL

- A. Testing for compaction of subgrade and fill materials shall be performed by an Independent Testing Laboratory selected and paid by Owner.
- B. If compaction requirements, embedment of reinforcing or other conditions are not met at any time during the construction process, Contractor shall remove and reconstruct deficient areas to obtain proper conditions at no additional cost to owner.
- C. Independent Testing Laboratory shall promptly prepare test reports and distribute to Owner, Owner's Consulting Civil Engineer and Contractor for all testing required by the certified and approved design documents. In the event any test performed fails to meet these requirements, Owner and Contractor shall be notified immediately by Independent Testing Laboratory.  
All costs related to retesting due to failures shall be paid for by the Contractor at no additional expense to Owner. Owner reserves the right to employ an Independent Testing Laboratory and to direct any testing that is deemed necessary. Contractor shall provide free access to site for testing activities.

**END OF SECTION #31 36 00**

## **SECTION #32 11 00 - PAVING BASE COURSE**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Granular Base
- B. Caliche Base
- C. Full Depth Asphalt Base
- D. Hot-Mix Sand Asphalt Base
- E. Soil Cement Stabilized Base

#### **1.2 RELATED SECTIONS**

- A. Section 31 10 00 - Site Preparation
- B. Section 31 14 00 - Earthwork
- C. Section 31 20 00 - Aggregate Materials
- D. Section 31 32 00 - Soil Stabilization
- E. Section 32 12 00 - Asphaltic Concrete Paving
- F. Section 32 13 00 - Portland Cement Concrete Paving
- G. Section 32 16 00 - Curbs and Sidewalk
- H. Construction Drawings
- I. Geotechnical Report for each campus

#### **1.3 REFERENCES**

- A. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
- B. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- C. ASTM D2167 - Test Method for Density and Unit Weight of Soil in-place by the Rubber Balloon Method.
- D. ASTM D1556 - Test Method for Density of Soil in-place by the Sand-Cone Method.
- E. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in-place by Nuclear Methods (Shallow Depth), Method 8 (Direct Transmission).
- F. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

### **PART 2 PRODUCTS**

#### **2.1 FILL MATERIALS**

- A. Submit materials certificate to on-site independent testing laboratory which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

Contractor shall verify that the subgrade has been inspected, tested and the gradients and elevations are correct, dry and properly prepared.

#### **3.2 CONSTRUCTION**

- A. Perform base course construction in a manner that will drain surface properly at all times and at the same time prevent runoff from adjacent areas from draining onto base course construction.

- B. Compact base material to not less than 98% of optimum density as determined by ASTM D 698 or 95% of optimum density, as determined by ASTM D 1557, unless otherwise indicated on the Drawings.
- C. Granular Base: Construct to thickness indicated on Drawings. Apply in lifts or layers not exceeding 8", measured loose.
- D. Caliche Base; Construct to thickness indicated on Drawings. Use 'Type A through E, Grades 1, 2,3 or 5" Base per TXDOT Spec. Item 247. Approximately three (3) percent lime by weight may be incorporated into the Flexible Base in the field at the Owner/Engineer's direction and will be paid for at the amount bid.  
The percent of density as determined by Compaction Ratio (Tex-113-E) for the new Flexible Base shall be a minimum of 98%.  
For water added under Item 247, the sulfate content will not exceed 3000-ppm and the chloride content will not exceed 3000-ppm.
- E. Asphalt Institute Type IV Mix for Full Depth Asphalt Base: Construct to thickness indicated on Drawings in lifts or layers not exceeding 3", measured loose.
- F. Asphalt Institute Type VI, VII, or VIII Mixes for Hot-mix Sand Asphalt Bases: Construct to thickness indicated on Drawings. Apply in lifts or layers not exceeding 3", measured loose.
- G. Soil Cement Stabilized Base: Construct to thickness and strength as indicated on Drawings and in accordance with applicable state highway specifications. If not indicated on the Drawings, the minimum compressive strength shall be 500 p.s.i., tested at 28 days.

### 3.3 FIELD QUALITY CONTROL

- A. An Independent Testing Laboratory, selected and paid by owner, shall be retained to perform construction testing of in-place base courses for compliance with requirements for thickness, compaction, density and tolerance. Paving base course tolerances shall be verified (by rod and level readings on not more than fifty-foot centers) to be not more than 0.05 feet above design elevation which will allow for paving thicknesses as shown in the Drawings. Contractor shall provide instruments and a suitable benchmark.
- B. The following tests shall be performed on each type of material used as base course material:
  - 1. Moisture and Density Relationship: ASTM D 698 or ASTM D 1557.
  - 2. Mechanical Analysis: AASHTO T-88.
  - 3. Plasticity Index: ASTM D-4318.
  - 4. Base material thickness: Perform one test for each 20,000 square feet of in-place base material area.
  - 5. Base material compaction: Perform one test in each lift for each 20,000 square feet of in-place base material area.
  - 6. Test each source of base material for compliance with applicable state highway specifications.
- C. Field density tests for in-place materials shall be performed according to one of the following standards as part of construction testing requirements:
  - 1. Sand-Cone Method: ASTM D 1556.
  - 2. Balloon Method: ASTM D 2167.
  - 3. Nuclear Method: ASTM D 2922, Method B (Direct Transmission).
- D. Independent Testing Laboratory shall prepare test reports that indicate test location, elevation data, and test results. The Owner, Engineer, and Contractor shall be provided with copies of reports within 96 hours of time test was performed. In event that any test performed fails to meet these Specifications, the Owner, Engineer and Contractor shall be notified immediately by Independent Testing Laboratory. The Owner reserves right to employ Independent Testing Laboratory and to direct any testing that is deemed by them to be necessary. Contractor shall provide free access to site for testing activities.

**END OF SECTION #32 11 00**

## **SECTION #32 12 00 - ASPHALTIC CONCRETE PAVING**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Asphaltic concrete paving; surface course, binder course and base course.

#### **1.2 RELATED SECTIONS**

- A. Section 31 22 00 - Excavation, Backfill and Compacting for Pavement
- B. Section 32 13 00 - Paving and Surfacing
- C. Section 32 11 00 - Paving Base Course
- D. Section 32 13 00- Portland Cement Concrete Paving
- E. Section 32 16 00 - Curbs
- F. Section 32 17 23 - Parking Lot and Roadway Marking
- G. Construction Drawings
- H. State Highway Department Standard Specifications
- I. Geotechnical Report for each campus

#### **1.3 SUBMITTALS**

- A. Design Mix: Before any asphaltic concrete paving is constructed, submit actual design mix to the Owner's Construction Department for review and/or approval. Design mix submittal shall follow the format as indicated in the Asphalt Institute Manual MS-2, Marshall Stability Method; and shall include the type/name of the mix, gradation analysis, grade of asphalt cement used, Marshall Stability (lbs.), flow, effective asphalt content (percent), and direct references to the applicable highway department specifications sections for each material. The design shall be for a mixture listed in the current edition of the applicable state roadway specifications. Mix designs over three (3) years old will not be accepted by the owner.
- B. Material Certificates: Submit materials certificate to on-site independent testing laboratory which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein.

#### **1.4 JOB CONDITIONS**

- A. Weather Limitations:
  - 1. Apply prime and tack coats when ambient temperature is above 40° F, and when temperature has been above 35° F for 12 hours immediately prior to application. Do not apply when base is wet, contains excess moisture, or during rain.
  - 2. Construct asphaltic concrete paving when atmospheric temperature is above 40° F.

#### **1.5 REFERENCES**

- A. MS-2-Mix design methods for asphaltic concrete and other hot mix types per The Asphalt Institute (AI)
- B. MS-3-Asphalt Plant Manual per The Asphalt Institute (AI)
- C. Hot Mix Asphalt Paving Handbook per US Army Corp of Engineers, UN-13 (CE MP-ET)
- D. MS-19-Basic Asphalt Emulsion Manual per The Asphalt Institute (AI)
- E. ASTM D946 - Penetration - Graded Asphalt Cement for use in Pavement Construction
- F. AASHTO M-226/ASTM D3381 Asphalt Cement
- G. AASHTO M-140/ASTM D997 or AASHTO M-208/ASTM D-2397 Tack Coat
- H. AASHTO M-117/ASTM D242 Mineral Filler
- I. AASHTO T-245/ASTM D1559 Marshall Mix Design



**PART 2 PRODUCTS**

**2.1 MATERIALS**

- A. Provide asphalt-aggregate mixture meeting TxDOT 2004 Standard Specification Item 340 for hot laid Type D (Fine Graded Surface Course). Use locally available materials and gradations which meet state highway specifications and exhibit satisfactory records of previous installations.
- B. Asphalt Cement: Comply with AASHTO M-226/ASTM D 3381; Table 2 AC-10, AC-20, or AC-30, viscosity grade, depending on local mean annual air temperature. (See chart below):

<u>Temperature Condition</u>	<u>Asphalt Grades</u>
Cold, mean annual air temperature at 7 degrees C (45 degrees F) or lower	AC-10 85/100 pen.
Warm, mean annual air temperature between 7 degrees C (45 degrees F) and 24 degrees C (75 degrees F)	AC-20 60/70 pen.
Hot, mean annual air temperature at 24 degrees C (75 degrees F) or higher	AC-30

- C. Prime Coat: A medium curing cut-back asphalt or an asphalt penetrating prime coat consisting of either MC- 30 or SS-1h.
- D. Tack Coat: Emulsified asphalt; AASHTO M-140/ASTM D 997 or AASHTO M 208/ASTM D 2397, SS-1h, CSS-1, or CSS-1h, diluted with one part water to one part emulsified asphalt.
- E. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with AASHTO M-17/ASTM D 242, if recommended by applicable state highway standards.
- F. Asphalt-Aggregate Mixture: Unless otherwise noted on the Drawings, the Design Mix shall have a minimum stability based on 50-blow Marshall complying with ASTM D 1559 of 1000 lb with a flow between 8 and 16.  
 The Design Mix shall be within sieve analysis and bitumen ranges below:

**SIEVE ANALYSIS OF MIX**

<u>Square Sieve</u>	<u>Total Percent Passing</u>	<u>Percent Tolerance</u>
¾"	100	7%
1/2"	80 – 100%	5%
3/8"	65 - 93%	4%
#8	40 - 55%	4%
#50	12 - 27%	2%
#200	0 - 10%	0%

Percent bitumen by weight of total mix: 5.0 - 8.5.  
 Air voids: 5-9%.  
 Percent aggregate voids filled with asphalt cement: 70 – 82%.  
 Allowable variance of percent bitumen by weight of total mix = 0.4

**2.2 EQUIPMENT**

Maintain equipment in satisfactory operating condition and correct breakdowns in a manner that will not delay or be detrimental to progress of paving operations.

**PART 3 EXECUTION**

**3.1 PREPARATION**

- A. Remove loose material from compacted base material surface immediately before applying prime coat.
- B. Proof roll prepared base material surface to check for areas requiring additional compaction and areas requiring removal and recompaction.
- C. Do not begin paving work until deficient base material areas have been corrected and are ready to receive paving.

### 3.2 APPLICATIONS

- A. Prime Coat:
  - 1. Apply bituminous prime coat to all base material surfaces where asphaltic concrete paving will be constructed.
  - 2. Apply bituminous prime coat in accordance with APWA Section 2204 and applicable state highway specifications.
  - 3. Apply at minimum rate of 0.25 gallon per square yard over compacted base material. Apply to penetrate and seal, but not flood surface.
  - 4. Make necessary precautions to protect adjacent areas from overspray.
  - 5. Cure and dry as long as necessary to attain penetration of compacted base and evaporation of volatile substances.
- Tack Coat:
  - 1. Apply to contact surfaces of previously constructed asphaltic concrete base courses or portland cement concrete and surfaces abutting or projecting into asphaltic concrete or into asphaltic concrete pavement.
  - 2. Apply tack coat to asphaltic concrete base course or sand asphalt base course. Apply emulsified asphalt tack coat between each lift or layer of full depth asphaltic concrete and sand asphalt bases and on surface of all such bases where asphaltic concrete paving will be constructed.
  - 3. Apply emulsified asphalt tack coat in accordance with APWA Section 2204 and applicable state highway specifications.
  - 4. Apply at minimum rate of 0.05 gallon per square yard of surface.
  - 5. Allow to dry until at proper condition to receive paving.

### 3.3 ASPHALTIC CONCRETE PLACEMENT

- A. Place asphaltic concrete mixture on completed compacted subgrade surface, spread, and strike off. Spread mixture at following minimum temperatures:
  - 1. When ambient temperature is between 40° F and 50° F, mixture temp. = 285° F
  - 2. When ambient temperature is between 50° F and 60° F, mixture temp. = 280° F
  - 3. When ambient temperature is higher than 60° F, mixture temp. = 275° F
- B. Whenever possible, all pavement shall be spread by a finishing machine; however, inaccessible or irregular areas may be placed by hand methods. The hot mixture shall be spread uniformly to the required depth with hot shovels and rakes. After spreading, the hot mixture shall be carefully smoothed to remove all segregated course aggregate and rake marks. Rakes and lutes used for hand spreading shall be of the type designed for use on asphalt mixtures. Loads shall not be dumped faster that they can be properly spread. workers shall-not stand on the loose mixture while spreading.
- C. Paving Machine Placement: Apply successive lifts of asphaltic concrete in transverse directions with the surface course placed in the direction of surface-water flow. Place in typical strips not less than 10'- 0" wide.
- D. Joints: Make joints between old and new pavements, or between successive days and work in a manner that will provide a continuous bond between adjoining work. Construction joints shall have same texture, density, and smoothness as other sections of asphaltic concrete course. Clean contact surfaces of all joints and apply tack coat.

### 3.4 ROLLING AND COMPACTION

- A. The mixture, after being spread, shall be thoroughly compacted by rolling as soon as it will bear the weight of the rollers without undue displacement. The number, weight, and types of rollers and sequences of rolling operations shall be such that the required density and surface are consistently attained while the mixture is in a workable condition
- B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
- C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling with hot material.
- D. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.
- E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.
- F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot asphaltic concrete. Compact by rolling to maximum surface density and smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.5 FIELD QUALITY CONTROL

- A. Independent Testing Laboratory, selected and paid by Owner, shall be retained to perform construction testing of in-place asphaltic concrete courses for compliance with requirements for thickness, compaction and surface smoothness. Asphaltic surface and base courses shall be randomly cored at a minimum rate of one core for every 20,000 square feet of paving. However, no less than three cores in light duty areas and three cores in heavy duty areas shall be obtained. Coring holes shall be immediately filled with full-depth asphalt or with concrete. Asphaltic Concrete pavement samples shall be tested for conformance with the mix design.
- B. Grade Control: Establish and maintain required lines and elevations.
- C. Thickness: In-place compacted thickness shall not be less than thickness specified on the drawings. Areas of deficient paving thickness shall receive a tack coat and a minimum ill overlay; or shall be removed and replaced to the proper thickness, at the discretion of the Owner; until specified thickness of the course is met or exceeded at no additional expense to the Owner.
- D. Surface Smoothness: Testing shall be performed on the finished surface of each asphalt concrete course for smoothness, using 10'-0" straightedge applied parallel with, and at right angles to centerline of paved area. The results of these tests shall be made available to the owner upon request. Surfaces will not be acceptable if the following 10' straightedge tolerances for smoothness are exceeded.

Base Course Surface: ¼"  
Wearing Course Surface: 3/16"

- E. Check surface areas at intervals necessary to eliminate ponding areas. Remove and replace unacceptable paving as directed by Owner.
- F. Compaction: Field density test for in place materials shall be performed by examination of field cores in accordance with one of the following standards:
  - 1. Bulk specific gravity of paraffin-coated specimens: ASTM D-1188.
  - 2. Bulk specific gravity using saturated surface-dry specimens: ASTM D-2726.Rate of testing shall be one core per 20,000 square feet of pavement, with a minimum of 3 cores from heavy- duty areas and 3 cores from standard-duty areas. Cores shall be cut from areas representative of the project.  
Areas of insufficient compaction shall be delineated, removed, and replaced in compliance with the specifications at no expense to the Owner.

**END OF SECTION #32 12 00**

Asphaltic Concrete Paving  
32 12 00-4

Melden & Hunt, Inc.  
PBK Project No. 20217  
Issue for Construction

CTE Barrientes  
Edinburg CISD  
June 4, 2024

Asphaltic Concrete Paving  
32 12 00-5

## **SECTION #32 13 00 - PORTLAND CEMENT CONCRETE**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Concrete, integral curbs, median barriers, parking areas and roads.

#### **1.2 RELATED SECTIONS**

- A. Section 31 10 00 - Site Preparation.
- B. Section 31 20 00 - Aggregate Material.
- C. Section 32 11 00- Paving Base Course.
- E. Section 32 16 00 - Curbs and Sidewalk.
- F. State Highway Department Standard Specifications.
- G. Construction Drawings.
- H. Geotechnical Report for each campus

#### **1.3 REFERENCES**

- A. ACI 301 - Specifications for Structural Concrete for Buildings.
- B. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- C. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.
- D. ANSI/ASTM A497 - Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
- E. ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural construction.
- F. ANSI/ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- G. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.
- H. ASTM C33 - Concrete Aggregates.
- I. ASTM C94 - Ready Mix Concrete.
- J. ASTM C150 - Portland Cement
- K. ASTM C260 - Air-Entraining Admixtures for Concrete.
- L. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
- M. ASTM C494 - Chemical Admixtures for Concrete.
- N. FS TT-C-800 - Curing Compound, Concrete, for New and Existing Surfaces.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Contractor shall maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. Coat forms with non-staining type coating that will not discolor or deface surface of concrete.
- B. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric, ASTM A 185. Furnish in flat sheets, not rolls, unless otherwise acceptable to Owner.
- C. Reinforcing Bars: Deformed steel bars, ASTM A 615, Grade 40.
- D. Concrete Materials: Comply with requirements applicable for concrete materials, admixtures, bonding materials, curing materials, and others as required.
- E. Joint Fillers: Resilient premolded bituminous impregnated fiberboard units complying with ASTM D 1751 FS HH-F-341, Type II, Class A; or AASHTO M 153, Type I.

- F. Joint Sealants: Non-priming, pourable, self-leveling polyurethane. Acceptable sealants are Sonneborn "Sonolastic Paving Joint Sealant, Sonneborn "Sonomeric CT 1 Sealant", Sonneborn "Sonomeric CT 2 Sealant", Mameco "Vulken 4511, or Woodmont Products "Chem-Caulk".

## 2.2 MIX DESIGN AND TESTING

- A. Concrete mix design and testing shall comply with requirements.
- B. Design mix to produce normal weight concrete consisting of Portland cement, aggregate, water-reducing admixture, air-entraining admixture, and water to produce the following properties:
1. Compressive Strength: 3,500 psi, minimum at 28 days, unless otherwise indicated on the Drawings.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Proof-roll prepared base material surface to check for unstable areas. The paving work shall begin after the unsuitable areas have been corrected and are ready to receive paving. Compaction testing for the base material shall be completed prior to the placement of the paving.
- B. Surface Preparation: Remove loose material from compacted base material surface to produce a firm, smooth surface immediately before placing concrete.

### 3.2 INSTALLATION

- A. Form Construction
1. Set forms to required grades and lines, rigidly braced and secured.
  2. Install sufficient quantity of forms to allow continuance of work and so that forms remain in place a minimum of 24 hours after concrete placement.
  3. Check completed formwork for grade and alignment to following tolerances:  
Top of forms not more than 1/8" in 10'-0".  
Vertical face on longitudinal axis, not more than 1/4" in 10'-0".
  4. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.
- B. Reinforcement: Locate, place and support reinforcement.
- C. Concrete Placement
1. Comply with applicable requirements.
  2. Do not place concrete until base material and forms have been checked for line and grade. Moisten base material if required to provide uniform dampened condition at time concrete is placed. Concrete shall not be placed around manholes or other structures until they are at the required finish elevation and alignment.
  3. Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.
  4. Deposit and spread concrete in continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hour, place construction joint
- D. Joint Construction: Construct expansion, weakened-plane Control (contraction), and construction joints straight with face perpendicular to concrete surface. Construct transverse joints perpendicular to centerline, unless otherwise detailed.
1. Weakened-Plane Control (Contraction) Joints: Provide joints at a spacing of 15'-0" o.c. maximum each way. Construct control joints for depth equal to at least 1/4 concrete thickness, as follows:
    - a. Form tooled joints in fresh concrete by grooving top portion with recommended tool and finishing edges with jointer.
    - b. Form sawed joints using powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.
  2. Construction Joints: Place concrete joints at end of placements and at locations where placement operations are stopped for period of more than 1/2 hour, except where such placements terminate at expansion joints. Construct joints using standard metal keyway-section forms.

3. Expansion Joints: Locate expansion joints at 180'-0" o.c. maximum each way. Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks, and other fixed objects.
- E. Joint Fillers: Extend joint fillers full-width and depth of joint, and not less than 1/2" or more than 1" below finished surface where joint sealer is indicated. Furnish joint fillers in one-piece lengths for full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler sections together.
- F. Joint Sealants: All joints shall be sealed with approved exterior pavement joint sealants and shall be installed per manufacturer's recommendations.

### **3.3 CONCRETE FINISHING**

- A. After striking off and consolidating concrete, smooth surface by screeding and floating. Adjust floating to compact surface and produce uniform texture. After floating, test surface for trueness with 10'-0" straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide continuous smooth finish.
- B. Work edges of slabs, gutters, back top edge of integral curb, and formed joints with an edging tool, and round to 1/2" radius. Eliminate tool marks on concrete surface. After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
  1. Inclined Slab Surfaces: Provide coarse, nonslip finish by scoring surface with stiff-bristled broom perpendicular to line of traffic.
  2. Paving: Provide coarse, nonslip finish by scoring surface with stiff-bristled broom perpendicular to line of traffic.
- C. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed.
- D. Protect and cure finished concrete paving using acceptable moist-curing methods, more particularly described in the "water-curing" section of ACI 308-81.

### **3.4 CLEANING AND ADJUSTING**

- A. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.
- B. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement when construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials.

### **3.5 FIELD QUALITY CONTROL**

An independent testing laboratory shall randomly core the pavement at a minimum rate of one core per 20,000 square feet of pavement, with a minimum of 3 cores from heavy-duty areas and 3 cores from standard duty areas. Core shall be tested for thickness and quality of aggregate distribution. Core holes shall be patched immediately with portland cement concrete conforming to section 2.02 and shall be finished to provide a level surface conforming to section 3.03 A & 3.03 B.

**END OF SECTION #32 13 00**

## **SECTION #32 16 00 - CURB AND SIDEWALKS**

### **PART I GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Combination concrete curb and gutter
- B. Concrete Curb
- C. Concrete Flume
- D. Concrete Sidewalk

#### **1.2 RELATED SECTIONS**

- A. Section 31 10 00 - Site Preparation.
- B. Section 31 20 00 - Aggregate Material.
- C. Section 32 11 00 – Paving Base Course
- D. State Highway Department Standard Specifications.
- E. Construction Drawings.

#### **1.3 REFERENCES**

- A. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- B. ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural construction.
- C. ANSI/ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- D. AS774 C33 - Concrete Aggregates.
- E. ASTM C94 - Ready Mix Concrete.
- F. AS7M C150 - Portland Cement
- G. AS7M C260 - Air-Entraining Admixtures for Concrete.
- H. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
- I. AS7M C494 - Chemical Admixtures for Concrete.
- J. FS TT-C-800 - Curing Compound, Concrete, for New and Existing Surfaces.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Contractor shall maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. The forms shall be of a depth equal to the depth of curbing or sidewalk, and so designed as to permit secure fastening together at the tops. Coat forms with non-staining type coating that will not discolor or deface surface of concrete.
- B. Concrete Materials: Comply with requirements for concrete materials, admixtures, bonding materials, curing materials, and others as required.
- C. Joint Fillers: Resilient premolded bituminous impregnated fiberboard units complying with ASTM D 1751 FS HH-F-341, Type II, Class A; or AASHTO M 153, Type I.



- D. Joint Sealers: Non-priming, pourable, self-leveling polyurethane. Acceptable sealants are Sonneborn "Sonolastic Paving Joint Sealant" Sonneborn "Sonomeric CT 1 Sealant", Sonneborn "Sonomeric CT 2 Sealant", Mameco "Vulken 4511, or Woodmont Products 'Chem-Caulk".

## 2.2 MIX DESIGN AND TESTING

- A. Concrete mix design and testing shall comply with requirements.
- B. Design mix to produce normal weight concrete consisting of Portland cement, aggregate, water-reducing admixture, air-entraining admixture, and water to produce the following properties:
1. Compressive Strength: 3,500 psi, minimum at 28 days, unless otherwise indicated on the Drawings.
  2. Slump Range: 2"-5" at time of placement.
  3. Air Entrainment: 5% to 8%.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Proof-roll prepared base material surface to check for unstable areas. The paving work shall begin after any unsuitable areas have been corrected and are ready to receive paving. Compaction testing for the base material shall be completed prior to the placement of the paving.
- B. Surface Preparation: Remove loose material from compacted base material surface to produce a firm, smooth surface immediately before placing concrete.

### 3.2 INSTALLATION

- A. Form Construction
1. Set forms to required grades and lines, rigidly braced and secured.
  2. Install sufficient quantity of forms to allow continuance of work and so that forms remain in place a minimum of 24 hours after concrete placement.
  3. Check completed formwork for grade and alignment to following tolerances:  
Top of forms not more than 1/8" in 10' - 0".  
Vertical face on longitudinal axis, not more than 1/4" in 10'-0".
  4. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.
- B. Concrete Placement
1. Comply with applicable requirements .
  2. Do not place concrete until base material and forms have been checked for line and grade. Moisten base material if required to provide uniform dampened condition at time concrete is placed. Concrete shall not be placed around manholes or other structures until they are at the required finish elevation and alignment.
  3. Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Consolidate with care to prevent dislocation of dowels, and joint devices.
  4. Deposit and spread concrete in continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hours, place construction joint. Automatic machine may be used for curb and gutter placement at Contractor's option. machine placement must produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified.
- C. Joint Construction
1. Contraction Joints: Concrete curb, concrete gutter or concrete curb and gutter, where specified on the plans, shall be constructed in uniform sections of the length specified on the plans. The joints between sections shall be formed either by steel templates 1/8 inch in thickness, of a length equal to the width of the gutter and/or curb, and with a depth which will penetrate at least 2 inches below the surface of the curb and/or gutter; or with 3/4-inch thick preformed expansion joint filler cut to the exact cross section of the curb

and/or gutter; or by sawing to a depth of at least 2 inches while the concrete is between 4 to 24 hours old. If steel templates are used, they shall be left in place until the concrete has set sufficiently to hold its shape, but shall be removed while the forms are still in place.

2. Longitudinal Construction Joints: Concrete curb, concrete gutter or combination concrete curb and gutter, where specified on the plans, shall be tied to concrete pavement with 1/2 inch round deformed reinforcement bars of the length and spacing shown on the plans.
  3. Transverse Expansion Joints: Transverse expansion joint in curb, curb and gutter, gutter or sidewalk shall have the filler cut to the exact cross section of the curb, curb and gutter, gutter or sidewalk. The joints shall be similar to the type of expansion joint used in the adjacent pavement.
- D. Joint Fillers: Extend joint fillers full-width and depth of joint, and not less than 1/2" or more than 1" below finished surface where joint sealer is indicated. Furnish joint fillers in one-piece lengths for full width being placed, wherever possible where more than one length is required, lace or clip joint filler sections together.
- E. Joint Sealants: All joints shall be sealed with approved exterior pavement joint sealants and shall be installed per manufacturer's recommendations.

### **3.3 CONCRETE FINISHING**

- A. After striking off and consolidating concrete, smooth surface by screeding and floating. Adjust floating to compact surface and produce uniform texture. After floating, test surface for trueness with 10'-0" straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide continuous smooth finish.
- B. Work edges of sidewalks, gutters, back top edge of integral curb, and formed joints with an edging tool, and round to 1/21, radius. Eliminate tool marks on concrete surface. After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
1. Inclined Slab Surfaces: Provide coarse, non-slip finish by scoring surface with stiff-bristled broom perpendicular to line of traffic.
  2. Curbs, gutters, and walks: Broom finish by drawing fine-hair broom across surface perpendicular to line of traffic. Repeat operation as necessary to produce a fine line texture.
- C. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed.
- D. Protect and cure finished concrete paving using acceptable moist-curing methods, more particularly described in the "water-curing" section of ACI 308-81.

### **3.4 BACKFILL**

After the concrete has set sufficiently, the spaces in front and back of the curb and gutter or sidewalk shall be refilled to the required elevation with suitable material which shall be compacted until firm and solid and neatly graded.

### **3.5 CLEANING AND ADJUSTING**

- A. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.
- B. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials.

**END OF SECTION #32 16 00**

## **SECTION #32 17 23 - PAVEMENT MARKINGS**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Painted pavement marking.
- B. Painted curbs, guard posts and light pole bases.

#### **1.2 RELATED SECTIONS**

- A. Section 31 14 00 - Earthwork
- B. Section 32 11 00 - Paving Base Course
- C. Section 32 12 00- Asphaltic Concrete Paving
- D. Section 32 13 00 - Portland Cement Concrete Paving
- E. Construction Drawings

#### **1.3 PROJECT CONDITIONS**

- A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize flagmen, barricades, warning signs and warning lights as required.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. The paint shall be a non-bleeding, quick-drying, alkyd petroleum base paint suitable for traffic-bearing surface and shall meet FS 7TP-85E and mixed in accordance with manufacture's instructions before application.

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Sweep and clean surface to eliminate loose material and dust.
- B. Where existing pavement markings are indicated on the drawings to be removed or would interfere with the adhesion of new paint, a motorized abrasive device shall be used to remove the markings. The equipment employed shall not damage the existing paving or create a surface hazardous to vehicle or pedestrian traffic. In all areas within public rights-of-way, the method of marking removal shall be approved by governing authority.

#### **3.2 APPLICATION**

- A. Apply two (2) coats of paint at manufacturer recommended rate without the addition of thinner, with a maximum of 100 square feet per gallon. Apply with mechanical equipment to produce uniform straight edges. At sidewalk curbs and crosswalks, use a straightedge to ensure a uniform, clean, and straight stripe.
- B. The following items shall be painted with the colors noted below:
  - 1. Pedestrian Crosswalks: Yellow
  - 2. Exterior Sidewalk Curbs, Light Pole Bases and Guardposts: Yellow
  - 3. Fire Lanes: Red or per local code
  - 4. Lane Striping where separating traffic in opposite directions: Yellow
  - 5. Lane Striping where separating traffic in the same direction: White
  - 6. Handicap Symbols: per local code
  - 7. Parking Stall Striping: plans Yellow, unless otherwise noted

**END OF SECTION #32 17 23**

## **SECTION #33 11 00 - WATER DISTRIBUTION SYSTEMS**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

Providing labor, materials, services, equipment, and other necessary items required for the construction of water systems. This shall include, but not be limited to the following: pipe and fittings for site water line including domestic water line and fire sprinkler system water line, valves and fire hydrants, setting line locations, elevations, and grades for water distribution systems work and control system for duration of work including careful maintenance of benchmarks, property corners, monuments, or other reference points.

#### **1.2 RELATED SECTIONS**

- A. Section 31 23 00 - Excavating, Backfill and Compacting for Utilities.
- B. Section 31 20 00 - Aggregate Materials.
- C. Section 33 39 00- Sewer Structures.
- D. Section - Fire Protection. (See Architectural/Building Specifications)
- E. Local Governing Authority and Code Requirements.
- F. All Necessary Construction Permits.
- G. Construction Drawings

#### **1.3 REFERENCES**

- A. AASHTO T180 - Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-in. (457 mm) Drop.
- B. ANSI/ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- C. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- D. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- E. ANSI/ASTM D2466 - Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
- F. ANSI/AWS A5.8 - Brazing Filler Metal.
- G. ANSI/AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
- H. ANSI/AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and other liquids.
- I. ANSI/AWWA C111- Rubber-Gasket Joints for Ductile Iron and Grey-Iron Pressure Pipe and Fittings.
- J. ANSI/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- K. ANSI/AWWA C500 - Gate Valves, 3 inch through 48 inch NPS, for Water and Sewage Systems.
- L. ANSI/AWWA C502 - Dry Barrel Fire Hydrants.
- M. ANSI/AWWA C504 - Rubber Seated Butterfly Valves.
- N. ANSI/AWWA C508 - Swing-Check Valves for Waterworks Service, 2 inch through 24 inch NPS.
- O. ANSI/AWWA C509 - Resilient Seated Gate Valves 3 inch through 12 inch NPS, for Water and Sewage Systems.
- P. ANSI/AWWA C600 - Installation of Ductile-Iron Water Mains and Appurtenances.
- Q. ANSI/AWWA C606 - Grooved and Shouldered Type Joints.
- R. ANSI/AWWA C651 - Disinfecting Water Mains
- S. ANSI/AWWA C900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch, for Water.
- T. ASTM B88 – Seamless Copper water Tube.
- U. ASTM D1785 - Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- V. ASTM D2241 - Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR).
- W. D2855 - Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings.
- X. ASTM D2922 - Test Methods for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth).
- Y. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

- Z. ASTM D3139 - Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.
- AA. ASTM D3035 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.
- BB. AWWA C901 - Polyethylene (PE) Pressure Pipe, Tubing, and Fittings, 1/2 inch through 3 inch, for water.
- CC. AWWA C600-82 - Hydrostatic Testing
- DD. UL 246 - Hydrants for Fire Protection Service.

#### **1.4 SUBMITTALS**

- A. Product Data: Provide Engineer with data on pipe materials, pipe fittings, hydrants, valves and accessories.
- B. Manufacturer's Certificate: Certify that products meet or exceed state or local requirements.

#### **1.5 PROJECT RECORD DOCUMENTS**

- A. Accurately record actual locations of piping mains, valves, connections, and top of pipe elevations
- B. Identify and describe unexpected variations to subsoil conditions and location of uncharted utilities.

#### **1.6 QUALITY ASSURANCE**

- A. Perform work in accordance with utility company and/or municipality requirements.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.

### **PART 2 PRODUCTS**

#### **2.1 PIPE**

- A. Pipe sizes less than 3 inch that are installed below grade and outside building shall comply with one or combination of the following:
  - 1. Seamless Copper Tubing: Type "K" soft copper to comply with ASTM B 88-62 and installed with wrought copper (95-5 Tin Antimony solder joint) fittings in accordance with ASTM B16.22.
  - 2. Polyvinyl Chloride (PVC) Water Pipe: Pipe shall conform to ASTM D-2241 with an SDR 21 rating and shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM D 1784 classification. Pipe joints shall be integrally molded bell ends in accordance with ASTM D 3139 with factory supplied elastomeric gaskets and lubricant.
- B. Pipe sizes 3 inch and larger that are installed below grade and outside building shall comply with one of the following:
  - 1. Gray Cast Iron Water Pipe: In accordance with ANSI A21.6, thickness class 22, and pressure class 150. Fittings shall be either mechanical joint or push-on joint and shall comply with ANSI A21.10 or ANSI A21.11.
  - 2. Ductile Iron Water Pipe: In accordance with ANSI A21.51, Fittings shall be either mechanical joint or push-on joint complying with ANSI A21.10 or ANSI 21.11 (AWWA C-151) (CLASS 50).
  - 3. Polyvinyl Chloride (PVC) Water Pipe: Pipe shall meet the requirements of AWWA C-900 and comply with ASTM D 2241, rated SDR 21 (Class 150). Pipe shall be continually marked as for smaller pipes. Pipe joints shall be integrally molded bell ends in accordance with ASTM D 3034, Table 2, with factory supplied elastomeric gaskets and lubricant.

#### **2.2 GATE VALVES - 2 Inches and Larger**

- A. Manufacturers:
  - Mueller Resilient Seat Gate Valves or approved equal.
- B. ANSI/AWWA C509, Iron body, bronze mounted double disc, parallel seat type, non-rising stem with square nut, single wedge, resilient seat, flanged or mechanical joint ends, control rod, post indicator where indicated on plans, extension box and valve key.

**2.3 BALL VALVES - 2 Inches and Smaller**

- A. Manufacturers:  
 Mueller Oriseal or approved equal.
- B. Brass body, teflon coated brass ball, rubber seats and stem seals, Tee stem pre-drilled for control rod, AWWA compression inlet end, compression outlet with electrical ground connector, with control rod, extension box and valve key.

**2.4 BUTTERFLY VALVES - From 2 inches to 24 inches**

ANSI/AWWA C504, iron body, bronze disc, resilient replaceable seat, water or lug ends, infinite position lever handle.

**2.5 Check valves, post indicator valves and backflow preventors - Refer to Section 15300 (Fire Protection) in the Architectural/Building Specifications**

**2.6 HYDRANT**

- A. Hydrant: Type as required by utility company and as shown on plans.
- B. Hydrant Extensions: Fabricate in multiples of 6 inches with rod and coupling to increase barrel length.
- C. Hose and Steamer Connection: Match sizes with utility company, two hose nozzles, one pumper nozzle.
- D. Finish: Primer and two coats of enamel or special coating to as color as required by utility company.

**2.7 ACCESSORIES**

- A. Concrete for Thrust Blocks: Place thrust blocking consisting of 2,500 psi concrete to provide sufficient bearing area to transmit unbalanced thrust from bends, tees, caps, or plugs to undisturbed soil without loading undisturbed soil in excess of 2,500 lbs/sq ft when water main pressure is 100 psi.

MINIMUM THRUST BLOCKING BEARING AREAS

Pipe Diameter	Tees Sq. Ft.	90° Bend Sq. Ft.	45° Bend Sq. Ft.	22 1/2° Bend Sq. Ft.	11 1/4° Bend Sq. Ft.
3"	1.0	1.0	1.0	1.0	1.0
4"	1.0	1.0	1.0	1.0	1.0
6"	1.5	2.0	1.0	1.0	1.0
8"	2.5	3.5	1.8	1.0	1.0
10"	4.0	5.5	2.8	1.5	1.0
12"	6.0	8.0	4.0	2.0	1.5
14"	8.0	11.0	5.5	3.0	2.0
16"	10.0	14.2	7.0	4.0	3.0
18"	21.0	21.0	12.0	6.0	4.0

- B. Locked Mechanical Joint fittings shall be installed where vertical changes in direction are required and, if approved by the Owner and governing authority, can be installed in lieu of the above thrust blocking requirements.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Verify existing conditions.

- B. Verify that building service connection and municipal utility water main size, location and depth are as indicated.

### **3.2 PREPARATION**

- A. Ream pipe and tube ends and remove burro.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare pipe for connections to equipment with flanges or unions.

### **3.3 BEDDING**

- A. Excavate pipe trench and place bedding material in accordance with Section 31 23 00 for work of this Section.

### **3.4 INSTALLATION - PIPE AND FITTINGS**

- A. Maintain separation of water main from sanitary and storm sewer piping in accordance with state or local code.
- B. Install pipe and fittings in accordance with ANSI/AWWA C600.
- C. Install pipe to allow for expansion and contraction without stressing pipe or joints or as specified by pipe manufacturer.
- D. Install access fittings in accordance with local codes to permit disinfection of water system performed under this Section.
- E. Connections with Existing Pipelines: Where connections are made between new work and existing piping, make connection using suitable fittings for conditions encountered. Make each connection with existing pipe at time and under conditions which least interfere with operation of existing pipeline and in compliance with the local utility company.
- F. Form and place concrete for thrust blocks or other specified methods of retainage at each change of direction or end of pipe main.
- G. Establish elevations of buried piping in accordance with Section 31 23 00 for work in this Section.
- H. Backfill trench in accordance with Section 31 23 00.

### **3.5 INSTALLATION - VALVES AND HYDRANTS**

- A. Install gate valves as indicated on Drawings and supported on concrete pads with valve stem vertical and plumb. Install valve boxes in a manner that will not transmit loads, stress, or shock to valve body. Center valve box over operating nut of valve vertical and plumb. Securely fit valve box together leaving cover flush with finished surface.
- B. Install fire hydrant assemblies as indicated on Drawings in vertical and plum position with steamer/pumper nozzle pointed perpendicular to traffic where hydrant is adjacent to a street, roadway or parking lot drive or toward the protected building unless otherwise directed by local authorities. Support hydrant assembly on concrete pad and firmly braced on side opposite inlet pipe against undisturbed soil and concrete blocking. Place minimum of 6 cu. ft. of crushed stone or gravel around hydrant base and barrel after thrust blocking has cured at least 24 hours. Exercise care when backfilling and compacting so proper vertical position will not be altered.

### **3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM**

Disinfect distribution system with chlorine before acceptance for domestic operation. Amount of chlorine shall be such as to provide dosage of not less than 50 parts/million. Thoroughly flush lines before introduction of chlorinating materials and after contact period of not less than 24 hours, system shall be flushed with clean water until residual chlorine content is not greater than 1.0 part/million. open and close valves in lines being disinfected several times during contact period. After disinfection, take water sample and bacteriologically test in accordance with AWWA specifications. Do not place distribution system in service until approval is obtained from applicable governing authorities.

### **3.7 SERVICE CONNECTIONS**

Provide water service connection in compliance with utility company requirements including reduced pressure backflow prevented if required and water meter with by-pass valves and sand strainer.

**3.8 FIELD QUALITY CONTROL**

- A. Compaction testing of trench backfill shall be performed in accordance with Section 31 23 00.
- B. Water distribution system pipe installed below grade and outside building shall be tested in accordance with following procedures:

- 1. The Contractor shall perform the testing of pipe materials, joints, and/or other materials incorporated into the construction of water mains and force mains to determine leakage and watertightness. All pressure pipeline shall be tested in accordance with Section 4 of AWWA C600-82. In the event any state or local code requires a more stringent test, the more stringent shall apply.

- 2. Pressure Test:  
After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing and not less than 1.25 times the working pressure at the highest point along the test section.

- 3. Leakage Test:  
The leakage test shall be conducted concurrently with the pressure test. Leakage is defined as the quantity of water that must be supplied into the newly laid pipeline, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipeline has been filled with water. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

No pipeline installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SDP}{133200}$$

L = allowable leakage, (gallons per hour)

S = length of pipe tested, (feet)

D = nominal diameter of pipe, (inches)

P = average test pressure during test, (psig)

- 4. Visible Leakage:  
All visible leaks shall be repaired regardless of the amount of leakage.
- 5. Acceptance of Installation:  
If any test of pipe laid in place discloses leakage greater than that specified, the Contractor shall, at his own expense, locate the leak and make repairs as necessary until the leakage is within the specified allowance.  
Contractor shall supply all water for testing at no expense to the Owner.
- 6. Contractor shall furnish one copy of results of meter test and hydrostatic pressure test to the Owner and utility company upon completion of water distribution backfilling operations.

**END SECTION #33 11 00**





## **SECTION #33 31 00 - SANITARY SEWER SYSTEM**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

Furnish labor, materials, services, equipment, and other necessary items required for accompanying the construction of the sanitary sewer systems. This shall include, but not be limited to, the following:

Sanitary sewer drainage piping, Fittings and Accessories, Cleanouts, and Bedding.

Set lines, elevations, and grades for sanitary sewer system work and control system for duration of work, including careful maintenance of benchmarks, property corners, monuments, or other reference points.

#### **1.2 RELATED REQUIREMENTS**

- A. Construction Drawings
- B. Specifications Section 31 23 00 Excavation, Backfilling, and Compacting for Utilities
- C. Specifications Section 33 39 00 Sewer Structures
- D. Local governing authority and code requirements
- E. All necessary construction permits

#### **1.3 REFERENCES**

- A. ANSI/ASTM A74 - Cast Iron Soil Pipe and Fittings.
- B. ANSI/ASTM C12 - Practice for Installing Vitrified Clay Pipe Lines.
- C. ANSI/ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.
- D. ANSI/ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- E. ANSI/ASTM C425 - Compression Joints for Vitrified Clay Pipe and Fittings.
- F. ANSI/ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- G. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
- H. ANSI/ASTM D3034 - Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
- I. ASTM A746 - Ductile Iron Gravity Sewer Pipe.
- J. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings,
- K. ASTM C700 - Vitrified Clay Pipe, Extra Strength, Standard Strength and perforated.
- L. ASTM D1785 - Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80 and 120.
- M. ASTM D2922 - Test Methods for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth).
- N. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

#### **1.4 DEFINITION**

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

#### **1.5 SUBMITTALS**

- A. Product Data: Provide catalog materials indicating pipe, pipe accessories, and fittings.
- B. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- C. Manufacturer's Certificate: Certify that products meet or exceed ASTM designations.

#### **1.6 COORDINATION**

- A. Coordinate the Work with termination of sanitary sewer connection outside building, connection to municipal sewer utility service, and trenching.

### **PART 2**

## **PART 2 PRODUCTS**

### **2.1 SEWER PIPE MATERIALS**

- A. Polyvinyl Chloride Sanitary Sewer
1. Pipe and fittings shall comply with ASTM D 3034, rated SDR 35 unless otherwise specified by the local utility. Pipe shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM D 3034 classification.
  2. Pipe joints shall be integrally molded bell ends per ASTM D 3034, Table 2, with factory supplied elastomeric gaskets and lubricant.
  3. Corrugated Polyvinyl Chloride sewer pipe and fittings shall comply with ASTM F 949. Pipe must be marked with manufacturer's name, pipe size, cell classification and ASTM F 949 Classification. Pipe must be installed per the manufacturer's installation requirements. Acceptable manufacturer: CON'RECH, INC. "A-2000" PVC sewer pipe or Owner-approved equivalent.

### **2.2 PIPE ACCESSORIES**

- A. Pipe Joints: Mechanical clamp ring type, stainless steel expanding and contracting sleeve, neoprene ribbed gasket for positive seal.
- B. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

### **2.3 CLEANOUTS**

- A. Lid and Frame: Heavy Duty cast iron construction, manufactured by Mueller Lid Design: Closed Lid.
- B. Shaft Construction: Cast Iron shaft of internal diameter as specified on plans with 2500 psi concrete collar for cleanouts.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

Verify that trench cut and excavation is ready to receive work and excavations, dimensions, and elevations are as indicated on civil engineering drawings.

### **3.2 PREPARATION**

- A. Hand trim excavations to required elevations. Correct over excavation with fine aggregate.
- B. Remove large stones or other hard matter which could damage pipe or impede consistent backfilling or compaction.

### **3.3 BEDDING**

- A. Excavate pipe trench and place bedding material in accordance with Section 31 14 00 for work of this Section.

### **3.4 INSTALLATION – PIPE**

- A. Install pipe, fittings, and accessories in accordance with ASTM C12, ASTM C14 and/or manufacturer's instructions and state or local requirements.
- B. Lay pipe to slope gradients noted on civil engineering drawings.
- C. Install pipe on bedding in accordance with Section 31 14 00 for work in this Section.
- D. Refer to Section 31 14 00 for trenching requirements. Do not displace or damage pipe when compacting.
- E. Refer to Section 33 39 00 for manhole requirements.
- F. Connect to building sanitary sewer outlet and municipal sewer system as indicated on the drawings.

**3.5 INSTALLATION – CLEANOUTS**

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe to be installed to proper elevations.

**3.6 FIELD QUALITY CONTROL**

- A. Compaction testing will be performed in accordance with ANSI/ASTM D698, ASTM D2922 or ASTM D3017.
- B. Test sanitary sewer pipe system installed below grade and outside building in accordance with the following procedures:

- 1. The Contractor shall perform the testing of manhole construction, pipe materials, joints and/or other materials incorporated into the construction of the sanitary sewer system to determine leakage and watertightness. In the event any state or local code requires a more stringent test, the more stringent shall apply.

- 2. Manhole Testing:  
 The Owner and/or Governing Agency shall determine the method of manhole testing set forth below. The test method selected will be determined by the depth of each manhole, groundwater level, concrete honeycombing, or other conditions which make the selected test suitable for determining the physical condition and watertightness of the manhole.

- 2.1 Manhole Exfiltration Testing:  
 All incoming and outgoing sewer lines shall be plugged the manhole filled with water up to the top of the poured concrete or above the highest precast barrel joint. If the water loss exceeds the maximum allowable as shown below; the manhole shall have failed the test.

Depth of Manhole	Maximum Allowable Water Loss
0-8 feet	1 inch over 5 minutes
greater than 8 feet	1/8 gallon per vertical foot over 5 minutes

- 2.2 Manhole Vacuum Testing:  
 The manhole vacuum test shall be performed with suitable apparatus made for such purpose and shall draw a vacuum of 10 inches of Mercury (Hg). The test shall pass if the vacuum remains at 10" of Mercury (Hg) or drops to not less than 9" of Mercury (Hg) in one minute.

- 3. Flexible Pipe Deflection Testing:  
 3.1 Allowable Deflection:  
 The maximum allowable pipe deflection shall not exceed **(5)** five percent of the nominal inside diameter.

- 3.2 Mandrel:  
 The mandrel (go/no-go) device shall be cylindrical in shape and constructed with either 9 or 16 evenly spaced arms or prongs. Mandrels with less arms will be rejected as not sufficiently accurate. The contact length of the mandrel's arms shall equal or exceed the nominal inside diameter of the sewer to be inspected. Critical mandrel dimensions shall carry a tolerance of plus or minus 0.01 inch. The mandrell and all necessary equipment for the mandrell test shall be provided by the Contractor.

- 3.3 Procedure:  
 The mandrel shall be hand-pulled by the contractor through all flexible pipe sewer lines no earlier than 30 days after the trench has been completely backfilled. Any sections of the sewer not passing the mandrel shall be uncovered and the Contractor shall rebed, reround, or replace the sewer to the satisfaction of the Owner and/or Governing Agency. Any repaired section shall be retested.

- 3.4 Mandrell O.D. (outside diameter):  
 The outside diameter of the mandrell shall be set according to the following table:

NOMINAL DIAMETER (IN.) .....	MANDRELL O.D. (IN.)
6".....	5.40
8".....	7.12
10".....	8.87
12".....	10.55
15".....	12.89
18".....	15.30

3.5 Contractor's Warranty:

The Owner and/or Governing Agency reserves the right to mandrell test any flexible pipe sewer line before acceptance, and also prior to expiration of the first year of operation. If a previously accepted line fails a mandrell test performed during the first year of operation, the defects must be corrected at the Contractor's expense.

4. Air Testing of Gravity Sewers:  
 4.1 Procedure:

- 4.1.1 Plug all pipe outlets with suitable test plugs. Brace each plug securely.
- 4.1.2 Pipe air supply to the pipeline to be tested in such a manner that the air supply may be shut off, pressure observed, and air pressure released from the pipe without workmen entering the manhole.
- 4.1.3 Add air slowly to the portion of pipe under test until the internal pressure of the line is raised to approximately 4 psig, but less than 5 psig.
- 4.1.4 Shut the air supply off and allow at least two minutes for the air pressure to stabilize
- 4.1.5 When the pressure has stabilized and is at or above the starting test pressure of 3.5 psi, start the test.
- 4.1.6 Determine the time in seconds with a stopwatch for the pressure to fall 0.5 psig so that the pressure at the end of the time is at or above 3.0 psig.
- 4.1.7 Compare the observed time with the minimum allowable times in the chart below for pass/fail determination.

1 Pipe Diameter(min: (in.)	2 Minimum Time (sec.)	3 Length for Minimum Time (ft.)	4 Time for Longer Length (sec.)	SPECIFICATION TIME FOR LENGTH (L) SHOWN (MIN:SEC)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	1:53	597	.190L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	.427L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	.760L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	46:54

30	14:10	50	10.683L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23

- 4.2 Safety Precautions:  
The low pressure air test may be dangerous to personnel if, through lack of understanding or carelessness, a line is over pressurized or plugs are installed improperly. It is extremely important that the various plugs be installed so as to prevent the sudden expulsion of a poorly inflated plug. As an example of the hazard, a force of 250 pounds; exerted on an 8 inch plug by an internal pressure of 5 psi. Observe the following safety precautions:
- 4.2.1 No person shall be allowed in the manholes during the test or when a plugged pipe is under pressure.
  - 4.2.2 Gauges, air piping manifolds, and valves, shall be located at the top of the ground.
  - 4.2.3 Install and brace all plugs securely.
  - 4.2.4 Do not over pressurize the lines.
- 4.3 Ground Water Elevation:  
If the pipeline to be tested is below the ground water level, the starting test pressure shall be increased by 0.433 psi for each foot the groundwater level is above the invert of the sewer pipe. In no case shall the starting test pressure exceed 9.0 psig.
- 4.4 Acceptance of Installation:  
No gravity sewer or manhole will be accepted that does not comply with the minimum requirements of tests described in this specification.
- 4.5 Test Equipment:  
All necessary equipment to perform the air test in accordance with this specification shall be provided by the contractor. The test gauge shall preferably have incremental division of 0.10 psi and have an accuracy of at least plus or minus 0.04 psi. In no case shall a test gauge be used which has incremental divisions of greater than 0.25 psi. The gauge shall be of sufficient size in order to determine this accuracy.
- 4.6 Contractor shall furnish one copy of gravity sewer and manhole test results to the Owner and Governing Agency upon completion of gravity sewer system backfilling operations.

**END OF SECTION #33 31 00**

## **SECTION #33 39 00 - SEWER STRUCTURES**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Monolithic concrete manhole barrel with the option of monolithic concrete or masonry transition to lid frame, covers, anchorage and accessories.
- B. Modular pre-cast concrete manhole barrel with tongue-and-groove joints and with the option of pre-cast concrete or masonry transition to lid frame, covers, anchorage and accessories.
- C. Masonry manhole barrel with masonry transition to lid frame, covers, anchorage and accessories.
- D. Pre-cast Polyethylene manhole assemblies.

#### **1.2 RELATED SECTIONS**

- A. Section 31 23 00 - Excavation, Backfill, and Compacting for Utilities
- B. Section 33 41 00 - Storm Sewer Systems
- C. Section 33 31 00 - Sanitary Sewer Systems
- D. Construction Drawings

#### **1.3 REFERENCES**

- A. ANSI/AS7M C55 - Concrete Building Brick.
- B. ASTM A48 - Gray Iron Castings.
- C. ASTM C478 – Pre-cast Reinforced Concrete Manhole Sections.
- D. ASTM C923 - Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
- E. ASTM D1248 – Pre-cast Polyethylene Manholes.
- F. International Masonry Industry All-Weather Council (IMIAC): Recommended Practices and Guide Specification for Cold Weather Masonry Construction.

#### **1.4 SUBMITTALS**

- A. Shop Drawings: Indicate reference to drawings of manhole locations, elevations, piping with sizes, locations and elevations of penetrations.
- B. Product Data: Provide data for manhole covers, manhole steps, component construction, features, configuration, and dimensions.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. Manhole Barrel: Reinforced pre-cast concrete, in accordance with ASTM C478 with gaskets in accordance with ASTM C923.
  - 1. Construct manholes of pre-cast concrete sections as required by Drawings to size, shape, and depth indicated, but never less than 4'-0" inside diameter.
- B. Manhole Barrel: Non-reinforced cast-in-place concrete .
  - 1. Cast-in place Manholes shall be constructed of 3500 psi concrete.
  - 2. Forms shall be made of steel sheets accurately shaped and fabricated of sufficient strength to form dense watertight walls to true dimensions.
  - 3. Concrete shall be deposited in evenly distributed layers of about 18 inches, with each layer vibrated to bond it to the preceding layer.
- C. Fiberglass Manholes:  
Fiberglass Wetwell:  
General: Fiberglass reinforced polyester wetwells shall be manufactured from commercial grade polyester resin or other suitable polyester or vinyl ester resin, with fiberglass reinforcements.

Materials:

Resins: The resins used shall be a commercial grade unsaturated polyester resin.

Reinforcing Materials: The reinforcing materials shall be commercial Grade "E" type glass in the form of mat, continuous roving, chopped roving, roving fabric, or a combination of the above, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.

Surfacing Materials: If reinforcing materials is used on the surface exposed to the contained substance, it shall be a commercial grade chemical-resistant glass that will provide a suitable bond with the resin and leave a resin rich surface.

Fillers and Additives: Fillers, when used, shall be inert to the environment and wetwell construction. Additives, such as thixotropic agents, catalysts, promoters, etc. may be added as required by the specific manufacturing process to be used. The resulting reinforced plastic material must meet the requirement of this specification.

Fabrication:

Exterior Surface: The exterior surface shall be relatively smooth with no sharp projections. Hand-work finish is acceptable if enough resin is present to eliminate fiber show. The exterior surface shall be free of blisters larger than 1/2 inch in diameter, delamination and fiber show.

Interior Surface: The interior surface shall be resin rich with no exposed fibers. The surface shall be free of crazing, delamination, blisters larger than 1/2 inch in diameter, and wrinkles of 1/8 inch or greater in depth. Surface pits shall be permitted up to 6/square feet if they are less than 3/4 inch in diameter and less than 1/16 inch deep.

Defects not Permitted:

- a. Exposed fibers: glass fibers not wet out with resin.
- b. Resin runs: Runs of resin and sand on the surface.
- c. Dry areas: Areas with glass not wet out with resin.
- d. Delamination: Separation in the laminate.
- e. Blisters: Light colored areas larger than 1/2 inch in diameter.
- f. Crazing: Cracks caused by sharp objects.
- g. Pits or Voids: Air pockets
- h. Wrinkles: Smooth irregularities in the surface.
- i. Sharp Projection: Fiber or resin projections necessitating gloves for handling.

Physical Requirements:

Load Rating: The complete wetwell shall have a minimum dynamic-load rating of 16,000 ft-lbs when tested in accordance with Testing Methods. To establish this rating, the complete wetwell shall not leak, crack, or suffer other damage when load tested to 40,000 ft-lbs and shall not deflect vertically downward more than 1/4 inch at the point of load application when loaded to 24,000 lbs.

Stiffness: The wetwell cylinder shall have a minimum pipe-stiffness values shown in the table below:

Stiffness Requirements	
Length, ft.	F/AY, psi
10 to 20	2.01
21 to 30	3.02
31 to 40	5.24

Physical Properties:

	<u>Hoop Direction</u>	Axial	<u>Direction</u>
a. Tensile Strength (psi)	18,000	5,000	
b. Tensile Modulus (psi)	0.8 x 10 <sup>6</sup>		0.7 x 10 <sup>6</sup>
c. Flexural Strength (psi)	26,000	4,500	
d. Flexural Modulus (psi)			
(no ribs – 48", 60", 72")	1.4 x 10 <sup>6</sup>	0.7 x 10 <sup>6</sup>	
(with ribs – 96", 144")	0.7 x 10 <sup>6</sup>		0.7 x 10 <sup>6</sup>

Test Methods: Test shall be performed as specified in ASTM D 3753 latest edition.



Required Thicknesses for Buried Fiberglass Manholes

Fiberglass manholes shall meet the following thickness requirements:

Diameter (in)	Wet Soil Depth (max) (ft)	Min. Thickness (in)	Min. Thickness Allowed (in)
48	10	.25	.375
	20	.3125	.375
	30	.375	.375
60	10	.375	.375
	20	.4375	.4375
	30	.5	.5000

Installation:

Fiberglass manholes will be confined to installations behind the curb, or out of heavy traffic lanes only. Further, the fiberglass manhole shall not be used for depths greater than ten (10) feet.

The manholes shall be installed according to the manhole details shown in the plans. After the manhole has been installed into the concrete base as shown, the excavated area will be backfilled with sand.

- D. Manhole Barrel: Pre-cast Polyethylene in accordance with ASTM D 1248. Manholes shall be manufactured with factory-molded steps. The nominal cylinder internal diameter shall be 4811 and shall be designed to accept concrete filled polyethylene manhole lids and standard cast iron frames with lid or grate. Manholes shall have compressive strength which meets ASTM D 2412 standards. Acceptable Manufacturers: Advanced Drainage Systems (ADS) or Owner-Approved equivalent manufacturer.
- E. Concrete Brick Units: ANSI/ASTM C55, Grade N Type I- Moisture Controlled, normal weight, of same Grade, Type and weight as block units, nominal modular size of 3 5/8 x 7 5/8 x 2 1/4 inches.
- F. Mortar and Grout: Mortar for finishing and sealing shall be Class "C". Honeycombing less than two (2) inches deep shall be repaired using Class "D" mortar.
- G. Brick Transition Reinforcement: Formed steel 8 gage wire with galvanized finish.

**2.2 COMPONENTS**

- A. Lid and Frame: ASTM A48, Class 30B Heavy Duty Cast iron construction, machined flat bearing surface, removable lid, closed or open as specified on plans; sealing gasket; manufactured by Neenah Foundry Company or approved equal.
- B. Manhole Steps: Neenah Foundry Company catalog No. R- 1982-F for pre-cast or catalog No. R-1980-0 for brick/cast-in-place manholes or M.A. Industries PS-1 or approved equal.
- C. Base Pad: Cast-in-place concrete.

**2.3 CONFIGURATION**

- A. Barrel Construction: Concentric with eccentric cone top section.
- B. Shape: Cylindrical.
- C. Clear Inside Dimensions: 48 inch diameter or as indicated on plans.
- D. Design Depth: As indicated on plans.
- E. Clear Lid Opening: 22 inches minimum.
- F. Pipe Entry: Provide openings as indicated on plans.
- G. Main and Lateral Pipes: Neatly cut off main and lateral pipes flush with inside of manhole or inlet where they enter structure walls, and point up irregularities and rough edges with non-shrinking grout.
- H. Inverts: Shape inverts for smooth flow across structure floor as shown on Drawings. Use concrete and mortar to obtain proper grade and contour and finish surface with fine textured wood float.

**PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into work.
- C. Verify excavation for manholes is correct.

### **3.2 PREPARATION**

Coordinate placement of inlet and outlet pipe or duct sleeves as indicated on plans.

### **3.3 PLACING PRE-CAST MANHOLE BARREL SECTIONS**

- A. Place base pad to proper elevation and location and trowel top surface level for placement of manhole barrel.
- B. Place manhole barrel plumb and level to correct elevations and anchor to base pad.
  - 1. After completion of slab foundation the first joint of manhole barrel shall be lowered into position, grooved end first and set level and plumb on concrete base. Align and adjust to proper grade prior to placing and forming invert which shall be poured immediately after setting of first section of manhole barrel.
  - 2. Prior to setting subsequent manhole barrel sections, apply primer to tongue and groove ends and allow to set in accordance with manufacturer recommendations. Place "Ram-nek", or equivalent, plastic rope on tongue end. Lower next section into position, and remove excess material from interior of structure. Add additional material on exterior of joint, if necessary, for completely watertight joint.

### **3.4 MASONRY MANHOLE BARREL CONSTRUCTION**

- A. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- B. Lay masonry units in running bond. Course 3 brick units and 3 mortar joints to equal 8 inches.
- C. Form flush mortar joints.
- D. Lay masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- E. Install joint reinforcement 16 inches o.c.
- F. Place joint reinforcement in first and second horizontal joints above base pad and below lid frame opening.
- G. As work progresses, build-in fabricated metal items.
- H. Cut and fit masonry for pipes in accordance with 2.03-6 of this Section.
- I. Set cover frames and covers level without tipping, to correct elevations.

**END OF SECTION #33 39 00**

## **SECTION #33 41 00 - STORM SEWER SYSTEMS**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Site storm sewerage drainage piping, fittings and accessories, and bedding.
- B. Connection of building storm water drainage system to municipal sewers.
- C. Catch basins, paved area drainage, site surface drainage, and stormwater detention facilities.

#### **1.2 RELATED REQUIREMENTS**

- A. Section 31 23 00 - Excavation, Backfill, and Compacting for Utilities
- B. Section 31 35 00 - Slope Protection and Erosion Control
- C. Section 33 39 00 - Sewer Structures
- D. Section 33 31 00 - Sanitary Sewerage System
- E. Local governing authority and code requirements.
- F. All necessary construction permits.
- G. Construction Drawings

#### **1.3 REFERENCES**

- A. AASTHO M294 and M252 - Corrugated Polyethylene pipe smooth interior.
- B. AASHTO M36 - Metallic (Zinc or Aluminum) Coated Corrugated Steel Culverts and Underdrains.
- C. AASHTO T180 - Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-in. (457 mm) Drop.
- D. ANSI/ASTM A74 - Cast Iron Soil Pipe and Fittings.
- E. ANSI/ASTM C12 - Practice for Installing Vitrified Clay Pipe Lines.
- F. ANSI/ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.
- G. ANSI/ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- H. ANSI/ASTM C425 - Compression Joints for Vitrified Clay Pipe and Fittings.
- I. ANSI/ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- J. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- K. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- L. ANSI/ASTM D3034 - Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
- M. ASTM C700 - Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated.
- N. ASTM D2922 - Test Methods for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth)
- O. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

#### **1.4 DEFINITIONS**

Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

#### **1.5 PROJECT RECORD DOCUMENTS**

- A. Accurately record actual locations of pipe runs, connections, catch basins, cleanouts, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions and location of uncharted utilities.

#### **1.6 COORDINATION**

Coordinate the Work with termination of storm sewer connection outside building including connection to municipal storm sewer system.

## **PART 2 PRODUCTS**

### **2.1 STORM SEWER PIPE MATERIALS AND ACCESSORIES**

- A. Reinforced Concrete Pipe: Comply with requirements of ASTM C 76, Class III unless another class type is indicated on Drawings, installed with flexible plastic (Bitumen) gaskets at all joints. Gaskets shall comply with AASHTO M-198 751, Type B, and shall be installed in strict accordance with pipe manufacturer's recommendations
- B. Polyvinyl Chloride (PVC) Pipe: Only permitted when specifically indicated on Drawings. Pipe and fittings shall comply with ASTM D 3034, rated SDR 35. Pipe shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM D 3034 classification. Pipe joints shall be integrally molded bell ends in accordance with ASTM D 3034, Table 2, with factory supplied elastomeric gaskets and lubricant.
- C. Polyvinyl Chloride (PVC) large diameter closed profile gravity sewer pipe, UNL-B-9: Only permitted when specifically indicated on drawings. Pipe and fittings shall comply with ASTM F-794. Pipe must be installed in accordance with pipe manufacturers installation guidelines. Acceptable manufacturer: Carlon "Vylon H.C." or approved equal.
- E. Polyvinyl Chloride (PVC) 8" through 30" diameter, smooth interior, open profile gravity sewer pipe. Only permitted when specifically indicated on drawings. Pipe and fittings shall comply with ASTM F-794 and Uni-Bell Uni-B-9. Pipe must be installed in accordance with pipe manufacturers installation guidelines. Acceptable manufacturer: Extrusion Technologies, Inc. "Ultra-Rib" or approved equal.
- F. ADS HP Storm 12" – 60" Pipe: This specification describes the 12 – through 60 – inch (300 to 1500 mm) ADS HP Storm pipe for use in gravity-flow storm drainage applications. Pipe requirements:
- 12 – through 30-inch (300 to 750 mm) pipe shall have a smooth interior and annular exterior corrugations and meet to exceed ASTM F2736 and AASHTO M330.
  - 36 – through 60-inch (900 to 1500 mm) pipe shall have a smooth interior and annular exterior corrugations and meet or exceed ASTM F2881 and AASHTO M330.
  - Manning's "n" value for use in design shall be 0.012.

#### Joint Performance:

Pipe shall be joined with a gasketed integral bell & spigot joint meeting the requirements of ASTM F2736 or F2881, for the respective diameters.

12-through 60-inch (300 to 1500 mm) shall be watertight according to the requirements of ASTM D3212. Spigots shall have gaskets meeting the requirements of ASTM F477. Gasket shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during joint assembly.

12-through 60-inch (300 to 1500 mm) diameters shall have a reinforced bell with a polymer composite band installed by the manufacturer.

#### Fittings:

Fittings shall conform to ASTM F2736, ASTM F2881 and AASHTO M330, for the respective diameters. Bell & spigot connections shall utilize a spun-on, welded or integral bell and a spigot with gaskets meeting ASTM F477. Bell & spigot fittings joint shall meet the watertight joint performance requirements of ASTM D3212. Corrugated couplings shall be split collar, engaging at least 2 full corrugations.

#### Field Pipe and Joint Performance:

To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F2487. Appropriate safety precautions must be used when field testing any pipe material. Contact the manufacturer for recommended leakage rates.

#### Material Properties:

Polypropylene compound for pipe and fitting production shall be impact modified copolymer meeting the material requirements of ASTM F2736, Section 4, ASTM F2881, Section 5 and AASHTO M330, Section 6.1 for the respective diameters.

#### Installation:

Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in traffic areas for 12 – through 48 – inch (300 to 1200 mm) diameters shall be one foot (0.3 m) and for 60 – inch (1500 mm) diameters, the minimum cover shall be 2 feet (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1, Class 2 (minimum 90% SPD) or Class 3 (minimum 95%) material. Maximum fill heights depend on embedment material and compaction level. Contact your local ADS representative or visit our website at [www.ads-pipe.com](http://www.ads-pipe.com) for a copy of the latest installation guidelines.

Pipe Dimensions:									
Nominal Diameter in.	12	15	18	24	30	36	42	48	60
(mm)	(300)	(375)	(450)	(600)	(750)	(900)	(1050)	(1200)	(1500)
Average Pipe I.D. in.	12.1	14.9	18.0	24.1	30.1	35.7	41.8	47.3	59.3
(mm)	(307)	(378)	(457)	(612)	(765)	(907)	(1062)	(1201)	(1506)
Average Pipe O.D. in.	14.5	17.6	21.2	28.0	35.4	41.1	47.2	53.8	66.5
(mm)	(368)	(447)	(538)	(711)	(899)	(1044)	(1199)	(1367)	(1689)
Minimum Pipe Stiffness at 5%	75	60	56	50	46	40	35	35	30
Deflection*#/in/in.(kN/m <sup>2</sup> )	(520)	(411)	(385)	(343)	(320)	(275)	(240)	(240)	(205)

**2.2 INLETS, CATCH BASINS AND JUNCTION BOXES**

- A. Lid and frame per details shown on plans.
- B. Structure construction in accordance with details shown on plans.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

Verify that trench cut and excavation is ready to receive work and excavations, dimensions, and elevations are as indicated on civil engineering drawings.

**3.2 PREPARATION**

- A. Hand trim excavations to required elevations. Correct over excavation with fine aggregate.
- B. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

**3.3 BEDDING**

- A. Excavate pipe trench and place bedding material in accordance with Section 02222 for work of this Section.

**3.4 INSTALLATION – PIPE**

- A. Install pipe, fittings, and accessories in accordance with ASTM C12, ASTM D2321 or manufacturer's instructions and state or local requirements.
- B. Install pipe on bedding in accordance with Section 31 23 00 for work in this Section.
- C. Lay pipe to slope gradients noted on construction drawings.
- D. Refer to Section 31 23 00 for trenching requirements. Do not displace or damage pipe when compacting.
- E. Refer to Section 33 39 00 for manhole requirements.

**3.5 INSTALLATION - CATCH BASINS, INLETS AND JUNCTION BOXES**

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete base pad, with provision for storm sewer pipe to be placed at proper elevation.
- C. Form and place cast-in-place concrete walls, sleeved at proper elevation to receive storm sewer pipe in accordance with details shown on the plans.
- D. Form and place cast-in-place top of structure in accordance with details shown on the plans.

**END OF SECTION #33 41 00**

## **SECTION 41 22 13.13 - BRIDGE CRANES**

### **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: Requirements including, but not limited to, the following:
  - 1. Materials and equipment required to install bridge crane, including, but not limited to, bridge, trolley, hoist, power, and control circuit conductors, safety and control mechanisms, and all other parts and services as required for a complete installation.
- B. Related Work not Included in This Section:
  - 1. Structure, up to and including, the runway girders on which the crane shall run.
- C. Related Sections:
  - 1. Section 05 12 00 - Structural Steel Framing: Structural steel for mounting crane.
  - 2. Division 26 - Electrical: Power connections.

#### **1.3 REFERENCE STANDARDS**

- A. 29 CFR 1910.179 - Overhead and Gantry Cranes; Current.
- B. ASME B30.2 - Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist); 2022.
- C. ASME B30.17 - Cranes and Monorails (With Underhung Trolley or Bridge); 2020.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. American National Standards Institute (ANSI):
  - 1. ANSI B15.1 - Safety Standard for Mechanical Power Transmission Apparatus.
  - 2. ASME B30.10 - Hooks.
  - 3. ASME B30.19 - Cableways.
  - 4. ASME HST-1M - Performance Standards for Electric Chain Hoists.
  - 5. ASME HST-4M - Performance Standards for Overhead Electric Wire Rope Hoists.
  - 6. ASME NOG-1 - Rules for Construction of Overhead and Gantry Cranes.
  - 7. ASME NUM-1 - Rules for Construction of Cranes, Monorails, and Hoists.
- F. AWS - American Welding Society:
  - 1. AWS D1.1 - Structural Welding Code - Steel.
  - 2. AWS D14.1 - Specifications for Welding Industrial and Mill Cranes.
- G. Crane Manufacturer's Association of America:
  - 1. Specifications for Electric Overhead Traveling Cranes - CMAA Specification Number 70.
- H. 29 CFR 1910, Subpart N, OSHA General Industry Standards, Materials Handling and Storage Subpart.
- I. 29 CFR 1926, Subpart H, OSHA Construction Standards, Materials Handling, Storage, Use, and Disposal Subpart.
- J. 29 CFR 1926, Subpart N, OSHA Construction Standards, Cranes, Derricks, Hoists, Elevators, and Conveyors Subpart.
- K. American Institute of Steel Construction, The Manual of Steel Construction, latest edition.

#### **1.4 DEFINITIONS**

- A. Terms used in this specification shall be as defined in ASME B30.2.
- B. Refer to Section 01 42 16 - Definitions for remainder of definitions.

## 1.5 PERFORMANCE REQUIREMENTS

- A. Vertical Impact: Impact allowance shall be included in design calculations for carriers (trolleys) and cranes. The impact shall be 0.5 percent of the rated load for each foot-per-minute of hoisting speed with a minimum allowance of 15 percent and a maximum of 50 percent.

## 1.6 SUBMITTALS

- A. General:
1. Submit under provisions of Section 01 33 00 - Submittal Procedures.
- B. Pre-Construction Submittals:
1. Provide submittals and await response prior to ordering or fabrication. No deviations from the submittals as accepted shall be permitted and any materials purchased prior to acceptance shall be at the sole risk of the Contractor.
  2. Administrative Data: Submit name, address and telephone number of the local representative; general sales and engineering bulletins covering the full line of products manufactured; certification that the line of products proposed for this project have been in continuous and successful use for not less than 5 years; general catalog information covering the characteristics of the systems proposed for this contract; and a statement that the components and the systems proposed will be maintained and supported by the manufacturer for parts and service for not less than 10 years.
  3. Shop Drawings and Calculations: Shop drawings shall be to scale, fully dimensioned, and shall provide sufficient detail to clearly indicate the arrangement of equipment and components. The drawings shall show plan, elevation, and sectional views along with all other pertinent data. Submit structural calculations for the bridge. Shop drawings and calculations shall be signed by a Professional Engineer registered in the state of Texas.
  4. Product Data: Submit technical product specification sheets for each system component and device. Include all data needed to prove compliance with this section. Clearly indicate the exact model of each component to be provided.
  5. Mill Test Reports: Submit mill test reports for the bridge.
  6. Inspection and Rated Load Test Reports: Submit inspection reports and operational and rated load test reports in accordance with ANSI B30.2.
  7. Manufacturer's Installation Instructions: Submit for all components provided under this section.
  8. Paint: Submit a complete list of products required for this work. Submit manufacturer's specifications for each product, including product description, features, composition, specifications, special surface preparation procedures, substrate conditions requiring special attention, and recommended method of application. Include the manufacturer's recommended dry mil thickness for each coat of each scheduled finish.
  9. Manufacturer's Directions: Follow manufacturer's directions covering items not shown on the drawings or specified herein. Manufacturer's directions do not take precedence over Drawings and specifications. Where these are in conflict with the drawings and specifications, notify the Architect for clarification before installing the work.
- C. Pre-Commissioning Submittals:
1. Submit prior to performing functional testing.
  2. Operator's manuals: Submit for bridge crane furnished.
  3. Testing Procedure: Submit a testing procedure to be used to verify compliance with this specification.
- D. Project Record Documents:
1. Submit upon completion of work.
  2. Drawings shall be submitted which record the installed conditions. Show actual locations of all system components and affected equipment.
  3. Submit all electronic files developed for this project including shop drawings, operator's manuals, and test procedures.
  4. Submit the crane certification documentation.



- E. Operating and Maintenance Data:
  - 1. Submit upon completion of work.
  - 2. Include a project information sheet including project name, building(s), and Installer contact information. Include name, address, and phone number of the service representative to be called in the event of equipment failure. Include a Statement of Guarantee including date of termination.
  - 3. Include As-Built schematics and wiring diagrams, Bill of Material, spare parts lists, replacement parts guides, lubricant and adjustment manuals, preventative maintenance guides, VFD programming, Radio Control local representatives names and phone numbers.
  - 4. Include operation and maintenance documentation for all equipment and devices, including the bridge, trolley, hoist, power and control circuit conductors, safety and control mechanisms, and all other parts and services as defined in this specification. Documentation shall include manufacturer's model number, manufacturer's installation instructions, frequency of inspection, recommended cleaning methods and materials, testing methods, and calibration tolerances. In the event such manuals are not obtainable from the manufacturer. Advertising brochures shall not be used in lieu of the required technical manuals.
  - 5. The maintenance and operating manuals shall include key component breakaway pictures for ease of parts ordering, catalog cut pages, part numbers, and sub-assembly details.
  - 6. Include copies of all testing forms completed for this project.
- F. As-Built Drawings:
  - 1. At the completion of the installation and after successful testing, As-Built drawings shall be provided in hardcopy and digital format.
- G. Warranty Period:
  - 1. Submit written reports on each service or inspection to the Owner's Designated Representative during the warranty period.
  - 2. During the warranty period, all copies of the drawings and manuals shall be updated to include all changes which were required to solve problems covered by the warranty.

## 1.7 QUALITY ASSURANCE

- A. Inspections: Comply with Section 01 45 23 - Testing and Inspecting Services.
- B. Workmanship and Supervision: Comply with General Conditions.
- C. Qualifications:
  - 1. Manufacturer shall have a minimum of five years documented product development, testing, and manufacturing experience with the products specified in this Section. Manufacturer shall be represented by a complete sales, installation, and service operation within 60 miles of Project Site.
  - 2. Installer shall have a minimum of five years documented experience applying the work of this Section.
  - 3. Installer shall have a service office which has been established for a minimum of five years and is staffed with factory-authorized service technicians capable of servicing all aspects of the crane.

## 1.8 PROJECT CONDITIONS

- A. Examination of Site: Installer shall examine the site and become familiar with all conditions that may affect the work covered by the specifications. Failure to do so shall not lessen the Installer's responsibility or entitle the Installer to additional compensation for work not included in the bid.

## 1.9 SCHEDULING

- A. Coordinate utility interruptions with the School District.

### **1.10 WARRANTY**

- A. Maintenance services shall be provided by the Installer for 1 year after final system acceptance at no additional cost to the School District. These services shall consist of manufacturer's factory-trained representatives providing emergency repair service with on-site response within 24 hours of call, all test equipment and hardware necessary for maintenance and repair work and installation of any hardware modifications designed to improve system performance or eliminate known problems or deficiencies.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
  - 1. American Crane and Equipment Corporation: [www.americancrane.com](http://www.americancrane.com).
  - 2. Gorbel Inc.: [www.gorbel.com](http://www.gorbel.com).
  - 3. Harrington, a Kito Group Company: [www.harringtonhoists.com](http://www.harringtonhoists.com)
  - 4. ProservCrane Group, Inc.: [www.proservcrane.com](http://www.proservcrane.com).
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

### **2.2 BASIS OF DESIGN**

- A. Model SEQM010SD-10 manufactured by Harrington.

### **2.3 MATERIALS AND SUSTITUTIONS**

- A. Materials and Equipment: Materials and equipment shall be uniform throughout the installation. All materials and equipment shall be new and shall be standard products of manufacturers regularly engaged in the production of such equipment equal to or superior to the material specified, and shall be the manufacturer's latest standard design that complies with the specification requirements.
- B. Substitutions: Comply with Section 01 25 00 "Substitution Procedures". Installation of any approved substituted equipment is the Installer's responsibility, and any changes required to the work included under other sections for installation of substituted products shall be made to the satisfaction of the Architect-Engineer and without change in price. Approval of substituted equipment and/or dimension drawings by the Architect-Engineer does not waive these requirements.

### **2.4 BRIDGE GIRDERS**

- A. Center-to-center dimension of runway rails shall be as indicated on Structural Drawings. Verify in field.
- B. Fabricate bridge girders from A36 steel.
- C. Runway end stops shall be capable of withstanding the impact of a fully loaded trolley or carrier traveling at 50 percent of the full-load speed.

### **2.5 TROLLEYS**

- A. Wheel axles shall be precision machined from high strength steel.
- B. Wheel bearings shall be double row precision ball or taper roller bearings, lubricated and sealed at assembly, and fitted with external grease fittings. Bearings must have minimum B-10 life of 5,000 hours.

### **2.6 CRANE DRIVE**

- A. Crane speed shall be controlled through a variable frequency drive from 2 to 80 feet per minute.

## **2.7 HOIST CARRIER**

- A. Hoist carrier shall be comprised of two end trucks, structural framing, carrier drive, and electrical controls.
- B. Carrier speed shall be controlled through a variable frequency drive from 2 to 40 feet per minute.

## **2.8 HOIST**

- A. Hoist and appurtenances shall be designed to withstand all stresses imposed under safe operating conditions while handling loads within the rated capacity. Load-bearing parts shall be designed such that the static stress, calculated for rated load, shall not exceed 20 percent of the ultimate strength of the material.
- B. All bearings shall be heavy duty, anti-friction type with a minimum B10 life of 5,000 hours. Motor bearings shall be lifetime lubricated, sealed ball bearings.
- C. All gearing shall be forged, heat-treated alloy steel machined for smooth, quiet operation. All gearing shall meet AGMA quality specifications. No cast gears shall be permitted.
- D. Bottom block shall be completely shrouded for safety and fabricated from steel. Sheaths must be forged or rolled steel, running on anti-friction bearings. Hooks shall be forged steel supported by anti-friction thrust bearings and permit 360 degree rotation. A latch shall be provided to bridge the opening of the hook for the purpose of retaining slings, chains, etc., under slack conditions.
- E. Motors shall be completely enclosed, specifically designed for hoist service, capable of starting and operating under any condition within the designed capacity, and provided with thermal overload protection.
- F. Hoist shall incorporate an upper plugging-type limit switch, automatically stopping the hoist motion when block reaches its highest position. Excessive hook drift shall cause the block to be momentarily reversed.
- G. Electric hoist controls shall comply with N.E.C. requirements for the application and shall include control circuit breakers and contactors mechanically and electrically interlocked.
- H. Hoist speed shall be controlled through a variable frequency drive from 2 to 20 feet per minute.

## **2.9 HEIGHT DIMENSIONS**

- A. Crane shall have a maximum height of 3 feet-6 inches from the top of the trolley to the top of the crane rail. Crane lift height shall ensure ability to lift loads from floor Refer to Structural Drawings for runway rail height above floor. Verify in field.

## **2.10 MOTORS**

- A. All variable speed motors shall be squirrel cage type, totally enclosed. Motor shall be provided with lifetime lubricated anti-friction bearings, unless otherwise specified.

## **2.11 ELECTRICAL SCOPE OF WORK**

- A. Provide all materials, labor, equipment and services necessary to provide a fully functioning and tested crane electrical system, complete with pendant and radio control.
- B. Codes:
  - 1. Electrical equipment shall meet NEMA Classification requirements for crane construction, except where higher grade devices are specified.
  - 2. The design and installation shall conform to the requirements of all applicable State Industrial Safety Regulations, and the National Electric Code NFPA 70.
- C. Submittals:
  - 1. Submit the Bill of Materials, Manufacturer's Brochures and Catalog Cuts, Shop Drawings, Erection Drawings, Wiring Diagrams, Schematics, and an Equipment layout.

2. Submit for approval all electrical controls, micro switches, wiring diagrams, schematics, control panels, identification labels, disconnect switches, wire, limit switches, enclosures, contactors, circuit breakers, pendants and buttons, radio control enclosure, master radio transmitter/receiver, hand held transmitter, radio selector switch, collectors and shoes, motors, electric brakes, variable frequency drives (VFD), factory and field default settings for each VFD, and alarm devices.
  3. Show location and elevation of all electrical controls and panels which shall be placed so that they are available for servicing when the crane is docked at the maintenance platform.
- D. AC Controls:
1. AC controls shall be provided with an under voltage device which will disconnect all motors from the line on failure of power or brownout and will not permit any motor to be restarted until a reset switch or push-button is operated.
  2. All magnetic contactors shall be fully rated for their horsepower load and sized for continuous duty.
  3. All crane components to be designed for a 480V, 3 phase, 3 wire, Delta system. The control voltage shall be 120VAC from a control power transformer with protective circuit breakers.
  4. Color Code for 480 VAC wiring is: AØ = brown, BØ = yellow, CØ = purple, Neutral = slate, insulated equipment ground = green.
  5. Bridge and runway conductors shall be Duct-O-Bar, Insul-8 or equal.
  6. All control wiring shall be 120 VAC, #14 minimum size, MTW or better in conduit or within panels.
  7. All wiring to be color coded and all terminal strips and wires to be identified with markings consistent with the drawings.
  8. All wiring between enclosures shall terminate on field wiring terminal strips at both ends, except where not practical at small field devices. Field terminal strips aren't required for circuit breakers and large power contactors. Splicing of wires to make connections is forbidden and not acceptable.
  9. Limit switches shall be installed at each end of travel on trolley and bridge to prevent trolley or bridge from striking the bumpers. Location of limit switches shall be adjustable. Use Heavy Duty limit switches.
  10. Furnish engraved plastic name plates (to be secured with screws not glue or double back tape) with 1/4 inch engraved lettering on the exterior of all controller enclosures with the appropriate marking i.e. Main Disconnect, Main Line and Bridge Control, Trolley Control, Hoist Control, etc.. Within the enclosure, all components including circuit breakers, contactors, relays, timers, terminal blocks, resistors etc. shall be labeled with 1/8 inch engraved lettering, firmly attached with metal screws to the equipment.
  11. All enclosures shall be NEMA type 12, with removable hinged doors with neoprene gaskets, in full compliance with the National Electric Code for size, and readily accessible with doors openable to 90 degrees.
  12. A 480 VAC lockable crane disconnect switch shall be provided at floor level and shall be the Point of Connection for connection to the power system. Disconnect switch shall be horsepower and heavy-duty rated.
  13. A heavy-duty, horsepower-rated, fused, disconnect switch shall be provided on the crane at the closest entry point to the crane from a maintenance platform that will shut off all power to the crane.
- E. Brakes:
1. Bridge and trolley shall have electrically operated fail-safe magnetic disc-type brakes for operation from a dedicated circuit breaker.
  2. Brakes shall be sized for the full load torque of the motor plus a safety factor. Provide bridge and trolley brake sizing calculations.
- F. Electrical Power:

1. Inverted V-Bar, fully insulated and supported on insulators and brackets, CAL OSHA and UL approved. All conductors shall be individually enclosed with spring loaded collector shoes running on the underside. All wire attachments to the collectors shall be fully insulated, protected from harm, and securely attached.
  2. All electrical wiring shall be in accordance with the latest requirements of the National Electric Code (NFPA 70). All wiring exterior to enclosures shall be in rigid steel conduit with bushings.
  3. Electrical motor connections shall be liquid-tight flexible metal steel conduit with ground wire pulled within and bushings.
  4. All wiring which interfaces with power system shall meet the requirements of Division 26: Electrical.
- G. Electrical Testing:
1. Test Hoist, Trolley, and Bridge VFDs under full load and no load conditions. Verify temperatures within VFD enclosures are within tolerance after full load tests.
  2. Verify operation of all Pendant and Radio controls. Verify that they operate independently of each other and that they do not interfere with each other.
  3. Verify that Pendant and Radio controls both work from the floor level.
  4. Verify operation of all limit switches. Verify operation of Bypass controls for limit switches.
  5. Verify that electrical maintenance of all control enclosures can be performed from the maintenance platform.

### **PART 3 EXECUTION**

#### **3.1 PAINTING**

- A. All material shall be cleaned of loose rust, mill scale and foreign matter.
- B. Crane bridge, hoist, trolleys, runways, and suspension fittings shall be painted one shop coat of primer and two finish coats of manufacturer's standard enamel finish paint.
- C. Equipment must be adequately protected against damage and rust in shipment.

#### **3.2 SYSTEM MARKING**

- A. Major components of the system shall be marked at the factory so as to assure prompt and proper field identification.

#### **3.3 CRANE ASSEMBLY AND TEST**

- A. Cranes shall be factory assembled, and a no-load running test of controls and drive machinery performed to ensure proper operation. Crane shall be disassembled only as necessary for shipment.

#### **3.4 PROTECTION OF EQUIPMENT**

- A. Care shall be exercised during construction to avoid damage or disfigurement of any kind. All equipment shall be protected from dust and moisture prior to and during construction.
- B. Where required or directed, construct temporary protection for equipment and installations so as to protect same from dust and debris caused by construction.
- C. All protection shall be substantially constructed with the use of clean canvas, heavy plastic, visqueen, and plywood as required, and made tight and dust proof as directed.
- D. Repair by spray or brush painting, after properly preparing the surface, all scratches or defects in the finish of the equipment. Only identical paint furnished by the equipment manufacturer shall be used for such purposes.
- E. Failure of the Contractor to protect the equipment as outlined herein shall be grounds for rejection of the equipment and its installation.

#### **3.5 EXAMINATION**

- A. Verify that systems are ready to receive work.

- B. Once construction has commenced, the Contractor shall be fully responsible for all modifications required to meet the requirements of the contract documents.

### **3.6 GENERAL INSTALLATION METHODS**

- A. Coordinate with Structural and Electrical.
- B. Seismic Mounting: Comply with applicable requirements.

### **3.7 CRANE INSTALLATION**

- A. Install the crane in accordance with the contract documents, manufacturer's instructions, and approved shop drawings.
- B. Touch up of any painted surfaces affected by installation of the crane.

### **3.8 TESTING**

- A. Provide all labor and equipment necessary to perform a comprehensive acceptance test of the crane prior to the acceptance testing witnessed by the School District and defined below. Complete the testing forms submitted and approved in the Pre-Commissioning Submittals. Submit to the Architect 3 copies of all test results, certified in writing, witnessed, signed and dated, within 24 hours of completion of work.
- B. Provide all labor and equipment necessary to certify the performance of the crane. Schedule the certification at least two weeks prior to the date of certification testing.
- C. Crane shall be certified in accordance with ASME B30.17 and 29 CFR 1910.179.
  - 1. Safety: Crane certification testing shall be performed in accordance with the accepted Safety Plan for this project.
  - 2. Crane Inspection: Prior to load testing, the following shall be inspected to verify that they are operative and in like-new condition:
    - a. Hoisting motors and brakes.
    - b. Trolley travel and brakes.
    - c. Bridge travel and brakes.
    - d. Hoist limit switch.
    - e. Steel hoisting ropes and hook.
  - 3. Holding Brake Load Test:
    - a. Conduct load tests in location where a falling test load will not cause any damage. Location shall facilitate measurements of crane hook movements.
    - b. If there is only one holding brake, test load shall be 125 percent of the rated capacity of the hoist. If there are two holding brakes, test load shall be 100 percent of the rated capacity of the hoist. Each holding brake shall be test loaded independently.
    - c. The test load shall first be raised three inches off the load support to check the brake. The test load shall then be raised 18 inches (457 mm) off the floor, the hoist stopped, and the load checked for downward drift. Record the downward drift of the test load after one minute of the holding brake being set. This test shall be performed twice for each holding brake.
    - d. Test load shall then be raised 3 feet (1 m) off the floor. Test load shall then be lowered eighteen inches at maximum lowering speed, the holding brake set, and the load checked for downward drift. Record the downward drift of the test load after one minute of the holding brake being set. This test shall be performed twice for each holding brake.
    - e. If the test load drifts downward more than 1/4 inch (6 mm) within one minute of the holding brake being set during any of the tests, the holding brake shall be adjusted. The tests shall be repeated until the downward drift is less than 1/4 inch (6 mm) within one minute of the holding brake being set, during all tests of all holding brakes.
  - 4. Mechanical Load Brake Test:
    - a. Conduct load tests in location where a falling test load will not cause any damage. Location shall facilitate measurements of crane hook movements.

- b. Test load for the mechanical load brake shall be 125 percent of the rated capacity of the hoist. Make the holding brake inoperative.
  - c. The test load shall be raised 3 feet (1 m) off the floor, hoist stopped, and load checked for downward drift. Record downward drift of test load after one minute of hoist being stopped. Test shall be performed twice.
  - d. Test load shall then be raised 5 feet (1.5 m) off floor. Test load shall then be lowered two feet at maximum lowering speed, hoist stopped, and load checked for downward drift. Record downward drift of test load after one minute of hoist being stopped. Test shall be performed twice.
  - e. If test load drifts downward more than 12 inches (305 mm) within one minute of the hoist being stopped during any of the tests, mechanical load brake shall be adjusted. Tests shall be repeated until downward drift is less than 12 inches (305 mm) within one minute of hoist being stopped, during all tests of mechanical load brake.
5. Operational Tests:
- a. Test load for these tests shall be 75 percent of the rated capacity of hoist.
  - b. Raise and lower test load. Verify hoisting and lowering speeds of the hoist and verify proper operation of limit switch.
  - c. Raise the test load 3 feet (1 m) off of the floor and move it transversely from side to side of the building. Verify trolley travel speeds and stops on bridge track rails.
  - d. Raise the test load three feet off of the floor and move it longitudinally from end to end of the building. Verify bridge travel speeds and stops on crane track rails.
- D. Crane will not be accepted until all tests described in this section have been performed to the satisfaction of the Architect and the School District. Any tests that cannot be performed due to circumstances beyond the control of the Contractor shall be exempt from the system acceptance requirements if stated as such in writing by the Architect and the School District. Such tests shall be performed as part of the crane warranty.
- E. Any unsatisfactory condition revealed by these test results, or unsatisfactory methods of tests and/or testing apparatus and instruments, shall be corrected by the Contractor to the satisfaction of the Architect and the School District.
- F. The School District reserves the right to require that the Contractor perform and repeat any tests that are deemed necessary to complete or check the tests or the certified records of the Contractor at any time during the course of the work. The Contractor shall correct any unsatisfactory portion of his work that is revealed by the tests or that may be due to progressive deterioration during this period, unless the item in question was a direct specification.

### **3.9 ELECTRICAL TESTING**

- A. Test Hoist, Trolley and Bridge VFDs under full load and no load conditions. Verify that temperature within VFD enclosures are still within tolerance after full load tests.
- B. Verify operation of all Pendant and Radio controls. Verify that they operate independently of each other and that they do not interfere with each other.
- C. Verify that Pendant and Radio controls both work from the pit area floor.
- D. Verify operation of all limit switches. Verify operation of Bypass controls for limit switches.
- E. Verify that electrical maintenance of all control enclosures can be performed from the maintenance platform.

### **3.10 CLEANING**

- A. Clean equipment as recommended by manufacturer.

### **3.11 DRAWINGS**

- A. Comply with Division 01.
- B. Provide all labor and equipment necessary to perform a comprehensive acceptance inspection of all as-built documentation. The inspection shall be performed under the supervision of the University. The Subcontractor shall contact the School District to schedule the inspection at

least one week prior to the date requested.

### **3.12 NOISE AND VIBRATION**

- A. Noise levels shall not exceed ASHRAE recommended noise criteria (NC) for a shop.
- B. If noise problems are a result of improper material or installation, or exceeds limits defined in this Section, these conditions shall be corrected at no cost to the School District.

### **3.13 TRAINING**

- A. Provide 8 hours of training developed specifically for this project. Training shall be provided where and when agreed upon by all parties. Manuals covering the training subject matter shall be submitted at least two weeks prior to each training session. Instructor conducting the training sessions shall be fully proficient in the subject matter. The School District reserves the right to cancel any training while in session, without loss of training time owed, if it feels that the instructor is not qualified in technical knowledge or ability to teach the subject matter. The training shall be in two sessions as follows:
  - 1. Session 1 - Four hours of training shall be provided prior to proof-of-performance testing. Training shall focus on overall system design, equipment functions, operation, and Pre-Commissioning Submittal documentation.
  - 2. Session 2 - Four hours of training shall be provided following acceptance of crane system. Training shall focus on Project Record Documents and Operating and Maintenance Data.

**END OF SECTION 41 22 13.13**



## **SECTION 41 22 13.19 - JIB CRANES**

### **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. Freestanding, mast-mounted jib cranes with a 360 degree rotating boom.
- B. Related Sections
  - 1. Section 03 30 00 - Cast-in-Place Concrete.
  - 2. Section 05 12 00 - Structural Steel Framing.
  - 3. Section 05 50 00 - Metal Fabrications: Miscellaneous steel.

#### **1.3 REFERENCES STANDARDS**

- A. American Institute of Steel Construction (AISC)
  - 1. Manual of Steel Construction, Part 5, Specification for Structural Joints using ASTM A 325 or ASTM A 490 Bolts
- B. American National Standards Institute (ANSI)
  - 1. ANSI B30.11 – Monorails and Underhung Cranes
- C. American Society for Testing and Materials (ASTM)
  - 1. ASTM A 36: Carbon Structural Steel
  - 2. ASTM A 325: Structural Bolts, Steel, Heat-Treated, 120/150 ksi Minimum Tensile Strength
  - 3. ASTM A 490: Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
  - 4. ASTM B 221: Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube
- D. American Welding Society (AWS) D1.1
  - 1. Structural Welding Code
  - 2. Certified Shop
- E. Occupational Safety and Health Administration (OSHA)
  - 1. 179: Overhead and Gantry Cranes
- F. National Electric Code (NEC)
- G. Society for Protective Coatings (SSPC)

#### **1.4 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: A company with more than 10 years of experience successfully designing and manufacturing cranes and material handling solutions.
- B. Cranes shall be designed, fabricated, and installed in accordance with ANSI B30.11, MH27.2, OSHA 1910.179, and applicable building codes and regulations.
- C. Applications where cranes will be used in potentially hazardous environments or explosive environments require special consideration. These conditions must be disclosed to the crane manufacturer.
- D. Applications where cranes will be used in essential facilities for groups such as emergency services, military, and communications or those located within 15 kilometers of known seismic sources require special consideration. These conditions must be disclosed to the crane manufacturer.
- E. If crane design must conform to standards other than building code and ANSI, crane modifications may be required and must be coordinated with crane manufacturer.

- F. Installer Qualifications: A company that is acceptable to the crane manufacturer and with at least five years of experience assembling and installing cranes for multiple applications. Installer must be able to:
1. Perform welding using certified operators in accordance with AWS D1.1.
  2. Bolt connections in accordance with torque tightening procedures specified in AISC Manual, Part 5.
  3. Clearly label crane with rated load capacity with label visible from floor level and loading position
  4. Perform OSHA Load Test Certification

### **1.5 SUBMITTALS**

- A. A complete list of all items proposed to be furnished and installed under this Section.
- B. Manufacturer's specifications, catalog cuts, and other data to demonstrate compliance with the specified requirements.
- C. Shop drawings indicating crane configuration and dimensions.
- D. Manufacturer's recommended installation procedures which, when approved by the Architect, shall be the basis for inspecting and accepting or rejecting actual installation procedures used on the Work.
- E. The Contractor shall be responsible for coordinating all Work of this section.
- F. Manufacturer's warranty.
- G. Manufacturer's Operation and Maintenance Manual.

### **1.6 PRE-INSTALLATION CONFERENCE**

- A. Refer to Section 01 31 13 "Project Coordination".

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

- A. Store products indoors and protect from moisture, construction traffic, and damage.
1. Store products in manufacturer's packaging until ready for installation.
  2. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer
- B. Store solvent-based materials in accordance with applicable regulations.

### **1.8 WARRANTY**

- A. Included warranty on manufacturer's standard form and outlining the manufacturer's agreement to repair or replace assemblies and components that fail in materials and/or execution within warranty period from date of substantial completion.
1. Warranty shall cover ten (10) years or twenty thousand (20,000) hours for manual push-pull Crane products to cover defects in materials and execution.
  2. Warranty shall cover two (2) years or 4 thousand (4,000) hours for motorized tractor products.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
1. Harrington, a Kito Group Company: [www.harringtonhoists.com](http://www.harringtonhoists.com).
  2. Spanco: [www.spanco.com](http://www.spanco.com).

### **2.2 BASIS OF DESIGN**

- A. Model 351-400-10-10 manufactured by Harrington.

## 2.3 PERFORMANCE REQUIREMENTS

- A. Crane shall be designed, fabricated, and installed in accordance with ANSI B 30.11 and OSHA 1910.179
- B. Crane shall be designed for Class C Normal / Industrial service as defined:
  - 1. System or equipment is used where operational time is up to 100 percent of the work period and lifted load is at 50 percent or below rated capacity.
  - 2. System or equipment is used where operational time is less than 50 percent of the work period and lifted load is greater than 50 percent of rated capacity.
  - 3. Applications involving vacuums, magnets, and other high impact lifters are considered severe usage and require special design considerations.
- C. Coverage: Crane shall provide coverage of circular area of 10 foot radius.
- D. Clearance: 10 feet under beam.
- E. Capacity: 4000 lbs..

## 2.4 SYSTEM COMPONENTS

- A. Materials: ASTM A36 steel with finished ends and surfaces
- B. Crane:
  - 1. Freestanding, base plate mounted jib crane
  - 2. Rotating boom with 360-degree rotation and will not drift when at rest
  - 3. Mast:
    - a. Stationary steel pipe perpendicular to boom
    - b. Mast top plate and pivot pin to receive head assembly
  - 4. Head Assembly:
    - a. Construction: Standard plate, angles, and channels to ensure minimum deflection and maximum rigidity.
    - b. Plate: Reinforced using angles to limit compression and buckling stresses
    - c. Lower Trunnion Roller Assembly: Mounted on a channel, which transfers the load to the top of the box.
    - d. Designed to inhibit dislodgement due to upward and forward motion while allowing bottom entry electrification inside the head.
    - e. Utilize a Timken tapered roller bearing provided with grease fitting for proper lubrication.
    - f. Welded steel plate and channel fabrication fitted over mast, bolted to boom, and designed to transfer boom load to mast and rotate.
    - g. Bearings shall be designed for 5000-hour, B-10 design lift.
    - h. Allow for installation of head prior to boom attachment and provide maximum hoist lift.
      - 1) Top pivot bearing assembly: Designed to connect head assembly to mast and transfer load from boom. Weight bearing channel connects the sides of the head assembly and contains tapered roller bearings that allow for easy rotation.
      - 2) Retaining clip: Inserted through mast pivot pin above weight bearing channel to prevent accidentally dislodging head assembly.
      - 3) Trunnion roller assembly: Designed to rotate around mast and transmit moment force from boom to mast. Includes trunnion rollers with tapered bearings held in steel channel with bolts. A mast that is less than 18 inches in diameter will have two rollers, and larger masts will have four rollers. Assembly rotates around mast with full roller face contact. Roller surface is sufficiently large to prevent cutting into mast. Cranes with small rollers or cams requiring wear band on mast are not acceptable.
  - 5. Compressed Air Swivels
    - a. Bottom Entry Compressed Air Swivel:
      - 1) Air swivel installed in weight bearing channel of head assembly to convey compressed air supply inside mast through mast pivot pin to air powered hoist

- on boom.
- 2) Swivel to allow continuous 360-degree crane rotation.
- b. Top Entry Compressed Air Swivel:
  - 1) Air swivel installed on top flange of boom to convey compressed air from overhead source to air powered hoist on beam.
  - 2) Swivel to be fitted with pivot arm connected to source hose and allow continuous 360-degree rotation.
- 6. Electrical Power Collector:
  - a. Bottom Entry Collector: Electrical collector installed in weight bearing channel of head assembly to conduct electrical power from inside mast through mast pivot pin to motor operator on head assembly and electrically operated hoist on boom allowing for 360-degree rotation.
  - b. Top Entry Collector: Electrical collector installed on top flange of boom to conduct electrical power from overhead electrical source to motor operator on head assembly and electrically operated hoist on boom. Collector to be fitted with pivot arm connected to source conduit and allow continuous 360-degree rotation.
- 7. Tagline Festoon System:
  - a. Attached to boom for supporting electrical cable or compressed air hose supplying trolley hoist; either S-hooks or wire rope trolleys may be used
  - b. Include system of wire rope tagline, S-hooks or wire rope trolleys, brackets and eyebolts for attachment to boom to support electrical cable and air hose supplying trolley hoist moving along boom.
- 8. Boom:
  - a. Horizontal, standard I-beam bolted to head assembly and designed for hoist trolley travelling on bottom flange.
  - b. Reinforce with cap channel as required for lateral stability.
  - c. Equip booms with stops to limit movement of trolley.
- 9. Rotation Means:
  - a. Boom rotation.
  - b. Rotation Stops: Limit boom rotation with steel plate stops welded to crane
- C. Foundation: Mount to permanent concrete foundation using the mounting method below:
  - 1. Base Plate Mount: Hexagonal base plate reinforced with six knee braces equally spaced on the mast.
  - 2. Foundation Mount: Square steel plate welded to bottom of column.
  - 3. Sleeve Insert Mount: Square steel plate welded to bottom of mast.
  - 4. Other method.
- D. Crane shall be designed for minimum effort manual rotation
- E. Crane shall be designed to manually move load with maximum force to load weight ratio of 1/100.
- F. Maximum deflection shall be L/150.
- G. Operating temperature range shall be 5 to 200 degrees F (-15 to 93 degrees C).
- H. The Crane's structural design shall be based upon the following:
  - 1. Hoist and Trolley: Live load capacity plus 15 percent.
  - 2. Impact: Live load capacity plus 25 percent.
  - 3. Inertia forces from crane and load movement.
  - 4. Live load capacity equal to net rated hook load.

## 2.5 SHOP FINISHING

- A. Standard Paint Colors:
  - 1. All runways and structural supports are to be shop painted in a standard color selected by the Architect from the manufacturer's line of standard colors.
  - 2. All bridges are to be painted safety yellow.

- B. Surface Preparation and Painting Procedures:
  - 1. Follow the standards of the Society for Protective Coatings (SSPC) for all product surface preparation.
  - 2. Deburr, descale, and wash components prior to painting.
  - 3. Coat all components with a semi-gloss enamel to a minimum dry-film thickness of three mils.

### **PART 3 EXECUTION**

#### **3.1 INSPECTION**

- A. Examine the areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to the proper and timely completion of the work. Do not proceed until satisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. General: Install the Work of this Section in strict accordance with the approved shop drawings, the original design, and all pertinent regulations and codes, anchoring all components firmly into position for long life under hard use.
- B. Install products in accordance with manufacturer's instructions.
- C. Do not install products under environmental conditions outside of manufacturer's absolute limits.

#### **3.3 TESTING**

- A. Upon completion of the installation, and as a condition of its acceptance, provide all necessary equipment and personnel and perform all tests required. Secure all required approvals from agencies having jurisdiction.

#### **3.4 ADJUSTING AND CLEANING**

- A. Fit, align, and adjust crane level and plumb
- B. Verify that crane operates smoothly and in accordance with manufacturer's specifications
- C. Provide any required lubrication and other preparation as required prior to use.
- D. Clean any excess lubricants and dirt from unit.

#### **3.5 DEMONSTRATION**

- A. Instruct the Owner's personnel in proper operation and maintenance of units.

**END OF SECTION 41 22 13.19**