PROJECT MANUAL

FOR

Beaver Acres Elementary School Improvements

Beaverton School District
16550 SW Merlo Road
Beaverton, Oregon 97003

Design Development
November 1, 2019

IBI GROUP

SET NO. _____

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FOR:

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Beaverton School District
16550 SW Merlo Road
Beaverton, Oregon 97003

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November 1, 2019

PROCUREMENT AND CONTRACTING REQUIREMENTS

DIVISION 00 -- PROCUREMENT AND CONTRACTING REQUIREMENTS

(Not Included This Printing)

SPECIFICATIONS

DIVISION 01 -- GENERAL REQUIREMENTS (Not Included This Printing)

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SELECTIVE STRUCTURE DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Building demolition excluding removal of hazardous materials and toxic substances.

B. Selective demolition of built site elements.

C. Selective demolition of building elements for alterations purposes.

D. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED REQUIREMENTS

A. Document 00 31 00 - Available Project Information: Existing building survey conducted by Owner; information about known hazardous materials.

B. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises and requirements related to abatement of hazardous materials.

C. Section 01 10 00 - Summary: Sequencing and staging requirements.

D. Section 01 10 00 - Summary: Description of items to be removed by Owner.

E. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

F. Section 01 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.

G. Section 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

H. Section 07 01 50.19 - Preparation for Re-Roofing: Removal of existing roofing, roof insulation, flashing, trim, and accessories.

1.03 REFERENCE STANDARDS

A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards.

B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Site Plan: Showing:
   1. Areas for temporary construction and field offices.
   2. Crane pick plan as applicable.

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.

1.05 PREINSTALLATION CONFERENCE

A. Pre-installation Meeting: Convene a pre-installation meeting one week before starting work of this section; schedule attendance with Architect, Owner, District Maintenance staff, Contractor, Subcontractors for demolition, mechanical, plumbing and electrical. Conference shall be held in conjunction with conferences specified in Section 07 01 50.19 - Preparation for Re-Roofing and Section 07 53 00 - Elastomeric Membrane Roofing.

   1. This is a required meeting prior to the commencement of any demolition.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 SCOPE

A. Remove portions of existing buildings as indicated on Drawings.
   1. Remove existing roof assembly including insulation at locations indicated on Drawings. Remove no more existing roofing than can be covered in one day by new roofing and so that building interior remains watertight.
      a. Comply with Section 07 01 50.19 - Preparation for Re-Roofing for requirements for existing roof tear-off.
      b. Comply with Section 07 53 00 - Elastomeric Membrane Roofing for installation of fully adhered EPDM re-cover roof assembly.
   2. Disconnect, lift and temporarily relocate curbed roof top units as required to accommodate new roof level insulation including but not limited to roof top HVAC units, skylights, vents and fans.
      a. Disconnect existing ductwork and reconnect ductwork to equipment after installation on new curb.
         1) Provide extensions to existing ductwork as required for connection to reinstalled equipment.
         2) Cap all ducts and piping that may temporarily be left unconnected.
         3) New ductwork to match existing in material and metal gage.
         4) Seal all joints.
      b. Disconnect and reconnect all electrical systems related to relocated mechanical units.
      c. Reinstall mechanical units on reconstructed curbs. Anchor equipment with size and spacing of anchors to match existing or as recommended by equipment manufacturer, whichever is more stringent. Provide seismic restraint on all equipment in accordance with code requirements.
      d. Employ services of qualified MEP subcontractors to disconnect and subsequently reconnect units.
      e. Verify proper operation of units in presence of Owner and Architect.
      f. Comply with requirements specified in Divisions 22, 23, 26 and 28.

B. Remove other items indicated, for salvage and relocation.
   1. Inventory and record the condition of items to be removed and reinstalled/salvaged.
   2. Removed and Reinstalled/Salvaged Items:
      a. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
      b. Pack or crate items after cleaning and repairing. Identify contents of containers.
      c. Protect items from damage during transport and storage.
         1) Storage areas will be provided on-site.
      d. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

C. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. 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.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Do not begin removal until built elements to be salvaged or relocated have been removed.

D. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.

E. 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.

F. 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.

G. If hazardous materials are discovered during removal operations, stop work, restrict/isolate work area, and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

H. Hazardous Materials: Employ subcontractors and others knowledgeable about asbestos abatement procedures and required safety procedures. Subcontractors on the jobsite shall take precautions when working to avoid contact with asbestos-containing components and, should any material suspected of containing asbestos be discovered, work shall be discontinued and the appropriate safety procedures shall be immediately initiated. Immediately notify the Owner and the abatement consultant for assistance. Additional cost for abatement of asbestos discovered during the course of construction work shall be brought to the attention of the Owner and fully agreed upon prior to commencing additional abatement work.
1. Refer to Document 00 31 00 - Available Project Information for Asbestos Survey and Abatement requirements.

I. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.

J. Perform demolition in a manner that maximizes salvage and recycling of materials.
1. Comply with requirements of Section 01 74 19 - Construction Waste Management and Disposal.
2. Dismantle existing construction and separate materials.
3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

3.03 EXISTING UTILITIES

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
1. Coordinate a utility coordinate 48 hour prior to beginning any utility construction for location mark-up of all existing utilities. Coordinate the utility local with municipality

having jurisdiction for all utility work within a public right-of-way. Inform Architect if locate indicates that existing utilities are different than shown on Drawings.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.04 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.

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 specified.
   2. Remove items indicated on drawings.

D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): 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. Verify that abandoned services serve only abandoned facilities before removal.
   4. 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.

3.05 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

SECTION 03 01 31
STRENGTHENING OF EXISTING CONCRETE

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Section includes design, supply and installation of bonded fiber reinforced polymer (FRP) system to strengthen existing masonry as shown in the drawings and supported by calculations.

B. The complete installation shall conform to all details and specifications related to the FRP design, for provision of the highest standard of installation.

C. Furnishing of materials, labor, equipment and all items necessary for repair of existing concrete members and strengthening by the application of externally bonded FRP reinforcement as specified in the contract drawings and specifications.

1.02 REFERENCES

A. American Concrete Institute (ACI)

1. ACI 440.2R-08: Guide for the Design and Construction of Externally Bonded FRP System for Strengthening Concrete Structures

B. ASTM International

1. ASTM D3039: Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials
2. ASTM D4541: Standard Test Method for Pull-off Strength of Coating Using Portable Adhesion Testers
3. ASTM D7522: Standard Test Method for Pull-Off Strength for FRP Bonded to Concrete Substrate
4. ASTM D7565: Standard Test Method for Determining Tensile Properties of Fiber Reinforced Polymer Matrix Composites Used for Strengthening of Civil Structures.
5. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials

C. International Concrete Repair Institute (ICRI)

1. ICRI Technical Guideline No. 310.2R-2013: Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair

D. International Code Council (ICC), Formerly International Conference of Building Officials (ICBO)

1. AC 125: Acceptance criteria for concrete strengthening using fiber reinforced composite systems.
2. AC 178: Acceptance criteria for inspection and verification of concrete strengthening using fiber reinforced polymer (FRP) composite systems.

E. 2012 IBC, and Oregon Structural Specialty Code (OSSC), 2019.

1.03 SUBMITTALS

A. Section 01 33 00 – Submittal procedures

B. Drawings and Calculations

1. Structural calculations and shop drawings stamped and signed by a licensed Professional Engineer in the State of Oregon shall be submitted for approval by the Engineer of Record. Design shall follow criteria in Section 2.1.A.2 of this specification and the requirements set forth in ACI 440.2R.
2. Working drawings shall detail the type, locations, dimensions, numbers of layers, and orientation of all FRP materials and coatings to be used.

C. Product Data:

1. Manufacturer's product data sheets indicating physical, mechanical, and chemical characteristics of all materials used in the FRP system. Mechanical properties shall be reported as minimum acceptable or guaranteed values in accordance with Section 2.1.A.2.
2. Manufacturer's installation instructions, maintenance instructions, and general recommendations regarding each individual material.
3. Samples of all FRP Systems to be used, each properly labeled.
4. Manufacturer's Material Safety Data Sheets (MSDS) for all materials to be used.
5. A current ICC-ES Evaluation Report in compliance with IBC 2012 and ICC AC 125.

D. Information as requested under Sections 1.4 and 1.5 of this specification.

1.04 QUALITY ASSURANCE

A. Provide the names of the applicator's key personnel (superintendent and assistant) who will perform the actual work. The superintendent and assistant shall have a minimum three years' experience with FRP System installation. The Engineer of Record shall be notified of any new or changes in key personnel. New key personnel or key personnel changes shall also have a minimum of three years' experience with FRP System installation.

B. Prepare and submit a detailed schedule describing the work to be accomplished for the FRP System installation.

1.05 QUALIFICATIONS

A. Manufacturer / Supplier Qualifications:

1. The Manufacturer / Supplier must specialize in the manufacturing of the products specified in this Section. The Manufacturer / Supplier shall submit a list of completed surface bonded FRP composite strengthening projects completed with the manufacturer's FRP system in the past 5 years. The list should include at a minimum 20 projects with proposed FRP system, the dates of work, description and amount of work performed.
2. The Manufacturer / Supplier must support and instruct applicators in the installation of the products specified in this Section.
3. Manufacturer / Supplier must hold a current ICC-ES Evaluation Report in the name of the manufacturer.

B. Applicator Qualifications:

1. Applicator must be approved by the FRP manufacturer and have been trained by the manufacturer in the installation of the products specified in this section.
2. Applicator must have documented experience on at least 5 projects of a similar nature, using similar materials within the last 5 years.

C. Testing Laboratory Qualifications:

1. Testing Laboratory must be able to perform the required ASTM D7565 and/or D3039 tests.

1.06 DELIVERY, STORAGE, AND HANDLING

A. The products shall be delivered and stored in original, factory-sealed containers. Containers must be clearly marked with legible and intact labels listing the Manufacturer's name, brand name, product identification, batch number and shelf life.

B. Store materials in an area protected from dust, soil, moisture, and chemical and UV exposure at a temperature between 40° and 100°F. Refer to manufacturer's requirements for further information.

C. Fiber reinforcement must not be handled roughly. Fiber, once removed from the original roll, must be stored either in rolls with a radius greater than 8 in or by dry stacking flat

PART 2 PRODUCTS

2.01 MATERIALS

A. FRP Composite Systems.

1. A single manufacturer/supplier shall supply all constituent materials of the FRP composite system, including the fiber reinforcement and all polymers, where specified. FRP composite systems consisting of fiber reinforcement and polymers provided by more than one manufacturer/supplier are not allowed. Manufacturer shall have a current ICC-ES Evaluation Report per Section 1.3.C.5.
2. The FRP composite system Manufacturer/Supplier shall supply the tensile properties of the composite material as determined by testing in accordance with ASTM D7565 or ASTM D3039. The design tensile properties of the composite system shall be based on a minimum of 20 tests and shall meet or exceed those tabulated below. In addition, the design level values shall also meet or exceed minimum project-specific values specified in the drawings or specifications.

Minimum Property	Laminate-Based Design Level Properties
Unidirectional Carbon FRP	
Ply Thickness	0.023 in - 0.050 in
Ultimate Tensile Strength	100,000 psi
Elastic Modulus	9,400 ksi
Ultimate Rupture Strain	0.85%
Unidirectional Glass FRP	
Ply Thickness	0.040in
Ultimate Tensile Strength	65,000 psi
Elastic Modulus	3,000 ksi
Ultimate Rupture Strain	1.4%

3. The FRP composite system shall be able to provide a minimum fire performance and smoke development classification in accordance with the 2014 OSSC for wall and ceiling in finishes and as tested in accordance with ASTM E84. A separate coating (certified as compatible with the FRP system by the manufacturer) shall be provided if the FRP system alone cannot achieve the rating. The ASTM E84 test shall include, at a minimum, the maximum number of FRP layers for the given project along with the appropriate coating. The test report, from an accredited testing agency, shall be provided upon request.
   a. At interior locations: Class B.
   b. At exterior locations: Class [X].
4. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.
5. Protection: FRP System must be capable of remaining exposed to sunlight and weather for a duration as required for construction, otherwise a protective coating is required.

B. Protective coatings and/or weather barrier: Protective coatings and/or weather barrier other than those provided by the material Manufacturer/Supplier may be used provided such coatings have been approved by the material manufacturer for use with the FRP system.

1. Where the FRP System requires protecting from sunlight and weather during construction, a protective coating is required.
2. Coordinate with Section 072500 Weather Barriers.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine existing conditions to assess quality of concrete substrate, identify potential obstructions, and verify dimensions/geometry shown on drawings.

3.02 PREPARATION

A. Environmental Conditions
   1. Do not install FRP when the ambient temperature is below 40 °F or above 100 °F or as specified on the epoxy component labels, unless the manufacturer proposes an installation process which is acceptable to the Engineer of Record. In cold conditions, auxiliary heat may be applied to raise the ambient temperature to a suitable level. Utilize clean heat sources for this purpose (in compliance with the manufacturer's requirements) that do not contaminate the substrate or adversely affect the FRP system.
   2. The presence of moisture inhibits the adhesion of the epoxies to the substrate. Do not install FRP when surface moisture is present on the substrate or when rainfall or condensation is anticipated in the work areas.
   3. If water leakage exists through cracks or concrete joints, water flow must be stopped prior to FRP installation.

B. Surface Preparation
   1. Contact-Critical Applications
      a. The surface to receive the composite shall be free from fins, sharp edges and protrusions that will cause voids behind the installed casing or that will damage the fibers. Remove all damaged concrete, spalls and irregular surfaces to create a flat, or slightly convex, surface. Unsound areas of the concrete substrate (such as broken pieces, delaminated areas, etc.) must be removed to reveal sound material. Well-adhered paint and concrete do not require removal. Existing uneven surfaces to receive composite shall be filled with the system epoxy filler or other material approved by the Engineer of Record to eliminate air surface voids greater than 0.5".
      b. Cracks in the concrete substrate greater than 0.02" wide must be injected with epoxy unless otherwise approved by the Engineer of Record. Reference Division 03 Section "Maintenance of Cast-in-Place Concrete".
      c. Round off sharp and chamfered corners (to be wrapped around) to a minimum radius of 0.75" by means of grinding or forming with the system's thickened epoxy. Variations in the radius along the edge shall not exceed 0.5" for each 12" of length.
   2. Bond-Critical Applications
      a. Surfaces shall be prepared for bonding by means of abrasive blasting or grinding to remove existing laitance and expose aggregate to a minimum concrete surface profile (CSP) 3 in accordance with ICRI 310.2R. All surfaces shall then be cleaned by hand or compressed air. Prior to the application of the saturated composite fabric, prime surfaces and fill any uneven surfaces with the manufacturer's thickened epoxy. Provide anchorage as detailed on construction drawings, if required.
      b. Cracks in the concrete substrate greater than 0.02" wide must be injected with epoxy unless otherwise approved by the Engineer of Record. Reference Division 03 Section "Maintenance of Cast-in-Place Concrete".
      c. Round off sharp and chamfered corners (to be wrapped around) to a minimum radius of 0.75" by means of grinding or forming with the system's thickened epoxy. Variations in the radius along the edge shall not exceed 0.5" for each 12" of length.

3. If corrosion of the existing steel reinforcement exists, the steel and concrete must be repaired before installation of the FRP. Any deteriorated concrete or corroding reinforcing steel must be repaired per ICRI Guideline 03730. Do not cover corroding reinforcing steel with FRP.

3.03 INSTALLATION

A. Surface preparation, priming of the substrate and installation of the FRP system shall be performed in conformance with the approved manufacturer's installation instructions and per Section 3.2 of this specification.

B. Components that have exceeded their shelf life shall not be used. Additionally, any batch that exceeds its pot life shall not be used.

C. All cutting of fabrics, mixing of epoxy and combination thereof shall take place in a protected area away from critical structure functions and any electrical equipment.

D. FRP anchors, when used, shall be according to the working/shop drawings. Anchors shall be installed per the manufacturer's installation instructions.

E. Seal all seams and edges of FRP with the system epoxy.

F. Clean up and protect area adjacent to element where FRP system is being applied.

G. Coordinate FRP system with structural fasteners per structural drawings.

H. Application of protective coatings and/or weather barrier

1. Protective coatings and/or weather barrier, where required, may be applied as a final, outermost layer to the externally bonded FRP reinforcement.
2. Protective coatings and/or weather barrier shall not be applied before the final resin coat has become tack free unless approved by the Manufacturer/Supplier.
3. The surface to which the protective coatings and/or weather barrier are to be applied must be cleaned of any dust or debris. The surface must also be free of any moisture, oils, or other substances that would prohibit bond of the coating.

3.04 QUALITY CONTROL, QUALITY ASSURANCE AND TESTING

A. Quality Control

1. The contractor shall adhere to all the manufacturer's installation instructions. Record batch numbers for fabric and epoxy used every day and note locations where the material was installed. Measure square footage of fabric and volume of epoxy used each day.
2. A field supervisor, provided by the contractor and trained by the manufacturer shall observe all aspects of onsite preparation and material application including surface preparation, resin component mixing, application of primer, application of resin and fiber sheet, curing of composite, and the application of protective coatings.
3. Newly installed FRP materials shall be visually inspected to insure complete saturation, full contact between layers and to substrate, proper fiber orientation (no more than 5 degrees from that specified on the design drawings), and lack of wrinkles, bubbles, and voids.
4. After allowing at least 24 hours for initial resin cure to occur, perform a visual and acoustic tap test inspection of the layered surface for voids and delaminations.

B. Quality Assurance

1. Special inspection shall be in accordance with the requirements of the ICC-ES Evaluation Report for the FRP System and this specification, whichever is more stringent.
2. Special inspection shall include, at a minimum, the following:
   a. Date and time of installation
   b. Ambient temperature, relative humidity, and general weather observations
   c. Surface temperature and dryness of concrete

d. Surface preparation methods and resulting profile using the ICRI surface profile chips
e. Qualitative description of surface cleanliness
f. Type of auxiliary heat source, if applicable
g. Widths of cracks not injected with epoxy
h. Fiber batch number and approximate location in structure
i. Batch numbers, mixture ratios, mixing times, and qualitative descriptions of the appearance of all mixed resins, including primers, putties, saturants, adhesives, and coatings mixed for the day
j. Observations of progress of cure of resins
k. Conformance with installation procedures
l. Pull-off test results: bond strength, failure mode and location
m. FRP properties from tests of field test panels: ultimate tensile strength, elastic modulus and ultimate rupture strain
n. Location and size of any delaminations or air voids

C. Field Bond Testing
1. Test Conditions
a. The FRP system shall be allowed to cure as per the manufacturer's requirements before execution of the direct tension pull-off test
b. The locations of the pull-off test shall be representative and on flat surfaces. Pull-off tests shall be performed on a representative adjacent area to the area being strengthened whenever possible. If no adjacent areas exist, pull-off tests shall be conducted on areas of the FRP system subjected to relatively low design stress.
2. Test Frequency
a. Perform a minimum of one pull-off test per 1000 ft^2 of surface area to be covered by the FRP system.
b. Pull-off tests must be performed on each area of fiber sheet installed on a single day.
c. Pull-off tests must be performed on each type of concrete substrate or for each surface preparation technique used if variations in such conditions exist.
3. Test Acceptance Criteria
a. The failure mode for each pull-off test must be cohesive failure within the substrate and must not be the epoxy-to-substrate bond.
b. The minimum acceptable tensile bond strength for any pull-off test is 175 psi or as specified within project drawings or specifications. The average of the tests for any single day shall not be less than 200 psi.
4. Repair the tested areas in accordance with Section 3.5 of this specification.

D. Laboratory Tension Testing
1. Test Panels
a. Test panels shall be fabricated on site using the same methods used to apply the FRP system. Test panels shall be prepared on a smooth, flat, level surface covered with polyethylene sheeting or 16 mil plastic film, primed with epoxy resin.
b. Test panels shall be fabricated as a minimum 12" x 12" laminate of two stacked layers of identical fiber orientation.
c. Test panels shall be allowed to cure on-site for a minimum of 72 hours before delivery to the test agency pre-approved in accordance with Section 1.5.C of this specification.

d. Test panels shall be labeled. The date, lot number of fabric and epoxy resin used, and location of installation shall be recorded for each test panel.

2. Test Frequency

a. Two test panels shall be fabricated for each workday. Each test panel shall be taken at appropriate times during the day so as to ensure the maximum material deviance in the components of the FRP composite.

b. A minimum of 15% of test panels or 10 coupons, whichever is larger, shall be tested at random. Where testing is specified to be performed for a given test panel, the panel shall but cut in to a minimum of five coupons. Testing shall be performed at a testing laboratory pre-approved in accordance with Section 1.5.C of this specification.

3. Test Acceptance Criteria

a. Tensile properties must meet or exceed the minimum required FRP system properties as defined in Section 2.1.A.2 or the design properties, whichever is more stringent. If one coupon does not achieve the design properties, the additional four coupons from the same test panel shall be tested. If these five coupons fail on average, all five coupons from the other test panel from the same batch for that day shall be tested. If the properties of the additional five coupons combined with the original five fail on average, the tests will be considered as having failed and testing frequency shall be increased to 25% of test panels until a lower testing frequency is approved by the Engineer of Record.

b. Where testing fails to meet the minimum required FRP system properties, calculations may be performed using the tested values to demonstrate that acceptable capacity as per the original design demands and concept is achieved. Otherwise, remedial measures shall be taken in accordance with Section 3.5 of this specification.

3.05 REPAIR OF DAMAGED OR DEFECTIVE AREA

A. Voids and delaminations less than 2 in^2 do not require repair as long as they do not constitute more than 5% of the laminate area and there are no more than 10 such voids and delaminations per 10 ft^2.

B. Voids and delaminations greater than or equal to 2 in^2 and less than 25 in^2 shall be injected or back filled with epoxy.

C. Voids and delaminations greater than or equal to 25 in^2 shall be reported to the Engineer of Record. Remediation shall be submitted by the contractor for approval by the Engineer of Record.

D. In the event that the FRP does not meet the test acceptance criteria per Section 3.4.E.3 of this specification, remedial measures shall be approved by the Engineer of Record.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete formwork.

B. Floors and slabs on grade and foundations.

C. Concrete foundation walls and exposed to view architectural concrete.

D. Concrete reinforcement.

E. Joint devices associated with concrete work.

F. Concrete curing.

1.02 RELATED REQUIREMENTS

A. Section 03 10 00 - Concrete Forming and Accessories: Forms and accessories for formwork.

B. Section 03 20 00 - Concrete Reinforcing.

C. Section 07 92 00 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.

1.03 REFERENCE STANDARDS

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.

B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.

C. ACI 301 - Specifications for Structural Concrete.

D. ACI 302.1R - Guide for Concrete Floor and Slab Construction.

E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

F. ACI 305R - Guide to Hot Weather Concreting.

G. ACI 306R - Cold Weather Concreting.

H. ACI 308R - Guide to Curing Concrete.

I. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.

J. ACI 347R - Guide to Formwork for Concrete.

K. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

L. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.

M. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

N. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.

O. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic Cement Concrete.

P. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

Q. ASTM C157/C157M - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.

R. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete.

S. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

T. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

U. ASTM C33/C33M - Standard Specification for Concrete Aggregates.

V. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

W. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.

X. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens).

Y. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete.

Z. ASTM C150/C150M - Standard Specification for Portland Cement.

AA. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.

AB. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete.

AC. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

AD. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.

AE. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

AF. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

AG. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.

AH. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

AI. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.

AJ. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

AK. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

AL. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers.

AM. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

AN. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

AO. OSSC - Oregon Structural Specialty Code, Section 1811, Radon Control Methods Public Buildings.

AP. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
   1. Provide design mixtures for each concrete mixture containing fly ash as a replacement for Portland cement or other Portland cement replacements and for equivalent concrete mixtures that do not contain Portland cement replacements.

C. Mix Design: Submit proposed concrete mix design.
   1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.

2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.
3. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
4. Indicate amounts of mixing water to be withheld for later addition at Project site.

D. Test Reports: Submit report for each test or series of tests specified.

E. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.

F. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.

G. Minutes of pre-installation conference.

H. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

I. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.

B. Follow recommendations of ACI 305R when concreting during hot weather.

C. Follow recommendations of ACI 306R when concreting during cold weather.

1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Warrant floor covering installed over SC-1 against failure due to moisture vapor migration or moisture-borne contaminates for a period of 15 years from date of original installation.
1. Warranty shall cover all labor and materials needed to replace floor covering that fails due to moisture vapor emission and moisture borne contaminates.

PART 2 PRODUCTS

2.01 FORMWORK

A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 117.

B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
2. Earth Cuts: Do not use earth cuts as forms for vertical surfaces. Natural rock formations that maintain a stable vertical edge may be used as side forms.
3. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
4. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

2.02 REINFORCEMENT MATERIALS

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
1. Type: Deformed billet-steel bars.
2. Finish: Unfinished, unless otherwise indicated.
3. Finish: Galvanized in accordance with ASTM A767/A767M, Class I, unless otherwise indicated.

B. Steel Welded Wire Reinforcement (WWR): Plain type, ASTM A1064/A1064M.
1. Form: Coiled Rolls.
2. WWR Style: As indicated on drawings.

C. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
   1. Acquire cement for entire project from same source.

B. Fine and Coarse Aggregates: ASTM C33/C33M.
   1. Acquire aggregates for entire project from same source.

C. Fly Ash: ASTM C618, Class C or F.

D. Calcined Pozzolan: ASTM C618, Class N.

E. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.

F. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.04 ADMIXTURES

A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

B. Air Entrainment Admixture: ASTM C260/C260M.

C. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.

D. High Range Water Reducing Admixture: ASTM C494/C494M Type F.

E. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.

F. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.

G. Accelerating Admixture: ASTM C494/C494M Type C.

H. Retarding Admixture: ASTM C494/C494M Type B.

I. Water Reducing Admixture: ASTM C494/C494M Type A.
   1. Shall not increase concrete shrinkage or promote water-bleeding.

2.05 ACCESSORY MATERIALS

A. Under Slab Vapor Retarder: Sheet material complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.
   1. Installation: Comply with ASTM E1643.
   2. Perm Rating: 0.1 maximum.
   3. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
   4. Manufacturers:
      a. ISI Building Products; Viper VaporCheck II 15-mil (Class A): www.isibp.com/#sle.
      b. Raven Industries; VaporBlock 15: www.vaporblock.com.
      c. Stego Industries, LLC; Stego Wrap Vapor Barrier 15-mil (Class A): www.stegoindustries.com.
      d. W. R. Meadows, Inc; PERMINATOR Class A - 15 mils: www.wrmeadows.com/#sle.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Grout: Comply with ASTM C1107/C1107M.
   2. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.

3. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.

C. Coatings, General: Provide products with VOC limits as established in SCAQMD 1113, Architectural Coatings.
1. Floor Coatings: 50 g/L maximum.
2. Sealers: 100 g/L maximum.
3. Concrete Curing Compounds: 100 g/L maximum.
4. Waterproofing Sealers: 100 g/L maximum.

D. Sealer SC-1: ASTM C1315, Type 1, Class A, ASTM C309, Type 1 Class A, penetrating product with no less than 34 percent solids content, leaving no sheen, VOC content rating as required to suit regulatory requirements with a 5 year documented history in controlling moisture vapor emission from damaging floor coverings.
1. Products:
a. Creteseal; SC2000: www.creteseal.com.
b. Curranseal PMC3300: www.curranseal.com.

2.06 BONDING AND JOINTING PRODUCTS

A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II.

B. Epoxy Bonding System:
1. Complying with ASTM C881/C881M and of Type required for specific application.
2. Manufacturers:
a. Adhesives Technology Corporation; Crackbond LR-321 G, or Miracle Bond 1450: www.atcepoxy.com/#sle.
b. Euclid Chemical Company; DURAL FAST SET LV: www.euclidchemical.com/#sle.
c. Substitutions: See Section 01 60 00 - Product Requirements.

C. Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.
1. Size: As indicated on drawings.

D. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
1. Material: ASTM D1751, cellulose fiber.

2.07 CURING MATERIALS

A. Moisture-Retaining Sheet: ASTM C171. Provide one of the following:
1. Curing paper, regular or white.
2. Polyethylene film, clear or white, minimum nominal thickness of 0.0040 in.
3. White-burlap-polyethylene sheet, weighing not less than 3.8 ounces per square yard.

B. Water: Potable, not detrimental to concrete.

2.08 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
1. Replace as much Portland cement as possible with fly ash, ground granulated blast furnace slag, silica fume, or rice hull ash as is consistent with ACI recommendations.

B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.

D. Normal Weight Concrete: Refer to Structural Drawings.
1. Refer to Structural Drawings for water-cement ratio and maximum aggregate size.

2.09 MIXING

A. Transit Mixers: Comply with ASTM C94/C94M.

B. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.

B. Verify that forms are clean and free of rust before applying release agent.

C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

D. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
   1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
   2. Use latex bonding agent only for non-load-bearing applications.

E. 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 unless noted otherwise on structural drawings.

F. Install vapor retarder under interior slabs on grade according to ASTM E1643 and manufacturer's written instructions. Lap joints minimum 12 inches and seal watertight by taping edges and ends with manufacturer's recommended tape. Use vapor retarder sheet to boot around all penetrations and seal with tape to create a continuous vapor retarder. Do not penetrate vapor retarder with screed pins, wood stakes or other items.
   1. Comply with requirements of Section 1811 of the OSSC for Radon Control Methods.
   2. Place vapor retarder under the entire soil-contact area of the floor in a manner that minimizes the required number of joints and seams. Take care to prevent damage to the membrane during the construction process.
   3. Where the slab edge is cast against a foundation wall or grade beam, install the membrane to seal to the foundation element.
   4. Fit membrane to all penetrations to within 1/2 inch of the penetration and seal with tape or mastic.
   5. Repair all damaged portions of the membrane with tape or with a patch made from the same or compatible material as the membrane, cut so as to provide a minimum 12-inch lap from any opening and taped continuously about its perimeter.
   6. Arrange for inspection of the installed membrane by the governing agency prior to placement of concrete.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

B. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.

C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Place concrete for floor slabs in accordance with ACI 302.1R.

C. Notify Architect not less than 24 hours prior to commencement of placement operations.

D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

E. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

F. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer. Where approved, record the amount of water added on site and provide with the special inspection reports.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

G. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

H. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   2. Maintain reinforcement in position on chairs during concrete placement.
   3. Screed slab surfaces with a straightedge and strike off to correct elevations.
   4. Slope surfaces uniformly to drains where required.
   5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

I. Cold-Weather Placement: Comply with ACI 306R and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When average high and low temperature is expected to fall below 40 degrees F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
   2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

J. Hot-Weather Placement: Comply with ACI 305R and as follows:
   1. Maintain concrete temperature below 90 degrees F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

K. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.05 SLAB JOINTING

A. Locate joints as indicated on drawings.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.

D. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.06 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. An independent testing agency, as specified in Section 01 40 00, will inspect finished slabs for compliance with specified tolerances.

B. Maximum Variation of Surface Flatness at Upper Levels:
1. Exposed Concrete Floors: 1/4 inch in 10 feet.

C. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:
1. Exposed to View and Foot Traffic: F(F) of 20; F(L) of 15, on-grade only.
2. Under Carpeting and Entry Mats: F(F) of 25; F(L) of 20, on-grade only.
3. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25, on-grade only.

D. Correct defects by grinding if affected area is concealed from view. If not concealed, removal and replacement of the defective work is required. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.07 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
2. Troweled smooth finish to top of Demo Table.

D. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
1. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 302.1R; thin floor coverings include thin set ceramic tile, resilient flooring, fluid applied flooring, carpeting, and entry mat.
2. Exterior Steps and Ramps: "Broom Finish." Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
3. Other Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.

3.08 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.09 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than seven days.
   2. High early strength concrete: Not less than four days.

C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.

D. Surfaces Not in Contact with Forms:
   1. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
      a. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 4 days.
      b. Spraying: Spray water over floor slab areas and maintain wet.
      c. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
   2. Final Curing: Begin after initial curing but before surface is dry.
      a. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.

E. Sealer Application: Comply with manufacturer's recommendations.
   1. Sealer SC-1: Apply sealer the day of the concrete pour just after final finishing and soff cutting. Apply with a low-pressure industrial sprayer at 200 square feet per gallon. After the concrete sealer is applied, broom evenly across the concrete slab until completely absorbed into the concrete surface.
      a. Locations of Use: All areas scheduled or indicated to receive resilient flooring, carpeting, and entry mats and at floors exposed to view.
      b. Verify with resilient flooring manufacturers that sealer is compatible with flooring and adhesive materials prior to application.

3.10 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
   2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.11 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.

E. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

F. Inspections:
1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.

5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.
8. Placement of vapor retarder - inspection by governing agency.

G. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:
   1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
      a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 degrees F and below and when 80 degrees F and above, and one test for each composite sample
   5. Compression Test Specimens: ASTM C31/C31M. Cast and laboratory cure five standard cylinder specimens for each composite sample.
   6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at 7 days and three specimens at 28 days, with the last specimen being held and broke as needed.
      a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
   7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
   8. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests. All testing needs to be verified and signed off by the structural engineer.
   9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
   10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders or by other methods as directed by Architect.
   11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
   12. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

H. Measure floor and slab flatness and levelness according to ASTM E1155 within 48 hours of finishing.

3.12 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.13 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

B. For concrete floors indicated to remain exposed to view, protect to prevent damage, including staining, gouges and scratching by construction traffic and activities.
   1. Inspect tires for debris prior to use on slab. Remove embedded items which may cause damage to the floor slab.
   2. Clean up spills on slab immediately.

C. Develop a concrete protection procedure which addresses the following:
   1. Communication of protection plan to subcontractors and vendors.
   2. Procedures for cleaning spills, including use of and availability of cleaning chemicals and absorptive materials at site.

END OF SECTION

SECTION 04 20 00
UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete block.

B. Mortar.

C. Reinforcement and anchorage.

D. Flashings.

E. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 05 50 00 - Metal Fabrications: Loose steel lintels.

B. Section 07 19 00 - Water Repellents: Water repellents and graffiti resistant coatings applied to unpainted exterior masonry.

C. Section 07 21 00 - Thermal Insulation: Insulation for cavity spaces.

D. Section 07 25 00 - Weather Barriers: Water-resistive barriers or air barriers applied to the exterior face of the backing sheathing or masonry.

E. Section 07 62 00 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.

F. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

G. Section 09 00 01 - Finish Legend: Masonry colors.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

B. ASTM A580/A580M - Standard Specification for Stainless Steel Wire.

C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

D. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

F. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

G. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement.

H. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

I. ASTM C27 - Standard Classification of Fireclay and High-Alumina Refractory Brick.

J. ASTM C34 - Standard Specification for Structural Clay Load-Bearing Wall Tile.

K. ASTM C73 - Standard Specification for Calcium Silicate Brick (Sand-Lime Brick).

L. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.

M. ASTM C91/C91M - Standard Specification for Masonry Cement.

N. ASTM C126 - Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.

O. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units.

P. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units.

Q. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.

R. ASTM C150/C150M - Standard Specification for Portland Cement.

S. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.

T. ASTM C270 - Standard Specification for Mortar for Unit Masonry.

U. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.

V. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.

W. ASTM C1072 - Standard Test Method for Measurement of Masonry Flexural Bond Strength.

X. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.

Y. ASTM C1634 - Standard Specification for Concrete Facing Brick.

Z. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry.

AA. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

AB. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.

AC. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials.

AD. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry.

AE. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing.

AF. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls.

AG. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls.

AH. BIA Technical Notes No. 46 - Maintenance of Brick Masonry.

AI. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.

C. Shop Drawings: Provide shop drawings for reinforcing steel showing bar sizes, bends and dimensions.

D. Samples: Submit four samples of decorative block and face brick 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. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.

1.05 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

B. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in Oregon.

C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum five years of documented experience.

D. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.06 PREINSTALLATION CONFERENCE

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.
   1. Meeting shall include review of integrated exterior mock-up to confirm installation procedures.
   2. Establish requirements for patching and repairing any penetrations or damage to water-resistive barrier caused by Work of this Section and material required for use for such repairs.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Regional Materials: Provide CMUs that have been manufactured within 500 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. CMUs: ASTM C 90.
   1. Basis-of-Design Manufacturer: Mutual Materials Company.
      a. Other Manufacturers: Other manufacturers will be considered only if they submit a substitution request during the bid phase with samples indicating acceptable match to colors specified and full compliance with specified requirements.
   2. Manufacturers:
      a. Basalite Concrete Products, LLC.
      b. Cement Products Manufacturing Co.
      c. Mutual Materials Company.
      d. Willamette Graystone, Inc.

C. Concrete Block: Comply with referenced standards and as follows:
   1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
   2. Special Shapes: Provide non-standard blocks configured for corners, lintels, control joint edges, and other detailed conditions.
   3. Non-Loadbearing Units: ASTM C129.
      a. Hollow block.
      b. Medium weight.
      c. Manufacturers:
         1) _____.
         2) Substitutions: See Section 01 60 00 - Product Requirements.
   4. Units with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.
      a. Performance of Units with Integral Water Repellent:
         1) Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
            (a) No water visible on back of wall above flashing at the end of 24 hours.
            (b) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
            (c) No more than 25 percent of wall area above flashing visibly damp at end of test.
         2) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
         3) Compressive Strength: ASTM C1314; maximum 5 percent decrease.
         4) Drying Shrinkage: ASTM C426; maximum 5% increase in shrinkage.
      b. Use only in combination with mortar that also has integral water repellent admixture.
      c. Use water repellent admixtures for masonry units and mortar by a single manufacturer.

d. Locations of Use: Exterior unpainted units indicated to receive water repellents and graffiti-resistant coatings.
e. Products:
1) ACM Chemistries; RainBloc Water Repellent Masonry Unit Admixture.
2) BASF Aktiengesellschaft; Rheopel Plus.
3) GCP Applied Technologies; Dry-Block Block Admixture.
4) Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MORTAR MATERIALS

A. Regional Materials: Provide aggregate for mortar and grout, cement, and lime that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Masonry Cement: ASTM C91/C91M, Type N.

C. Portland Cement: ASTM C150/C150M, Type I.
1. Not more than 0.60 percent alkali.

D. Hydrated Lime: ASTM C207, Type S.

E. Mortar Aggregate: ASTM C144.

F. Grout Aggregate: ASTM C404.

G. Water: Clean and potable.

H. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
1. Use only in combination with masonry units manufactured with integral water repellent admixture.
2. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
3. Meet or exceed performance specified for water repellent admixture used in masonry units.
4. Available Products:
a. ACM Chemistries; RainBloc for Mortar Admixture.
b. BASH Aktiengesellschaft; Rheopel Plus Mortar Admixture.
c. GCP Applied Technologies; Dry-Brick Mortar Admixture.
d. Substitutions: See Section 01 60 00 - Product Requirements.
5. Locations of Use: CMU with water repellent admixture and exposed exterior brick.

I. Packaged Dry Material for Mortar for Unit Masonry: Premixed masonry cement and mason's sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
1. Type: Type N.
2. Color: Standard gray.
3. Water-repellent mortar for use with water-repellent masonry units.
4. Manufacturers:
a. The QUIKRETE Companies; QUIKRETE® Mason Mix: www.quikrete.com/#sle.
b. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 REINFORCEMENT AND ANCHORAGE

A. Manufacturers:
1. Blok-Lok Limited: www.blok-lok.com/#sle.
2. CTP, Inc: www.ctpanchors.com.
3. Heckmann Building Products: www.heckmannanchors.com.
4. Hohmann & Barnard, Inc: www.h-b.com.
5. WIRE-BONDwww.wirebond.com/#sle.
6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; galvanized.

C. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

D. 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 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 thick.
   3. Vertical adjustment: Not less than 2 inches.
   4. Seismic Feature: Provide lip, hook, or clip on end of wire ties to engage or enclose not less than one continuous horizontal joint reinforcement wire of 9 gage diameter.
   5. Products:
      a. CTP, Inc: CTP-16 with WT: www.ctpanchors.com.
      b. Heckmann Building Products; Pos-I-Tie: www.heckmannanchors.com.
      c. Hohmann & Barnard, Inc; HB-213-2X S.I.S. with Seismiclip: www.h-b.com.
      d. WIRE-BOND; #2401 RJ-711 with Welded Seismic Clip: www.wirebond.com.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 FLASHINGS

A. Metal Flashing Materials: Stainless Steel, as specified in Section 07 62 00.

B. Membrane Asphaltic Flashing Materials:
   1. Rubberized Asphalt Flashing: Self-adhering polymer modified asphalt sheet; 40 mils (0.040 inch) minimum total thickness; 8 mil cross-laminated polyethylene bonded to adhesive rubberized asphalt, with a removable release liner.
      a. Manufacturers:
         1) Advanced Building Products, Inc; Strip-N-Flash: www.advancedbuildingproducts.com/#sle.
         2) Heckmann Building Products, Inc: www.heckmannbuildingprods.com/#sle
         3) WIRE-BOND: www.wirebond.com/#sle.
         4) York Manufacturing, Inc; York Seal: www.yorkmfg.com/#sle.
         5) Substitutions: See Section 01 60 00 - Product Requirements.

C. Factory-Fabricated Flashing Corners and End Dams: Stainless steel.
   1. Manufacturers:
      a. Hohmann & Barnard, Inc: www.h-b.com/#sle.
      b. Mortar Net Solutions; CompleteFlash: www.mortarnet.com/#sle.
      c. York Manufacturing, Inc: www.yorkmfg.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

D. Stainless Steel Flashing: ASTM A666, Type 304, soft temper; 26 gage, 0.0187 inch thick; finish 2B to 2D.
   1. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual."
   2. 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.
   3. Provide formed watertight non-sealant dependent end dams at all end terminations.
   4. Solder lap joints watertight. Provide expansion joints at panel ends as required.

E. Flashing Sealant/Adhesives: Silicone, polyurethane, or silyl-terminated polyether/polyurethane or other type required or recommended by flashing manufacturer; type capable of adhering to type of flashing used.
   1. Manufacturers, Modified Polyether Products:
      a. Mortar Net Solutions: www.mortarnet.com/#sle.
      b. York Manufacturing, Inc; UniverSeal US-100 Liquid Tape: www.yorkmfg.com/#sle.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

F. Termination Bars: Stainless steel; compatible with membrane and adhesives.
   1. Manufacturers:
      a. York Manufacturing, Inc; Termination Bar: www.yorkmfg.com/#sle.
      b. Mortar Net Solutions; Termination Bars: www.mortarnet.com/#sle.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

G. Drip Edge: Stainless steel; angled drip with hemmed edge; compatible with membrane and adhesives.
   1. Manufacturers:
      a. Mortar Net Solutions; Metal Drip Edges: www.mortarnet.com/#sle.
      b. Substitutions: See Section 01 60 00 - Product Requirements.

H. Lap Sealants and Tapes: As recommended by flashing manufacturer; compatible with membrane and adhesives.

2.05 ACCESSORIES

A. Preformed Control Joints: Rubber material designed to fit sash block and to maintain lateral stability in masonry wall. Provide size and configuration as applicable to masonry width and conditions, fused joints.
   1. Manufacturers:
      a. Hohmann & Barnard, Inc; #RS Series Rubber Control Joint: www.h-b.com.
      b. WIRE-BOND; Series 2900 Rubber Control Joint: www.wirebond.com.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; in maximum lengths available.
   1. Manufacturers:
      a. Hohmann & Barnard, Inc: www.h-b.com/#sle.
      b. WIRE-BOND: www.wirebond.com/#sle.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

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. Full-Height Airspace Maintenance and Drainage Material: Mesh panels, fitted between masonry ties.
      a. Manufacturers:
         1) Advanced Building Products, Inc; Mortairvent-CW: www.advancedbuildingproducts.com/#sle.
   2. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
      a. Manufacturers:
         1) Advanced Building Products, Inc; Mortar Break DT: www.advancedbuildingproducts.com/#sle.
         2) Advanced Building Products Inc; Mortar Break or Mortar Break II, as applicable: www.advancedflashing.com/sle.
         3) Hohmann & Barnard, Inc; Mortar Trap: www.h-b.com.
         4) Mortar Net Solutions; Mortar Net with Insect Barrier: www.mortarnet.com.
         5) WIRE-BOND; Cavity New DT: www.wirebond.com.
         6) Substitutions: See Section 01 60 00 - Product Requirements.

D. Weeps: Cellular plastic. One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, 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 to match mortar color.

E. Drainage Fabric: Polyester or polypropylene mesh bonded to a water and vapor-permeable fabric.
   1. Manufacturers:
      a. Advanced Building Products, Inc; Mortairvent: www.advancedbuildingproducts.com/#sle.

b. Mortar Net Solutions; DriPlane: www.mortarnet.com/#sle.
c. York Manufacturing, Inc; Weep Armor Weep Vent Protection: www.yorkmfg.com/#sle.
d. Substitutions: See Section 01 60 00 - Product Requirements.

F. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.
1. Cleaners for Red and Light-Colored Brick Not Subject to Metallic Staining with Mortar Not Subject to Bleaching:
a. 202 New Masonry Detergent; Diedrich Technologies, Inc.
b. Masonry Cleaner Type L; Fabrikem Manufacturing Ltd.
c. NMD 80; EaCo Chem Inc.
d. Sure Klean 600 New Masonry Cleaner; ProSoCo, Inc.
2. Cleaners for Red and Dark-Colored Brick Not Subject to Metallic Staining:
a. 200 Lime Solv; Diedrich Technologies, Inc.
b. Masonry Cleaner Type R; Fabrikem Manufacturing Ltd.
c. NMD 80; EaCo Chem Inc.
d. Sure Klean 101 Lime Solvent; ProSoCo, Inc.
3. Cleaners for Brick Subject to Metallic Staining:
a. 202V Vana-Stop; Diedrich Technologies, Inc.
b. Masonry Cleaner Type V; Fabrikem Manufacturing Ltd.
c. NMD 80; EaCo Chem Inc.
d. Sure Klean Vana Trol; ProSoCo, Inc.
4. Cleaners for Concrete Masonry Units:
a. 202V Vana-Stop; Diedrich Technologies, Inc.
b. Masonry Cleaner Type L; Fabrikem Manufacturing Ltd.
c. NMD 80; EaCo Chem Inc.
d. Heavy Duty Concrete Cleaner; ProSoCo, Inc.
5. Substitutions: See Section 01 60 00 - Product Requirements.

G. Self-Adhered Membrane (SAM): Self-adhesive sheet flashing, ASTM D1970/D1970M and ASTM E2178.
1. Self-Adhered Membrane: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.036 inch.
a. Verify material selection with Work of Section 07 25 00 - Weather Barriers for compatibility of materials.
b. Available Products:
1) BASF; MasterSeal AWB 970 FIB.
2) GCP Applied Technologies; Perm-A-Barrier Wall Flashing.
3) Henry Company; Blueskin SA.
4) Tremco Inc; ExoAir 110 or ExoAir 110 LT.
5) Substitutions: See Section 01 60 00 - Product Requirements.

H. Self-Adhered Membrane (SAM): Self-adhesive sheet flashing, ASTM D1970/D1970M.
1. Self-Adhered Membrane: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.025 inch.
a. Verify material selection with Work of Section 07 25 00 - Weather Barriers for compatibility of materials.
b. Products:
1) DuPont Company; Tyvek StraightFlash and FlexWrap.
2) GCP Applied Technologies; Perm-A-Barrier Wall Flashing.
3) Henry Company; Blueskin SA.
4) Protecto Wrap Company; Protecto Seal 45 White.
5) Substitutions: See Section 01 60 00 - Product Requirements.

2.06 MORTAR MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Property Specification. Use Type S throughout.
   1. Masonry below grade and in contact with earth: Type S.
   2. Exterior, loadbearing masonry: Type N.
   3. Exterior, non-loadbearing masonry: Type N.
   4. Interior, loadbearing masonry: Type N.
   5. Interior, non-loadbearing masonry: Type O.

B. New Mortar for Old Brick: Proportion by volume only; no more than 20 percent of the total volume of Portland cement and lime combined to be Portland cement.

C. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.

D. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 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.

C. 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.

3.03 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
   2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
   3. After completion of walls, protect top of wall until permanent wall caps are installed.

3.04 COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

B. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.

C. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

3.05 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: Running.
   2. Coursing: One unit and one mortar joint to equal 8 inches.

3. Mortar Joints: Concave.
   a. Provide flush joints at substrates for water-resistive barriers, fluid-applied waterproofing, wall tile, and resilient base.

3.06 PLACING AND BONDING

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.
   1. At walls indicated to receive ground faces concrete masonry units _____, continue the ground faced units behind all wall mounted elements. Do not infill such areas with standard block.

B. Lay hollow masonry units with face shell bedding on double buttered head and bed joints.

C. Double strike head and bed joints.

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.

G. Provide smooth faced concrete masonry units where flashing or other elements overlap or abut split faced units.

H. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

I. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

J. Cut mortar joints flush where wall tile is scheduled, fluid-applied waterproofing, water-resistive membrane is applied, or resilient base is scheduled.

3.07 WEEPS/CAVITY VENTS

A. Install weeps in veneer walls at 24 inches on center horizontally above through-wall flashing, above shelf angles and lintels, at bottom of walls, and at tops of walls.
   1. Use cellular plastic weep vents in open head joints to form weep holes.

3.08 CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

B. 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.

3.09 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

A. Anchor masonry veneers to wall framing, concrete backup, and masonry backup with seismic masonry-veneer anchors to comply with the following requirements:
   1. Embed connector sections and continuous wire in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.
   2. Seal all fastener penetrations through water-resistive barrier using EPDM washers, sealants, SAM or sealant tape placed between water-resistive barrier and veneer ties as required to prevent the passage of air and water in accordance with water-resistive barrier performance requirements.

B. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

C. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place

additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

D. Seismic Reinforcement: Connect veneer anchors with continuous horizontal wire reinforcement before embedding anchors in mortar.

3.10 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.
   1. 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 water-resistive barrier, lapping at least 4 inches.
   2. 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.
   3. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up flashing ends at least 1 inch, minimum, to form watertight pan at non-masonry construction.
   4. Remove or cover protrusions or sharp edges that could puncture flashings.
   5. Seal lapped ends and penetrations of flashing before covering with mortar.

B. Terminate flashing up 8 inches minimum on vertical surface of backing:
   1. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer’s directions.
   2. Terminate vertical leg of flashing into bed joint in masonry or reglet in concrete.
   3. Anchor vertical leg of flashing into backing with a termination bar and sealant.
   4. Apply cap bead of sealant on top edge of self-adhered flashing.

C. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7.

D. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.

E. Extend metal flashings to within 1/2 inch of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.

F. Support flexible flashings across gaps and openings.

G. Extend plastic, laminated, and EPDM flashings to within 1/2 inch of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.

H. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

I. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
   1. Use cellular plastic weep/vents in open head joints to form weep holes.
   2. Space weep holes 24 inches o.c. unless otherwise indicated.

3.11 GROUTED COMPONENTS

A. Reinforce components as indicated on Structural Drawings.

B. Lap splices minimum 48 bar diameters, unless otherwise indicated.

C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

D. Place and consolidate grout fill without displacing reinforcing.

E. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.12 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.

B. Form control joint with a sheet building paper bond breaker fitted to one side of the hollow contour end of the block unit. Fill the resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.

C. Install preformed control joint device designed to fit standard sash block in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

D. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.

E. Space control joints as follows, unless Drawings indicate closer spacing:
   1. Concrete Masonry Units: 3 to 1, length to height. 30 foot maximum.
   2. Concrete Masonry Veneer: 1 to 1, length to height. 20 foot maximum.

3.13 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 from framed openings.

D. Do not build into masonry construction organic materials that are subject to deterioration.

3.14 TOLERANCES

A. Install masonry within the site tolerances found in TMS 402/602.

B. Maximum Variation from Alignment of Columns: 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 Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.

H. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.15 CUTTING AND FITTING

A. Cut and fit for pipes, conduit, and sleeves. 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.

3.16 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.

B. Testing and Inspecting: Owner 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 comply with specified requirements shall be done at Contractor's expense.

C. Inspections: Level 1 special inspections according to the International Building Code. Refer to Structural Drawings for special inspection tables.
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
   2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
   3. Place grout only after inspectors have verified proportions of site-prepared grout.

D. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.

E. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

3.17 CLEANING

A. Remove excess mortar and mortar droppings.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

D. Clean masonry with specified cleaners applied according to manufacturer's written instructions.

3.18 PROTECTION

A. Without damaging completed work, protect exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural steel framing members.

B. Structural steel support members and struts.

C. Steel columns.

D. Steel braces, struts and gusset plates.

E. Other steel framing and accessories.

F. Shop and field welding.

G. Field bolting.

H. Base plates, shear stud connectors and anchor bolts, with nuts and washers.

I. Grouting under base plates.

1.02 RELATED REQUIREMENTS

A. Section 05 50 00 - Metal Fabrications: Steel fabrications affecting structural steel work.

B. Section 09 96 00 - High-Performance Coatings: Primers.

1.03 REFERENCE STANDARDS

A. AISC (MAN) - Steel Construction Manual.

B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges.

C. AISC 360 - Specification for Structural Steel Buildings.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

F. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished.

G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

H. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

I. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.

J. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

K. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

L. ASTM A514/A514M - Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding.

M. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.

N. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric).

O. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.

P. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

Q. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.

R. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

S. 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.

T. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

U. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film.

V. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments.

W. ASTM E165/E165M - Standard Test Method for Liquid Penetrant Examination for General Industry.

X. ASTM E709 - Standard Guide for Magnetic Particle Testing.

Y. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

Z. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.

AA. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

AB. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.

AC. AWS D1.1/D1.1M - Structural Welding Code - Steel.

AD. AWS D1.8/D1.8M - Structural Welding Code - Seismic Supplement.

AE. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections.

AF. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113.

AG. SSPC-PA 1 - Shop, Field, and Maintenance Painting of Steel.

AH. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

AI. SSPC-SP 2 - Hand Tool Cleaning.

AJ. SSPC-SP 3 - Power Tool Cleaning.

AK. SSPC-SP 6 - Commercial Blast Cleaning.

AL. SSPC-SP 11 - Power Tool Cleaning to Bare Metal.

AM. SSPC-SP 13 - Surface Preparation of Concrete; (Reaffirmed 2015).

1.04 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC S303, "Code of Standard Practice for Steel Buildings and Bridges."

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

C. Shop Drawings/Erection Drawings: Show fabrication of structural-steel components.
   1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   2. Include embedment drawings.

3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
5. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
6. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

D. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.

E. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.
1. Structural steel.
2. Bolts, nuts and washers.

F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

G. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.06 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."

B. Structural steel members designated as architecturally-exposed structural steel (AESS) to also comply with Section 05 12 13.

C. Fabricator: Company specializing in performing the work of this section with minimum five years of documented experience.

D. Erector: Company specializing in performing the work of this section with minimum five years of documented experience.

E. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in Oregon.

F. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
2. Certify to WABO Standard No. 27-13 "WABO Welder and Welding Operator Performance Qualification Standard."

1.07 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 PRODUCTS

2.01 MATERIALS

A. See General Structural Notes in Drawings for specification and grade of framing members.

B. Steel Angles, Plates, Channels, S Shapes, M Shapes, and HP Shapes: ASTM A36/A36M.

C. Steel W Shapes and Tees: ASTM A992/A992M.

D. Rolled Steel Structural Shapes: ASTM A992/A992M.

E. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.

F. Hot-Formed Structural Tubing: ASTM A501/A501M, seamless or welded.

G. Steel Plate: ASTM A514/A514M.

H. Steel Sheet: ASTM A1011/A1011M, Designation SS, Grade 30 hot-rolled, or ASTM A1008/A1008M, Designation SS, Grade 30 cold-rolled.

I. Pipe: ASTM A53/A53M, Grade B, Finish black and galvanized, as indicated.

J. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars.

K. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A and galvanized in compliance with ASTM A153/A153M, Class C.

L. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers.

M. Tension Control Bolts: Twist-off type; ASTM F3125/F3125M.

N. Unheaded Anchor Rods: ASTM F1554, Grade 36, plain, with matching ASTM A563 or ASTM A563M nuts and ASTM F436/F436M Type 1 washers.

O. Headed Anchor Rods: ASTM F 1554, Grade 36, plain.

P. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

Q. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
   2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.

R. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A108, Grade 1018.

S. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

T. All paints and coating wet applied on the building interior must meet the applicable limits of SCAQMD 1113.

U. Shop and Touch-Up Primer:
   1. Concealed Interior Steel in Non-Corrosive Environments: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.
   2. Exposed Interior Surfaces: Either Tnemec Series 27 Typoxy WB at 3 to 4 mils DFT or primer specified in Section 09 96 00 - High-Performance Coatings.
   3. Exterior Steel and Steel in Corrosive Environments: Either Tnemec Series 394 PerimePrime at 2.5 to 3.5 mils, or primer specified in Section 09 96 00 - High-Performance Coatings.
      a. Corrosive environments include the following areas:
         1) Swimming pools.

V. Primer and Touch-Up Primer for Galvanized Surfaces: Either Tnemec Series 27 Typoxy WB at 2 to 2.5 mils or primer specified in Section 09 96 00 - High-Performance Coatings, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Shop fabricate to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel according to ASTM A6/A6M and maintain markings until structural steel has been erected.
   4. Mark and match-mark materials for field assembly.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
   2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
   3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

H. Continuously seal joined members by continuous welds. Grind exposed welds smooth.

I. Fabricate connections for bolt, nut, and washer connectors.

2.03 FINISH

A. Shop prime steel surfaces except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches. Hold back is not required for Tnemec Series 394.
   2. Surfaces to be field welded.
   3. Surfaces to be high-strength bolted with slip-critical connections. Hold back is not required for Tnemec Series 394.
   4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing). Hold back is not required for Tnemec Series 394.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
   1. Concealed Interior Steel in Non-Corrosive Environments: SSPC-SP 3, "Power Tool Cleaning."
   2. Exposed Interior Surfaces: SSPC-SP 3," Power Tool Cleaning."
   3. Exterior Steel and Steel in Corrosive Environments: SSPC-SP 6, "Commercial Blast Cleaning."

C. Preparing Galvanized Steel for Shop Priming: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
   1. Clean surfaces of weld seams according to SSPC-SP 11, "Power Tool Cleaning to Bare Metal," unless otherwise recommended by coating manufacturer for substrate and exposure conditions.

D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
   2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

E. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.

F. Galvanize all exterior structural steel members to comply with ASTM A123/A123M. Provide minimum 1.85 oz/sq ft galvanized coating.
   1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
   2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.04 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
   1. Provide testing agency with access to places where structural steel work is being fabricated or produced to perform tests and inspections.
      a. Pay for any additional cost required caused by travel outside a 25 mile radius from the job site.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
   1. Liquid Penetrant Inspection: ASTM E165/E165M.
   2. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
   3. Ultrasonic Inspection: ASTM E164.
   4. Radiographic Inspection: ASTM E94.

E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
   1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

F. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts", testing at least ____ percent of bolts at each connection.

G. Welded Connections: Visually inspect all shop-welded connections and test at least ____ percent of welds using one of the following:
   1. Radiographic testing performed in accordance with ASTM E94/E94M.
   2. Ultrasonic testing performed in accordance with ASTM E164.
   3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
   4. Magnetic particle inspection performed in accordance with ASTM E709.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
   1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 ERECTION

A. Erect structural steel in compliance with AISC 303.

B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Field weld components and shear studs indicated on shop drawings.

D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".

E. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate.
   3. Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

F. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

G. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.
   2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

H. Splice members only where indicated.

I. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

J. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

K. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

L. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

M. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.03 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC (HSBOLT) for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC S303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections. Refer to Structural Drawings for Special Inspection Program.

B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC (HSBOLT)"Specification for Structural Joints Using High-Strength Bolts".

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
   1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
      a. Liquid Penetrant Inspection: ASTM E165/E165M.
      b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
      c. Ultrasonic Inspection: ASTM E164.
      d. Radiographic Inspection: ASTM E94.

D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
   1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

F. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.

G. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts", testing at least ____ percent of bolts at each connection.

H. Welded Connections: Visually inspect all field-welded connections and test at least ____ percent of welds using one of the following:
   1. Radiographic testing performed in accordance with ASTM E94/E94M.
   2. Ultrasonic testing performed in accordance with ASTM E164.
   3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
   4. Magnetic particle inspection performed in accordance with ASTM E709.

3.06 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A780/A780M.
   1. Repair galvanizing prior to installation where repair areas will be inaccessible.
   2. Clean surfaces of weld seams according to ,SSPC-SP 11 "Power Tool Cleaning to Bare Metal."

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION

SECTION 05 40 00
COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formed steel stud interior wall framing, including the following:
   1. Interior non-load-bearing wall framing.
   2. Z-Furring for support of exterior finishes.

1.02 RELATED REQUIREMENTS

A. Section 04 20 01 - Masonry Veneer: Veneer masonry supported by wall stud metal framing.

B. Section 06 10 00 - Rough Carpentry: Wood blocking and miscellaneous framing.

C. Section 06 10 00 - Rough Carpentry: Roof and wall sheathing.

D. Section 07 42 13 - Metal Wall Panels: Coordination of placement of Z-furring behind metal wall panels.

E. Section 07 92 00 - Joint Sealants.

F. Section 09 21 16 - Gypsum Board Assemblies: Lightweight, non-load bearing metal stud framing.

1.03 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute.

B. ANSI A208.1 - American National Standard for Particleboard.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

F. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

G. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

H. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board.

I. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

J. ASTM C955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.

K. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.

L. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

M. ASTM C1396/C1396M - Standard Specification for Gypsum Board.

N. AWS D1.1/D1.1M - Structural Welding Code - Steel.

O. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel.

P. ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers; ICC Evaluation Service, Inc.

Q. PS 1 - Structural Plywood.

R. SFIA - Steel Framing Industry Association.

S. SSMA - Steel Stud Manufacturers Association.

T. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113.

U. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic").

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations.

C. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, type and location of fasteners, and splices, and accessories or items required of related work.
   1. Indicate stud and ceiling joist layout.
   2. Describe method for securing studs to tracks and for bolted framing connections.

D. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention.

E. Designer Qualifications: Design framing system under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in Oregon.

F. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum five years of documented experience.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum 5 years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

C. AISI Specifications and Standards: Comply with AISI S100-12.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Framing Members, General: Comply with ASTM C754 for conditions indicated. All products to be manufactured by current members of the Steel Stud Manufacturers Association (SSMA) or the Steel Framing Industry Association (SFIA).

B. Metal Framing:
   1. CEMCO: www.cemcosteel.com/#sle.
   2. ClarkDietrich Building Systems: www.clarkdietrich.com.
   3. Marino: www.marinoware.com/#sle.
   4. SCAFCO Corporation: www.scafco.com/#sle.
   5. Steel Construction Systems: www.steelconsystems.com/#sle.
   6. SCAFCO Corporation: www.scafco.com.
   7. Steeler, Inc: www.steeler.com.
   8. The Steel Network, Inc: www.SteelNetwork.com/#sle.
   9. Substitutions: See Section 01 60 00 - Product Requirements.

C. Framing Connectors and Accessories:
   1. Same manufacturer as metal framing.
   2. ClarkDietrich: www.clarkdietrich.com/#sle.
   3. Simpson Strong Tie: www.strongtie.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FRAMING SYSTEM

A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

B. Refer to SSMA standard for identification of cold-formed metal section sizes. SFIA members shall provide equivalent sizes while maintaining the same depth, flange and/or leg width.

C. Design Requirements: Provide completed framing system having the following characteristics:
   1. Live load deflection meeting the following, unless otherwise indicated:
      a. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height for siding applications and 1/600 of the wall height for masonry veneer applications.
      b. Design non-axial loadbearing framing to accommodate not less than 1/2 in vertical deflection.
   2. Able to tolerate 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.
   3. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

2.03 FRAMING MATERIALS

A. Studs and Track: ASTM C955; studs formed to channel, "C", or "Sigma" shape with punched web; U-shaped track in matching nominal width and compatible height.
   1. Provide unpunched studs at opening heads, jambs and sills at exterior walls where flashing will occur.
   2. Gage and Depth: As indicated on drawings.
   3. Galvanized in accordance with ASTM A653/A653M, G90/Z275 coating.
   4. Provide components fabricated from ASTM A1008/A1008M, Designation SS (structural steel).

B. Z-Furring and Strapping: Z-furring members of depths indicated on drawings, 0.052 inch, 18 gage, with minimum ASTM A653/A653M G185 coating. For all attachment devices exterior to water-resistive barrier, comply with the following:
   1. Screws: #10 size, coated with Leland Industries DT2000 plating system to achieve at least 2000 hours of corrosion resistance to rust per ASTM B117.
   2. Low-velocity power-driven fasteners, expansion anchors, screw anchors and threaded rods to be Type 316, SAE 316 stainless steel able to achieve at least 1000 hours of corrosion resistance to rust per ASTM B117.
   3. Provide 2-inch wide, 0.052 inch, 18 gage strapping with same coating for attachment of metal wall panels.

C. Framing Connectors: Factory-made, formed steel sheet.
   1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10 gage, 0.1345 inch, and factory punched holes and slots.
   2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
   3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
      a. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
      b. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 10 feet.
      c. Products:
         1) ClarkDietrich; Drift FastClip Slide Clip D-FCSC: www.clarkdietrich.com/#sle.
         2) ClarkDietrich; FastClip Slide Clip FCSC: www.clarkdietrich.com/#sle.
         3) Simpson Strong Tie: www.strongtie.com/#sle.
         4) Substitutions: See Section 01 60 00 - Product Requirements.

d. Acceptable Products: VertiClip(r) or DriftClip(tm) manufactured by The Steel Network Inc. or Fast Top Clips manufactured by ClarkDietrich.

4. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.
5. Wall Stud Bridging Connections: Provide mechanical load-transferring devices that accommodate wind load torsion and weak axis buckling induced by axial compression loads. Provide bridging connections where indicated on the drawings.

2.04 FASTENERS

A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.

B. Anchorage Devices: Powder actuated.

C. Welding: Comply with AWS D1.1/D1.1M.

2.05 WALL SHEATHING

A. Plywood; PS 1, Grade C-D, Exposure I.

B. Particleboard; ANSI A208.1, Grade M-3 EXTERIOR GLUE.

C. Fiberboard; ASTM C208, Type IV, Grade 1 - Regular, square edges.

D. Gypsum Board Wall Sheathing: See Section 09 21 16.

E. Glass mat faced gypsum board; ASTM C1177/C1177M, square long edges, 5/8 inch thick, Type X - Fire Resistant.

2.06 ACCESSORIES

A. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers, knee braces, and girts.
9. Hole reinforcing plates.
10. Backer plates.

B. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.

C. Plates, Gussets, Clips: Formed Sheet Steel, thickness determined for conditions encountered; finish to match framing components.

D. Sill Gasket on Top of Foundation Wall: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.
1. Product: Grace Construction Products; Vycor V40 Self-Adhered Flashing.

E. All paints and coating wet applied on the building interior must meet the applicable limits of SCAQMD 1113.

F. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Verify field measurements and adjust installation as required.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

B. Install sill gasket under stud track of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts. Prime surfaces as required for proper adhesion.
   1. Provide 3-inch minimum, laps between lengths of gasket material.
   2. Firmly roll sill gasket after installation.

C. Install sill gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.03 INSTALLATION OF STUDS

A. Install cold-formed metal framing according to AISI S100-12 and to manufacturer's written instructions unless more stringent requirements are indicated.

B. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.

C. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

E. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

F. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
   1. Install unpunched studs at opening heads, jambs and sills at exterior walls where flashing will occur.

G. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 24 inches on center. Coordinate installation of sealant with floor and ceiling tracks.

H. Place studs at 16 inches on center; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using welding method.

I. Install glass fiber batt insulation inside box headers and similar closed frame members. Coordinate with Work of Section 07 21 00 - Thermal Insulation.

J. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.

K. Install load bearing studs full length in one piece. Splicing of studs is not permitted.

L. Install load bearing studs, brace, and reinforce to develop full strength and achieve design requirements.

M. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

N. Install intermediate studs above and below openings to align with wall stud spacing.

O. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.

P. Attach cross studs to studs for attachment of fixtures anchored to walls.

Q. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

R. Touch-up field welds and damaged galvanized surfaces with primer.

3.04 INTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install deflection tracks and anchor to building structure.
   2. Connect vertical deflection clips to bypassing studs and anchor to building structure.
   3. Connect drift clips to cold formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
   1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
      a. Install solid blocking at centers indicated on Shop Drawings.
   2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.05 INSTALLATION OF WALL SHEATHING

A. Install wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.
   1. Provide steel diagonal bracing at corners with foam insulation or gypsum board wall sheathing.
   2. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.

3.06 INSTALLATION OF Z-FURRING

A. Verify that water-resistive barriers have been fully installed as applicable.
   1. Install a 6-inch by 6-inch diamond shaped patch of self-adhered membrane behind each fastener through water-resistive barrier.

B. Install Z-furring horizontally behind metal wall panels and wood siding as indicated. Coordinate spacing and layout of Z-furring with installers of exterior insulation and cladding.
   1. Install at 16 inches on center, unless otherwise indicated.
   2. Refer to applicable wall types for maximum spacing.
   3. Install strapping as indicated.

3.07 TOLERANCES

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

3.08 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

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

3.09 REPAIRS AND PROTECTION

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

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated and manufactured steel and aluminum, including, but not limited to, the following:
   1. Lintels.

B. Shop fabricated steel and aluminum items.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.

B. Section 04 20 00 - Unit Masonry: Placement of metal fabrications in masonry.

C. Section 07 72 00 - Roof Accessories: Safety posts to be installed on vertical ladders.

D. Section 09 91 23 - Interior Painting: Paint finish and metal primers for use for shop primers.

E. Section 09 96 00 - High-Performance Coatings: Coating finish and metal primers for use for shop primers.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

G. 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.

H. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

I. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

J. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

K. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

L. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

M. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

N. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

O. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.

P. ASTM F1941 - Standard Specification for Electrodeposited Coatings on Threaded Fasteners.

Q. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.

R. AWS D1.1/D1.1M - Structural Welding Code - Steel.

S. AWS D1.2/D1.2M - Structural Welding Code - Aluminum.

T. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113.

U. SSPC-SP 11 - Power Tool Cleaning to Bare Metal.

V. SSPC-SP 2 - Hand Tool Cleaning.

W. SSPC-SP 6 - Commercial Blast Cleaning.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Prepare shop drawings from field measurements where possible.
   2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   3. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

D. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

1.05 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.06 DELIVERY, STORAGE AND PROTECTION

A. Transport, handle, store and protect products with special custom wrapping and handling procedures to protect and touch-up shop primers at every stage of shipping.

1.07 PROJECT CONDITIONS

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

1.08 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.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A500/A500M, Grade B cold-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Slotted Channel Fittings: ASTM A1011/A1011M.

E. Fasteners: Provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade and class required.

F. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, galvanized to ASTM A153/A153M where connecting galvanized components.

G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

H. All paints and coating wet applied on the building interior must meet the applicable limits of SCAQMD 1113.

2.02 MATERIALS - ALUMINUM

A. Sheet Aluminum: ASTM B209 (ASTM B209M), 5052 alloy, H32 or H22 temper or 5005 alloy, H34 temper, as standard with manufacturer.

B. Extruded Structural Pipe and Round Tubing: ASTM B429/B429M, Alloy 6063-T6, standard weight, Schedule 40 pipe, unless otherwise required to meet performance requirements.

C. Bolts, Nuts, and Washers: Stainless steel.

D. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.03 MISCELLANEOUS MATERIALS

A. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

B. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C1107/C1107M, specifically recommended by manufacturer for heavy-duty loading applications.

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

D. Concrete: Comply with requirements in Section 03 30 00 - Cast-in-Place Concrete for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.04 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Use materials of size and thickness indicated or, if not indicated, as required to produce strength and durability in finished product for intended use and, where applicable, to meet performance requirements.

C. Fabricate items with joints tightly fitted and secured.

D. Continuously seal joined members by continuous welds, unless otherwise indicated on Drawings.

E. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

F. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

G. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
   1. Provide anchor bolts for connecting to other work.
      a. Drill and tap steel as required to receive bolted connections.
      b. Make bolt holes 1/16 inch larger than nominal bolt diameter.
   2. Do not furnish bolts with threads within shear plane of the bolt.

H. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.05 MISCELLANEOUS FRAMING AND SUPPORTS

A. Lintels: As detailed; galvanized finish.

1. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.

2.06 PREFABRICATED LADDERS

A. Prefabricated Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
   1. Components: Manufacturer's standard rails, rungs, treads, handrails, returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
   2. Products with Platform:
      a. Alaco Ladder Company; Model 564: www.alacoladder.com.
      b. O'Keeffe's Inc; Model 500: www.okeeffes.com/sle.
      c. Precision Ladders LLC; Fixed Ladder with Parapet Platform and Roof Side Return: www.precisionladders.com.
      d. UPNOVR; Model U203: www.upnovr.com.
      e. Substitutions: See Section 01 60 00 - Product Requirements.
   3. Products with Handrails Over Roof:
      a. Alaco Ladder Company; Model 561: www.alacoladder.com.
      b. O'Keeffe's Inc: Model 502: www.okeeffes.com/sle.
      c. Precision Ladders LLC; Fixed Ladder with Walk-Thru: www.precisionladders.com.
      d. UPNOVR; Model U201G: www.upnovr.com.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

2.07 FINISHES - STEEL

A. Galvanize and prime paint all exterior steel items.

B. Prime paint all steel items.
   1. Exceptions: Galvanize items to be embedded in concrete and items to be embedded in masonry.

C. Prepare surfaces to be primed in accordance with SSPC-SP 2 where indicated to receive manufacturer's standard primer.

D. Prepare surfaces to be primed in accordance with SSPC-SP 6 where indicated to receive high-performance coating finish.

E. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

F. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements.

G. Galvanizing: Galvanize after fabrication to ASTM A123/A123M requirements.

2.08 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

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. 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.

C. Install items plumb and level, accurately fitted, free from distortion or defects.

D. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

E. Field weld components as indicated.

F. Perform field welding in accordance with AWS D1.1/D1.1M.
   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.

G. Obtain approval prior to site cutting or making adjustments not scheduled.

H. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.04 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.

3.05 ADJUSTING AND CLEANING

A. Touchup Painting: 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.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.
   1. Clean surfaces of weld seams according to SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

3.06 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural dimension lumber framing.
B. Exposed timber structural framing.
C. Non-structural dimension lumber framing.
D. Rough opening framing for doors, windows, and roof openings.
E. Sheathing.
F. Underlayment.
G. Roof-mounted curbs.
H. Roofing nailers.
I. Preservative treated wood materials.
J. Fire retardant treated wood materials.
K. Miscellaneous framing and sheathing.
L. Communications and electrical room mounting boards.
M. Concealed wood blocking, nailers, and supports.
N. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

A. Section 07 25 00 - Weather Barriers: Water-resistive barrier over sheathing.
B. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.03 REFERENCE STANDARDS

A. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings.
B. APA PRP-108 - Performance Standards and Qualification Policy for Structural-Use Panels (Form E445).
C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
F. AWPA U1 - Use Category System: User Specification for Treated Wood.
G. PS 1 - Structural Plywood.
H. PS 2 - Performance Standard for Wood-Based Structural-Use Panels.
I. PS 20 - American Softwood Lumber Standard.
J. WCLIB (GR) - Standard Grading Rules for West Coast Lumber No. 17.
K. WWPA G-5 - Western Lumber Grading Rules.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide technical data on wood preservative materials and application instructions.
    1. For composite-wood products, provide documentation indicating that product contains no urea formaldehyde.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Douglas Fir-Larch or Douglas Fir, unless otherwise indicated.
   2. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
   3. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Grading Agency: West Coast Lumber Inspection Bureau; WCLIB (GR).

B. Grading Agency: Western Wood Products Association; WWPA G-5.

C. Sizes: Nominal sizes as indicated on drawings, S4S.

D. Moisture Content: As indicated on structural drawings.

E. Stud Framing (2 by 2 through 2 by 6):
   1. Species: Douglas Fir-Larch or Douglas Fir.
   2. Grade: As indicated on structural drawings.

F. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16):
   1. Species: Douglas Fir-Larch or Douglas Fir.
   2. Grade: As indicated on structural drawings.

G. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: As indicated on structural drawings.
   2. Boards: Standard or No. 3.

2.03 STRUCTURAL COMPOSITE LUMBER

A. Structural Composite Lumber: Factory fabricated beams, headers, and columns, of sizes and types indicated on drawings; structural capacity as published by manufacturer.
   1. Columns: Use laminated veneer lumber, laminated strand lumber, or parallel strand lumber with manufacturer's published E (modulus of elasticity): See structural drawings for psi, minimum.
   2. Beams: Use laminated veneer lumber, laminated strand lumber, or parallel strand lumber with manufacturer's published E (modulus of elasticity): See structural drawings for psi, minimum.
   3. Headers Not Longer Than 48 inches: Use laminated veneer lumber, laminated strand lumber, or parallel strand lumber.
   4. Manufacturers:
      a. Weyerhaeuser Company: www.weyerhaeuser.com/#sle.
      b. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 CONSTRUCTION PANELS

A. Roof Related Plywood Nailers and Fascias: APA PRP-108, Structural I Rated Sheathing, Exterior Exposure Class, and as follows:
   1. Span Rating: 24/0.
   2. Thickness: 3/4 inch, nominal, unless otherwise indicated.

B. Underlayment: APA Underlayment; plywood, Exposure 2, 1/2 inch thick. Fully sanded faces at resilient flooring and tile carpeting installed over existing wood substrates.
   1. Field verify thickness.
   2. Coordinate with Work of Section 09 65 00 - Resilient Flooring and Section 09 68 13 - Tile Carpeting

C. Roof Sheathing: Any PS 2 type, rated Sheathing.
   1. Bond Classification: Exterior.
   2. Span Rating: 48.
   3. Performance Category: See structural drawings for PERF CAT.

D. Wall Sheathing: Plywood, PS 1, Grade C-D, Exposure I.

E. Wall Sheathing for Plywood Cladding at locations indicated in the drawings: Plywood, PS 1, Grade C-D, Plugged or better.
   1. Thickness: 1/2 inch minimum.

F. Gypsum Wall Sheathing: See Section 09 21 16.

G. Communications and Electrical Room Mounting Boards: PS 1 A-B plywood; 3/4 inch thick; frame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

H. Other Applications:
   1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
   2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
   3. Other Locations: PS 1, C-D Plugged or better.

2.05 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel per ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Anchors: Toggle bolt type for anchorage to hollow masonry.

B. Die-Stamped Connectors: Hot dipped galvanized steel, sized to suit framing conditions.
   1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.

C. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.
   1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.

D. Sill Gasket on Top of Foundation Wall: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.
   1. Product: Grace Construction Products; Vycor V40 Self-Adhered Flashing.

2.06 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Preservative Treatment:
   1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
      a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
      b. Treat lumber exposed to weather.
      c. Treat lumber in contact with roofing, flashing, or waterproofing.

d. Treat lumber in contact with masonry or concrete.
e. Treat lumber less than 18 inches above grade.
f. Treat lumber in other locations as indicated.

2. Preservative Pressure Treatment of Plywood Above Grade: AWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative.
   a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
   b. Treat plywood in contact with roofing, flashing, or waterproofing.
   c. Treat plywood in contact with masonry or concrete.
   d. Treat plywood less than 18 inches above grade.
   e. Treat plywood in other locations as indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Where wood framing bears on cementitious foundations, install full width sill flashing continuous over top of foundation, lap ends of flashing minimum of 4 inches and seal.

B. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts. Prime surfaces as required for proper adhesion.
   1. Provide 3-inch minimum, laps between lengths of gasket material.
   2. Firmly roll sill gasket after installation.

C. Coordinate installation of rough carpentry members specified in other sections.

D. Coordinate with Work of other Sections for removal of existing roof. Do not remove more sheathing than can be replaced the same day.
   1. Inspect existing roof sheathing and remove and replace any damaged decking, fascia or other wood as directed by the Owner or its representative. In particular, remove any wood exhibiting dry rot, mold or mildew. Chase damage to extinction.
   2. Provide solid blocking for support of new plywood sections where needed.
   3. Record number and lengths of replaced components.
      a. Prior to starting work, notify Architect of defects requiring correction.
      b. Refer to Section 01 22 00 - Unit Prices.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.

B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

C. Install structural members full length without splices unless otherwise specifically detailed.

D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWI (WFCM) Wood Frame Construction Manual.

E. Install horizontal spanning members with crown edge up and not less than 1-1/2 inches of bearing at each end.

F. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.

G. Provide bridging at joists in excess of 8 feet span as detailed. Fit solid blocking at ends of members.

H. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.04 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.

C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
   1. Provide 1-inch thick AC, fire-resistive plywood 12 inches by stud width for door hardware, toilet accessories, hand towel and soap dispensers.

E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

F. Provide the following specific non-structural framing and blocking:
   1. Cabinets and shelf supports.
   2. Countertop supports.
   3. Wall brackets.
   4. Handrails.
   5. Grab bars.
   6. Toilet and bath accessories.
   7. Wall-mounted door stops.
   8. Marker boards and tackboards.
   9. Joints of rigid wall coverings that occur between studs.

3.05 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. Provide wood curb at all roof openings except where specifically indicated otherwise. Form corners by alternating lapping side members.

C. Provide nailers as required for a complete roofing assembly.

3.06 INSTALLATION OF CONSTRUCTION PANELS

A. Roof Nailers and Fascia Backing: Secure panels with long dimension perpendicular to framing members with ends staggered and over firm bearing.

B. Underlayment: For use where resilient flooring or tile carpeting will be installed over existing wood substrates. Secure to subflooring with nails and glue.
   1. Fill and sand splits, gaps and rough areas.

C. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
   1. Provide a 1/8-inch space between panel edge and end joints to allow for expansion.
   2. Screw panels to framing; staples are not permitted.

D. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
   1. Protect sheathing protect from moisture. Do not cover wet sheathing materials. Remove and replace wet materials.

2. Provide a 1/8-inch space between panel edge and end joints to allow for expansion.

E. Wall Sheathing for Plywood Cladding: Secure with long dimension parallel to wall studs, with ends over firm bearing, using screws.

F. Communications and Electrical Room Mounting Boards: Secure to studs, where applicable, with edges over firm bearing; space fasteners on all edges and in field of board.
1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
2. Mount 4 foot by 8 foot sheets vertically, unless other sizes are indicated.
3. Install adjacent boards without gaps.
4. Mount boards 6 inches from floor; cover all walls within each telecommunications space as shown in Drawings.
5. Mount boards with the smooth A surface facing away from the wall. Paint the backboard prior to mounting.
6. Install boards plumb, level and secured to studs or solid concrete or masonry walls. Use countersunk galvanized or stainless steel fasteners spaced to provide completely smooth surface.
7. Power drive anchors, molly bolts, drywall screws and tappets are not allowed.

3.07 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.08 CLEANING

A. Waste Disposal: Comply with the requirements of Section 01 74 19 - Construction Waste Management and Disposal.
1. Comply with applicable regulations.
2. Do not burn scrap on project site.
3. Do not burn scraps that have been pressure treated.
4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 06 20 00
FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Finish carpentry items including, but not limited to, the following:
   1. Running wood trim, including wall caps, wood base, miscellaneous trim, and window sills.
   2. Plastic laminate wainscots WSCT-1.

1.02 RELATED REQUIREMENTS

A. Section 06 41 00 - Architectural Wood Casework: Shop fabricated plastic laminate custom cabinet work.

B. Section 07 92 00 - Joint Sealants: Sealants used at juncture of different materials.

C. Section 09 00 01 - Finish Legend: Color and finish selections.

1.03 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard.

B. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use.

C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards.

D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0.

E. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.

F. NEMA LD 3 - High-Pressure Decorative Laminates.

G. PS 1 - Structural Plywood.

H. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data:
   1. For installation adhesives, include printed statement of VOC content.
   2. For each composite-wood product used, provide documentation indicating that the bonding agent contains no urea formaldehyde.
   3. For each adhesive used, provide documentation indicating that the adhesive contains no urea formaldehyde.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store materials in interior, ventilated location under constant minimum temperature of 60 degrees F and minimum relative humidity of 55 percent.

B. Protect work from moisture damage.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.

2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

2.03 LUMBER MATERIALS

A. Softwood Lumber: Douglas fir species, plain sawn, maximum moisture content of 6 percent; with vertical grain, of quality suitable for transparent finish.

B. Hardwood Lumber: White maple species, plain sawn, maximum moisture content of 6 percent; with vertical grain of quality suitable for transparent finish.

2.04 SHEET MATERIALS

A. Softwood Plywood, Not Exposed to View: Any face species, veneer core; PS 1 Grade A-B, glue type as recommended for application.

B. Hardwood Plywood: Face species White Maple, plain sawn, book matched, medium density fiberboard core; HPVA HP-1, Front Face Grade AA, Back Face Grade 1, glue type as recommended for application.

C. Particleboard: ANSI A208.1; medium density industrial type as specified in AWI/AWMAC/WI (AWS), composed of wood chips bonded with NAF or ULEF adhesive, under heat and pressure; sanded faces; 1/2-thickness unless otherwise indicated; use for all components not indicated as another material.
   1. Available Products:
      a. Evergreen manufactured by Boise Cascade: www.bc.com.
      b. Vesta manufactured by Flakeboard: www.flakeboard.com.
      c. Skyblend Particleboard manufactured by Roseburg: www.roseburg.com.

D. Medium Density Fiberboard (MDF): ANSI A208.2; type as specified in AWI/AWMAC/WI (AWS); composed of wood fibers pressure bonded with NAF or ULEF adhesive, to suit application; sanded faces; thickness as required.
   1. Moisture Resistant Medium Density Fiberboard Panels made with NAF Resin:
      a. Basis of Design: Medex by Roseburg Forest Products Company.
         1) Standards Compliance:
            (a) ANSI A208.2 - Grade 155; MR50.
            (b) ASTM D1037-06a: Passed the 6-Cycle Accelerated Aging Test.
      b. Medium Density Fiberboard (Moisture Resistant) Sustainable, Moisture Resistant, medium density fiberboard panel manufactured from 100 percent post-industrial recycled wood fiber complying with ANSI A208.2, having a minimum 48 psf density; minimum for screw holding capacity on face and edge of 350 pounds and 275 pounds respectively; an ASTM E84 Class C flame spread rating; fabricated with binder containing no urea formaldehyde.
   2. Interior Medium Density Fiberboard Panels made with NAF Resin:
      a. Basis of Design: Arreis by Roseburg Forest Products Company.
         1) Standards Compliance: ANSI A208.2 - Grade 130; MR10 for panels greater than or equal to 5/8 in (16 mm).
   3. Interior Medium Density Fiberboard Panels for Profile Machining made with CARB compliant Resin:
      a. Basis of Design: Medite 3D by Roseburg Forest Products company.
         1) Standards Compliance: ANSI A208.2 - Grade 130;
   4. Interior Medium Density Fiberboard Panels made with NAF Resin:
      a. Basis of Design: Medite II by Roseburg Forest Products Company.
         1) Standards Compliance: ANSI A208.2 - Grade 155; MR30 for panels greater than or equal to 5/8 in (16 mm).
   5. Flame-Retardant Medium Density Fiberboard Panels made with NAF Resin:
      a. Basis of Design: Medite FR by Roseburg Forest Products Company with Class 1 (A) Fire Rating in accordance to ASTM E-84
         1) Standards Compliance:
            (a) ANSI208.2 - Grade 130.
            (b) ASTM E 84.
            (c) MEA 244,

b. Medium Density Fiberboard made from 100 percent post-industrial recycled softwood fibers complying with ANSI A208.2, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame spread index of 25 or less and smoke developed index of 200 or less per ASTM E84. having a minimum 48 psf density; minimum for screw holding capacity on face and edge of 350 pounds and 275 pounds respectively; fabricated with binder containing no urea formaldehyde.

6. Interior Medium Density Fiberboard Panels made with NAF Resin for Profile Machining and Powder Coat Finishing.
   a. Basis of Design: PermaCore by Roseburg Forest Products Company.
      1) Standards Compliance: ANSI A208.2 - Grade 155; MR30 for panels greater than or equal to 5/8 in (16 mm).

2.05 PLASTIC LAMINATE MATERIALS

A. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
   1. Provide specific types as follows:
      a. Horizontal Surfaces: HGS, 0.048 inch nominal thickness.
      b. Vertical Surfaces: VGS, 0.028 inch nominal thickness.

B. Laminate Backing Sheet: NEMA LD 3, BKL; undecorated plastic laminate.

C. Colors: As indicated in Section 09 00 01 - Finish Legend.

2.06 ADHESIVE

A. Adhesive: Type recommended by laminate manufacturer to suit application.
   1. Do not use adhesives that contain urea formaldehyde.
   2. VOC Limits for Installation Adhesives and Glues: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.
      a. Wood Glues: 30 g/L.
      b. Contact Adhesive: 80 g/L.

2.07 FASTENINGS

A. Fasteners: Of size and type to suit application; plain finish in concealed locations and stainless steel finish in exposed locations, unless otherwise indicated.

B. Concealed Joint Fasteners: Threaded steel.

C. Nails: Size and type to suit application, plain finish.

D. Bolts, Nuts, Washers, Blind Fasteners, Lags, and Screws: Size and type to suit application; plain.

E. Joint Sealants: As specified in Section 07 92 00 - Joint Sealants.

2.08 ACCESSORIES

A. Edge Trim for Plastic Laminate Wainscots:
   1. "J" Molding JDM-625 manufactured by Fry Reglet Corporation: www.fryreglet.com.
   2. "Reveal Channel Screed" DCS-625-50 manufactured by Fry Reglet Corporation: www.fryreglet.com.
   3. Finish: Clear anodized.

B. Wood Filler: Solvent base, tinted to match surface finish color.

2.09 LUMBER SELECTION

A. Selection of Lumber Pieces:
   1. Carefully select all members. Select individual pieces so that obvious defects are not on exposed surfaces and will not interfere with proper nailing or fastener connections.
   2. Lumber may be rejected by Architect whether or not it has been installed for reasons of: excessive warp, twist, bow, crook, mildew or fungus, mold, as well as for improper cutting and fitting.
   3. Finger jointing of trim pieces is not acceptable and will be rejected.

2.10 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

B. Fit exposed sheet material edges with matching veneer edging. Use one piece for full length only.

C. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

D. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

E. Apply laminate backing sheet to reverse face of plastic laminate finished surfaces.

F. Plastic Laminate Wainscots, Sills, and Chair Rails: Fabricate with 1/2-inch thick particleboard backer, unless otherwise indicated, as detailed:
   1. Conform to AWI Custom quality standards.
   2. Apply plastic laminate over particleboard, adhered with adhesive over entire surface.
   3. Apply adhesive over entire back surface of panels and adhere to gypsum board or other wall substrate. Attach wainscot panels at top corners and at two intermediate points equally spaced along top. All fasteners to be concealed.
   4. Provide self-edge at all joints.

G. Fabricate hardwood trim from hardwood lumber. Ease all edges 1/16-inch.
   1. Finish: Satin with conversion varnish finish.

2.11 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. Apply wood filler in exposed nail and screw indentations.

C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.

D. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. System - 5, Varnish, Conversion.
      b. Sheen: Semigloss.

E. Back prime woodwork items to be field finished, prior to installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

C. Verify that gypsum board substrates have received a coat of primer prior to installation of wainscots and wood panels.

D. Verify the substrates behind open joints between wainscots and between adjacent wall panels have been painted black prior to installation of panels.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure materials and components in place, plumb and level.

C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

D. Install with blind nailing typical; use finish nails at all applications unless detailed otherwise.

E. Plastic Laminate Wainscots: Install wainscot panels with adhesive suitable for application, unless detailed otherwise. Do not face nail.
   1. Paint substrate behind panels as indicated on Drawings for exposed reveal joints.
   2. Install reveal and trim pieces as detailed.
   3. Space panels as detailed on Drawings.

F. Provide sealant at the intersection of dissimilar materials.

3.03 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch.

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION

SECTION 06 41 00
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured cabinet units.

B. Specially fabricated cabinet units.

C. Shelving.

D. Countertops, including the following:
   1. Plastic laminate.

E. Cabinet hardware.

F. Factory finishing.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.

B. Section 06 20 00 - Finish Carpentry: Finish carpentry items not included in this Section.

C. Section 07 92 00 - Joint Sealants.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards.

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0.

C. NEMA LD 3 - High-Pressure Decorative Laminates.

D. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168.

1.04 DEFINITIONS

A. Definitions in the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" apply to the work of this Section.

B. MDF: Medium-density fiberboard.

C. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive and faced both front and back with hardwood veneers.

1.05 DESIGN REQUIREMENTS

A. Quality Standard: Unless otherwise indicated, comply with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" for grades of casework indicated for construction, finishes, installation, and other requirements.
   1. Grade: Premium.

B. Product Designations: Drawings indicate sizes, configurations, and finish materials of manufactured wood-veneer-faced casework by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish materials, and complying with the Specifications may be considered. See Section 016000 "Product Requirements."

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Informational Submittals: Quality Standard Compliance Certificates: AWI Quality Certification.

C. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, cutouts and holes for items installed in casework, accessory listings, hardware location and schedule of finishes.
   1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
   2. Provide the information required by AWI/AWMAC/WI (AWS).

3. Indicate seismic bracing and fastening requirements.

D. Resubmittal of Shop Drawings: If field measurements result in significant changes to the casework design, resubmit all shop drawings after field dimensions have been verified.
   1. Indicate on resubmitted drawings all dimensions which were verified.
   2. Indicate significant changes to casework resulting from field-measured conditions. Do not proceed with fabrication until approved by Architect.

E. Delegated-Design Submittal: For architectural wood casework taller than six feet tall, submit seismic anchorage calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Submit submittals as "Deferred Submittals" in accordance with Section 01 30 00 - Administrative Requirements. Transmit a copy of each submittal indicating agency approval to the Architect for record.

F. Product Data: Provide data for panel products, countertop materials and hardware accessories.
   1. For installation adhesives, include printed statement of VOC content.
   2. For each adhesive used, provide documentation indicating that the adhesive contains no urea formaldehyde.

G. Selection Samples: Submit actual samples of the full range of available colors for the following items:
   1. Thermoset decorative panels.
   2. Shop applied transparent finishes.
   3. Plastic edge banding materials.

H. Samples:
   1. Submit 2 samples of wood trim 12 inches long with specified finish.
   2. Submit 2 samples of each plastic laminate color specified.

I. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Adjustable Shelf Supports, including pin supports: Quantity equivalent to 2 percent of amount provided for project.
   3. Extra Magnetic Catches: Quantity equivalent to 2 percent of amount provided for project.
   4. Extra Elbow Catches: Quantity equivalent to 2 percent of amount provided for project.

1.07 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.

B. Recycled Content of Medium-Density Fiberboard and Particleboard: Provide products with an average recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 20 percent.

C. Formaldehyde Free Panel Products: Provide fiberboard, particleboard and plywood products made with binders and adhesives containing no urea formaldehyde.

1.08 DELIVERY, STORAGE, AND HANDLING

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

B. Protect units from moisture damage.

1.09 FIELD CONDITIONS

A. Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

C. Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Delamination of components or other failures of glue bond.
      b. Warping of components.
      c. Failure of operating hardware.
      d. Deterioration of finishes.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The following manufacturers are approved subject to conformance with Specifications:
   1. Advance Cabinet Designs, Inc; Eugene, OR 541-465-3394.
   2. Cascade Casework Corp; Lebanon, OR; 541-258-3255.
   3. Custom Source Woodworking Inc; Olympia, WA; 360-491-9365.
   4. Fremont Millwork Co; Klamath Falls, OR; 541-258-3255.
   5. Genothen; Tumwater, WA; 360-352-3636.
   6. ISEC Cabinets; Bothell, WA; 425-488-1333.
   7. Kriegsco Manufacturing, Inc; Hubbard, OR; 503-981-9083.
   8. Legend Custom Woodworking, Inc; Portland, OR; 503-669-1000.
   9. Neil Kelly Cabinets; Portland, OR; 503-335-9207.
   10. Pacific Cabinets, Inc; Ferdinand, ID; 208-962-5546.
   11. Specialty Cabinets; Amity, OR; 971-241-4952.

B. Substitutions: See Section 01 60 00 - Product Requirements.
   1. Substitution requests shall be accompanied by a mock-up of a typical cabinet produced by the manufacturer showing quality of workmanship normally produced for custom-grade work. Mock-up shall include a door and drawer combination with related specified hardware, countertop with edge and base. Mock-up shall meet quality and specified requirements of cabinets and hardware specified herein.

2.02 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Plastic Laminate Faced Cabinets: Custom grade.

2.03 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

2.04 MATERIALS

A. Low-Emitting Materials: Fabricate manufactured wood casework, including countertops, with adhesives and composite wood products containing no urea formaldehyde.

B. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated; made without urea formaldehyde.

C. Softwood Plywood: DOC PS 1.

D. Particleboard: ANSI A208.1, Grade M-2 made with binder containing no urea formaldehyde.

E. MDF: ANSI A208.2, Grade 130; made with binder containing no urea formaldehyde.

F. Hardboard: ANSI A135.4, Class 1 Tempered.

2.05 LUMBER MATERIALS

A. Softwood Lumber: Graded in accordance with AWI/AWMAC/WI (AWS), Custom Grade; average moisture content of 5-10 percent; species as recommended by manufacturer.
   1. Exposed Surfaces: Not allowed.
   2. Semi-Exposed Surfaces: Not allowed.

B. Hardwood Lumber: Graded in accordance with AWI/AWMAC/WI (AWS), Custom Grade; average moisture content of 5-10 percent; species as recommended by manufacturer.
   1. Exposed Surfaces: Not allowed.
   2. Semi-Exposed Surfaces: Not allowed.

C. Wood Species and Cut for Transparent Finish: White maple, plain sawn or sliced.

2.06 LAMINATE MATERIALS

A. Manufacturers:
   1. Formica Corporation: www.formica.com/#sle.
   2. Panolam Industries International, Inc; Nevamar: www.nevamar.com.
   3. Pionite Decorative Surfaces: www.pionite.com.
   4. Wilsonart: www.wilsonart.com.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Thermoset Decorative Panels (Melamine): Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with NEMA LD 3.
   1. Colors: As selected by Architect from manufacturer's full range of available colors.

C. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
   1. Provide specific types as indicated.
      a. Horizontal Surfaces: HGS, 0.048 inch nominal thickness.
      b. Vertical Surfaces: VGS, 0.028 inch nominal thickness.
      c. Post-Formed Horizontal Surfaces: HGP, 0.039 inch nominal thickness.
      d. Cabinet Liner: CLS, 0.020 inch nominal thickness, or decorative thermoset panels.
      e. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.
   2. Colors: As selected by Architect from manufacturer's standard range.

2.07 COUNTERTOPS

A. Plastic Laminate Countertops: Particleboard covered with high-pressure laminate.

2.08 ACCESSORIES

A. Adhesive: Type recommended by AWI/AWMAC to suit application.
   1. VOC Limits for Installation Adhesives and Glues: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.
      a. Wood Glues: 30 g/L.
      b. Contact Adhesive: 80 g/L.

B. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; of width to match component thickness.
   1. Color: To match adjacent plastic laminate color.

2. Use 3 mm at all exposed edges, doors and drawer fronts, vertical case ends, bottoms and sub-tops.
3. Use 3 mm at all exposed shelf edges.
4. Do not use adhesives that contain urea formaldehyde.
5. Manufacturers: Dollken Woodtape: www.doellken-woodtape.com, 800-426-6362 or equal.

C. Countertop Support Brackets: Prefinished cold-rolled steel L-bracket with 1,200 lbs. per pair load rating. Mount with manufacturer's recommended fasteners to wall backing.
1. Size: 20 inches long by 13 inches high nominal.
2. Finish: White.
3. Product: Model 208 WH 500 Ultimate L-Bracket manufactured by Knape & Vogt.

D. Fasteners: Size and type to suit application.

E. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

F. Concealed Joint Fasteners: Threaded steel.

G. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

2.09 HARDWARE

A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard commercial-quality, heavy-duty hardware.
1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard, except where hardware is through bolted from back side.

B. Adjustable Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated shelf rests, nickel plated finish, for nominal 1 inch spacing adjustments.
1. Product:
a. Heavy duty 5mm double pin shelf supports for book shelving manufactured by Hafele: www.hafeleonline.com.

C. Drawer and Door Pulls: "U" shaped wire pull, stainless steel with satin finish, 4 inch centers.

D. Drawer and Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with satin finish. Key to building master keyway.

E. Catches: Magnetic.
1. Product: 592 manufactured by EPCO: www.epcohardware.com, or approved equal.

F. Elbow Catches: Aluminum, satin nickel finish; install on left-hand door of double door cases where locks are indicated.

G. Drawer Slides:
1. Type: Full extension.

H. Hinges: Five knuckle, fixed pin in chrome finish. Steel hinge 2-3/4 inches high with 270 degree opening.

I. Coat Hooks: Dull chrome finish wardrobe hook.
1. Products:
a. Wall Mounted: No. 571 manufactured by Ives: http://us.allegion.com/brands/ives.
b. Under-Shelf Mount: No. 580 manufactured by Ives: http://us.allegion.com/brands/ives.

2.10 FABRICATION

A. Laminate Finished Surface Definitions: Comply with requirements of AWI/AWMAC/WI (AWS) and the following:

1. Exposed portions of casework include all surfaces visible when doors and drawers are closed, interior faces of cabinet doors and exposed surfaces of open cases including top and bottom of shelving, interior cabinet surfaces visible behind glass doors.
2. Semi-exposed surfaces of casework include those members behind opaque doors such as shelves, drawers, dividers, interior faces of ends, case backs and backs and bottoms.
3. Concealed portions of casework include sleepers, dust panels, and other surfaces not visible after installation.

B. Surface Finishes:
1. Exposed Surfaces: High-Pressure Laminate unless otherwise indicated. Provide colors and finishes as scheduled in Section 09 00 01 - Finish Legend.
2. Semi-Exposed Surfaces: Thermoset decorative overlay. Colors as selected by Architect from manufacturer's full range of available colors.

C. Cabinet Style: Reveal overlay.

D. Cabinet Doors and Drawer Fronts: As indicated.

E. Drawer Construction Technique: As recommended by fabricator.

F. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

G. Construct cabinets without integral base. Provide separate structural base as specified below.

H. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

I. Cabinet Backs: Provide minimum 1/2-inch thick cabinet back. Where back of cabinet is exposed to view, provide 3/4-inch particleboard with high pressure laminate facing.

J. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

K. Base Construction: Construct cabinet bases of 3/4-inch thick marine grade plywood, glued and screwed. Provide reinforcing blocks as required for maximum strength. Recess base for toe space as indicated. Set base on floor where casework is to be installed. Level top surface and scribe bottom surface to floor line leaving a height of 4-inches between floor and bottom of casework.

L. Drawers:
1. Fronts: One piece 3/4-inch thick plywood with 3 mm plastic edge facing on all four sides.
2. Sides: 1/2-inch thick medium density overlay plywood.
3. Back and Sub-Front: 3/4-inch thick particleboard.
4. Edge band top edges of sides, backs and sub-front.
5. Bottoms: Minimum 1/2-inch particleboard or 1/4-inch hardboard set into 1/4-inch deep grooves at front, back and both sides.
6. Drawer Reinforcement: Reinforce drawer bottoms in excess of 400 square inches in area with 1 inch by 3 inch wood strip running front to back centered on drawer.
7. Fabricate drawers full depth of cabinet.
8. Mount drawers with positive in and out stops.

M. Cabinet Doors: Plastic laminate clad 3/4-inch thick particleboard with 3 mm plastic edge facing on all edges.
1. Provide hinges in the following quantities:
   a. Two hinges for doors up to 36 inches high, 24 inches wide.
   b. Three hinges for doors up to 48 inches high, 24 inches wide.
   c. Four hinges for doors up to 82 inches high, 24 inches wide.
   d. For doors in excess of dimension indicated above, comply with hinge manufacturer's recommendations for size and weight of door.
2. Surface apply hinges, do not let-in hinges.

N. Semi-Exposed Cabinet Shelving: 1-inch thick plywood shelving with high-pressure laminate cladding. Provide plastic edge facing in color to match laminate.:
   1. Minimum 1-inch thick shelving for all lengths more than 32 inches.
   2. Provide "Line Bored" multi-hole shelf support holes.
   3. Allow 1/16-inch clearance at each end of loose shelving (1/8-inch overall) for ease of moving shelves.

O. Countertops:
   1. Plastic Laminate Countertops: High-pressure laminate bonded to particleboard top over wood framing.
      a. Provide Self Edge.
      b. At areas with sinks, provide moisture-resistant particleboard. Provide shop installed 1/4-inch maximum radius integral coved backsplashes and mechanically attached end splashes. If sink counter configuration is "L" or "U" shape, miter corners and continue integral coved backsplash detail for entire counter assembly. Scribe countertops or backsplashes to abutting wall surfaces for hairline joint. Seal joint with mildew-resistant silicone sealant as specified in Section 07 92 00 - Joint Sealants.
      c. Provide 3/4-inch backsplash covered with matching plastic laminate. Panel to extend to the entire length of base cabinet and return to all exposed ends.
         1) Shop install backsplashes.
         2) Mechanically fasten end splashes to countertops with steel brackets at 16 inches on center.
      d. Coordinate with plumbing and electrical installation of pipes, drains, electrical outlets and fixtures.

P. Filler Panels: Provide 3/4-inch thick filler panels covered with matching plastic laminate to fill in all voids between cabinets and walls.

Q. Closet Shelving: Provide adjustable shelving unless noted as fixed on Drawings. Finish exposed and semi-exposed surfaces with thermoset decorative laminate. Finish bottom, vertical and top edges with 3 mm plastic edge facing. Install mid-support bracket for shelves over 48 inches long.

R. Plastic Laminate, General: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners.
   1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
   2. Balanced construction on all laminate-finished panels is mandatory. Unfinished stock surfaces, including all concealed surfaces and edges will not be permitted.

S. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches on center.

T. Provide cutouts for plumbing fixtures and fixtures and fittings. Verify locations of cutouts from on-site dimensions. Seal cut edges.

2.11 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.

C. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. System - 5, Varnish, Conversion.
      b. Stain: As selected by Architect.
      c. Sheen: Satin.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with Work of this section.

3.02 INSTALLATION

A. Install seismic bracing and fastening in accordance with approved shop drawings.

B. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

C. Cabinets:
   1. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
   2. Shim as required using concealed shims.
   3. Use fixture attachments in concealed locations for wall mounted components.
   4. Use concealed joint fasteners to align and secure adjoining cabinet units.
   5. Attach wall-mounted cabinets with concealed continuous cleats screwed to solid framing or blocking.
   6. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
   7. Install to a tolerance of 1/8 inch in 8 feet for plumb and level, and with 1/32 inch maximum offset in flush adjoining surfaces, and 1/16 -inch maximum offset in revealed adjoining surfaces.
   8. Drill pilot holes at corners prior to making field-cutouts.
   9. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures and fittings. Verify location of cutouts from field-verified dimensions. Seal contact surfaces of cut edges.
   10. Secure cabinets to floor using appropriate angles and anchorages.
   11. Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.

D. Countertops and Backsplashes:
   1. Secure countertops to grounds, furring and blocking with concealed or countersunk fasteners and by blindnailing. Fasteners shall not be exposed to view.
   2. Abut top and edge surfaces in one true plane, with internal supports placed to support joints in substrates and to avoid deflection. Use clamping devices to provide flush, hairline joints.
   3. Fasten countertop support brackets at maximum of 48-inches on center under unsupported counter surfaces. At corners, provide two brackets minimum - one at each unsupported corner, perpendicular to each wall surface. Provide even spacing of brackets beneath each countertop.
   4. Provide holes and cutouts neatly cut where required for mechanical and electrical services.
   5. Scribe backsplash at juncture with walls and other surfaces as recommended by AWI standards. Seal where backsplashes and endsplashes meet different surface materials with mildew-resistant silicone sealant as specified in Section 07 92 00 - Joint Sealants.

3.03 ADJUSTING

A. Repair damaged and defective casework, where possible, to eliminate functional and visual defects; where not possible to repair, replace casework. Adjust joinery for uniform appearance.

B. Clean, lubricate and adjust hardware.

C. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

B. Provide protection of installed casework from damage until final acceptance by Architect.
   1. Cover casework with 4-mil polyethylene film for protection against dust and soiling. Maintain for duration of construction period.
   2. Do not allow use of casework for storage of construction equipment or materials.
   3. Do not allow use of casework as scaffolding for construction operations.
   4. Do not allow use of countertops as construction work surfaces.

C. Repair or replace defective portions of Work as directed prior to Substantial Completion.

D. Remove plastic film and thoroughly clean as required prior to Punchlist review.

END OF SECTION

SECTION 07 01 50.19
PREPARATION FOR RE-ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Removal of existing roof and base flashings.

B. Removal of existing sheet metal flashings.

1.02 RELATED REQUIREMENTS

A. Section 01 22 00 - “Unit Prices” unit prices for replacement wood sheathing and nailers where required.

B. Section 02 41 19 - Selective Structure Demolition.

C. Section 06 10 00 - Rough Carpentry.

D. Section 07 53 00 - Elastomeric Membrane Roofing.

E. Section 07 62 00 - Sheet Metal Flashing and Trim.

1.03 SUBMITTALS

A. Photographs: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces that might be misconstrued as having been damaged by re-roofing operations. Submit prior to start of Work.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with affected mechanical and electrical work associated with roof penetrations.

B. Schedule work to coincide with commencement of installation of new roofing system.

1.05 PREINSTALLATION CONFERENCE

A. Preinstallation Meeting: Convene one week before starting work of this section.
   1. Meet with Owner, Architect, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, sheathing Installer, and installers whose work interfaces with or affects roofing, including installers of roof-mounted equipment.
   2. Review preparation and installation procedures related to roofing system tear-off and replacement including, but not limited to, the following:
      a. Verify items to be removed and items to remain or to be reinstalled.
      b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, facilities needed to make progress and avoid delays.
      c. Review re-roofing preparation, including membrane roofing system manufacturer's written instructions.
      d. Existing roof drains and roof drainage during each stage of re-roofing and roof drain plugging and plug removal requirements.
      e. Examine sheathing substrate conditions and finishes for compliance with requirements, including flatness and fastening.
      f. Review structural loading limitations of roof deck.
      g. Review temporary protection requirements for existing and new roofing system.
      h. Review protection requirements for interior spaces, both occupied and unoccupied, of the building.
      i. Review base flashing, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that will affect reroofing.
      j. Shutdown of fire-suppression, fire-protection and fire alarm and detection systems.
      k. Timing and sequencing for shutdown of existing MEP equipment located on the roof.
      l. Existing conditions that may require notification of Architect before proceeding.

1.06 QUALITY ASSURANCE

A. Materials Removal Firm Qualifications: Installer of new membrane roofing system.

1.07 FIELD CONDITIONS

A. Do not remove existing roofing membrane when weather conditions threaten the integrity of the building contents or intended continued occupancy.

B. Maintain continuous temporary protection prior to and during installation of new roofing system.

C. Protect existing building to be re-roofed, adjacent buildings, walkways, exterior plantings and landscaping from damage or soiling from re-roofing operations.

D. Limit overall roof loads and equipment wheel loads on existing roofing to avoid damage to areas not scheduled for immediate replacement.

E. Weather Limitations: Proceed with roofing preparations only when existing and forecasted weather conditions permit work to proceed without water entering the building.

F. Owner will occupy portions of building immediately below re-roof areas. Conduct re-roofing so Owner's operations will not be disrupted. Provide Owner with not less than 48 hours' notice of activities that may affect Owner's operations.
   1. Place protective dust or water leakage covers over sensitive equipment or furnishings. Coordinate with Owner the shutdown of HVAC and/or fire-alarm or detection equipment if needed and the evacuation of occupants from below the work area(s) when/if necessary.
   2. Before working over structurally impaired areas of sheathing, if any are discovered, notify Owner to evacuate occupants from below the affected area. Verify that occupants below the work area have been evacuated before proceeding with work over the impaired deck area.

G. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

H. Coordinate with Owner for timing of disconnection of existing mechanical equipment to permit continued possible operation of the existing facility during roof replacement activities.

PART 2 PRODUCTS

2.01 MATERIALS

A. Protection: Provide plastic sheets, tarps, roof membranes, and/or other appropriate products to use as protective coverings at roof repair and replacement locations exposed during the work. Provide weights, mechanical attachment or approved adhesives, to retain temporary protective coverings in position.
   1. Use protective coverings as necessary as temporary means to prevent moisture intrusion into building interior.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing roof surface is clear and ready for work of this section.

B. Inspect existing substrate, sheet metal flashings, nailers and sheathing for deterioration and damage. If nailers and/or sheathing have deteriorated, immediately notify Architect.

3.02 PREPARATION

A. Sweep roof surface clean of loose matter.

B. Remove loose refuse and dispose off site.

C. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work, when applicable. Cover air-intake louvers before proceeding with re-roofing work that could affect indoor air quality or activate smoke detectors in the ductwork.

D. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.

E. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday. Prevent debris from entering or blocking roof drains and conductors. Use roof drain plugs specifically designed for this purpose. Remove roof drain plugs at end of each workday, when no work is taking place or when rain is forecast.

1. If roof drains are temporarily blocked or unserviceable during performance of work, provide alternative drainage method to remove water and eliminate ponding. Do not permit water to enter into or under new or existing membrane roofing system.

3.03 MATERIAL REMOVAL

A. Remove only existing roofing materials that can be replaced with new materials the same day.

B. Remove sheet metal flashing and trim as indicated on Drawings.

C. Remove roofing membrane, perimeter base flashings, flashings around roof protrusions down to existing roof sheathing.

D. Remove existing cant strips, damaged wood blocking, nailers, and other components not shown on Drawing details, unless considered detrimental to system performance.

E. Raise existing curbs or install new curbs as required to accommodate new roofing assembly. Coordinate with Work of Section 02 41 19 - Selective Structure Demolition and Section 06 10 00 - Rough Carpentry.

F. Repair existing wood sheathing surfaces as necessary to provide smooth working surface for new roof assembly.
   1. Coordinate with Work of Section 06 10 00 - Rough Carpentry for identification and replacement of damaged wall sheathing.

G. If sheathing surface is not suitable for new roofing, or if structural integrity of sheathing is suspect, notify Architect immediately.

H. Existing Sheet Metal Flashing and Wall Panels: Where indicated as "existing", do not damage sheet metal flashings and wall panels associated with work to be performed or elsewhere during daily working activities.

3.04 ROOF TEAR-OFF

A. General: Notify Owner each day of extent of roof tear-off proposed for that day.

B. Comply with requirements specified in Section 02 41 19 - Selective Structure Demolition for removal of selected building elements.

C. Sheet Metal Removal: Detach and recycle existing sheet metal flashings where new flashings are to be installed as shown on the Drawings.
   1. Avoid damaging existing sheet metal flashings that are to remain.
   2. Existing flashings or metal elements that will remain but that are damaged beyond acceptable use are to be replaced with new flashing or elements that match existing.
   3. Immediately offload and transport sheet metal flashing to locations indicated by the Owner as conditions allow until permanent disposal is performed.

3.05 DECK PREPARATION

A. Inspect roof sheathing after tear-off of existing roofing system.

B. Verify that substrates are visibly dry and free of moisture at start of each day's work. Do not proceed with roofing work if moisture is present.

C. If sheathing surface is not suitable for receiving new roofing or if structural integrity of sheathing is suspect, immediately notify Owner and Architect. Do not proceed with installation until directed by Owner and Architect.

D. All damaged sheathing must be removed and replaced with new to matching existing.

E. Remove and replace damaged and deteriorating plywood wall sheathing and wood nailers in accordance with Section 01 22 00 - Unit Prices and Section 06 10 00 - Rough Carpentry upon authorization by Owner or Architect.

3.06 INFILL MATERIALS INSTALLATION

A. After roof tear off, substrate inspection and repair, fill in tear-off areas with roof assembly.
   1. Installation of infill materials is specified in Section 07 53 00 - Elastomeric Membrane Roofing.

2. Installation of wood blocking, curbs, nailers and wall sheathing is specified in Section 06 10 00 - Rough Carpentry.

3.07 FASTENER PULL-OUT TESTING

A. Perform fastener pull-out tests according to SPRI FX-1, and submit test report to Architect and Consultant before installing new roofing system.

3.08 PROTECTION

A. Provide temporary protective sheeting over uncovered sheathing surfaces.

B. Turn sheeting up and over parapets and curbing. Retain sheeting in position with weights.

C. Provide for surface drainage from sheeting to existing drainage facilities. Do not allow sheeting to pond water.

D. Do not permit traffic over unprotected or repaired sheathing surface.

E. Protect interior and adjacent exterior spaces from falling debris and asphalt dust during all phases of the roof replacement.

3.09 DISPOSAL

A. Collect demolished materials and place in containers. Promptly dispose of demolished materials not indicated to be recycled. Do not allow demolished materials to accumulate on-site. Transport and legally dispose of demolished materials off Owner's property.

END OF SECTION

SECTION 07 19 00
WATER REPELLENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water repellents applied to the following surfaces:
   1. Exterior concrete masonry.

1.02 REFERENCE STANDARDS

A. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units.

B. ASTM C642 - Standard Test Method for Density, Absorption, and Voids in Hardened Concrete.

C. ASTM D1653 - Standard Test Methods for Water Vapor Transmission of Organic Coating Films.

D. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry.

1.03 PERFORMANCE REQUIREMENTS

A. Performance Requirements for Exterior CMU:
   1. No change in surface texture, no blotchy appearance.
   2. ASTM C140/C140M - 24 hour submersion test: 99.7 percent reduction in water absorption.
   3. ASTM C642 - 24 hour immersion: 97.5 percent effective.
   4. ASTM D1653: 72.5 g/sq ft/24 hours - 100 percent breathable.
   5. ASTM E514/E514M
      a. 100 percent reduction in leakage rate over the control wall.
      b. Control wall must have a leakage rate of at least 0.01 liters/hours.

1.04 PREINSTALLATION CONFERENCE

A. Preinstallation Meeting: Convene a meeting at least one week prior to starting work; require attendance of affected installers; invite Architect and Owner.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, details of tests performed, limitations, and chemical composition.
   1. Include manufacturer's printed statement of VOC content.

C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention; cautionary procedures required during application.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Pre-application Field Test Reports: Results of RILEM uptake tests for water repellents and for graffiti-resistant coatings.

F. Warranty: Special warranties specified in this Section.

G. Maintenance Data: Include procedures for stain removal, repairing surface, and cleaning.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
   1. Provide products for water repellents and graffiti-resistant coatings by a single manufacturer.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years experience and trained and approved by manufacturer.

C. Test Application: Apply a finish sample for each type of water repellent and substrate required and of graffiti-resistant coating. Duplicate finish of approved sample. Test area for RILEM uptake test(s) can serve as finish samples.
   1. Locate each test application as directed by Architect.
   2. Size: 9 sq. ft. minimum.
   3. Final approval by Architect of water-repellent and graffiti-resistant coating application will be from test applications.
   4. Conduct RILEM test(s) to comply with requirements specified in Field Quality Control Article.

1.07 FIELD CONDITIONS

A. Protect liquid materials from freezing.

B. Do not apply water repellent when ambient temperature is lower than 50 degrees F or higher than 100 degrees F.

C. Do not proceed with application on materials if ice or frost is covering the substrate.

D. Do not proceed with the application of materials in rainy conditions of if heavy rain is anticipated within 4 hours after application.

E. Sealer Coordination: Verify compatibility with curing compounds, patching materials, repair mortar, paints, sealants, and similar items to be used on substrates to verify compatibility with the water repellents and graffiti-resistant coatings.

1.08 WARRANTY

A. Special Warranty for Water Repellents: Manufacturer's standard form in which manufacturer agree(s) to repair and replace materials that fail to maintain water repellency specified within specified warranty period.
   1. Loss of Water Repellency:
      a. Concrete Masonry Units: 1.0 ml/20 minutes or greater (60 mph wind driven rain equivalent) using a water uptake tube meeting the requirements of RILEM Method II.
   2. Warranty Period: Ten years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. 100 Percent Active Silane Water Repellents:
   1. BASF Construction Chemicals: www.buildingsystems.basf.com.
   2. Evonik Industries: www.protectosil.com. (Basis-of-Design)
   3. PROSOCO, Inc: www.prosoco.com.

B. Substitutions: See Section 01 60 00 - Product Requirements.
   1. For proposed substitutions, prepare side-by-side mock-ups of specified and substitute products. Acceptance of substitution requests will be determined based on mock-up, including RILEM uptake test results and cleanability of surfaces after graffiti application.

2.02 MATERIALS

A. Water Repellent: Non-glossy, colorless, penetrating, water-vapor-permeable, non-yellowing sealer, that dries invisibly leaving appearance of substrate unchanged.
   1. Applications: Vertical surfaces and nontraffic and traffic horizontal surfaces.
   2. Number of Coats: One.
   3. Maintains dry appearance when wetted.
   4. Exterior Products: Non-glossy, colorless, penetrating, water-vapor-permeable, non-yellowing sealer, that dries invisibly leaving appearance of substrate unchanged.
      a. Basis-of-Design Products:
         1) Exterior Unpainted CMU:
            (a) BASF; MasterProtect H 1001
            (b) Evonik Industries; Protectosil CHEM-TRETE PB 100.
            (c) Prosoco; Blok-Guard & Graffiti Control Ultra.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify joint sealants are installed and cured.
   1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

C. Verify surfaces to be coated are dry, clean, and free of efflorescence, oil, or other matter detrimental to application of water repellent.

D. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION FOR WATER REPELLENT APPLICATION

A. Protection of Adjacent Work:
   1. Protect adjacent landscaping, property, and vehicles from drips and overspray.
   2. Protect adjacent surfaces not intended to receive water repellent.

B. Prepare surfaces to be coated as recommended by water repellent manufacturer for best results.

C. Do not start work until masonry mortar and concrete substrate is cured a minimum of 60 days.

D. Remove loose particles and foreign matter.

E. Verify that masonry joints found to be unsound, hollow or otherwise defective have been raked out to a depth of 1/2 inch and pointed with mortar.

F. Verify that cracks that exceed 1/64 inch wide have been filled with pointing mortar.

G. Remove oil and foreign substances with a chemical solvent that will not affect water repellent.

H. Coordination: Verify compatibility of water repellent and graffiti-resistant coatings with curing compounds, patching materials, repair mortar, paints, sealants, etc. to be used on or adjacent to surfaces to be coated.

I. Scrub and rinse surfaces with water and let dry.

J. Allow surfaces to dry completely to degree recommended by water repellent manufacturer before starting coating work. Allow mortar to cure as required by water repellent manufacturer.

3.03 WATER REPELLENT APPLICATION

A. Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. Apply water repellent in accordance with manufacturer's instructions, using procedures and application methods recommended as producing the best results.

C. Apply at rate recommended by test application, continuously over entire surface.

D. Apply one coat, minimum.

E. Remove water repellent from unintended surfaces immediately by a method instructed by water repellent manufacturer.

F. Provide manufacturer's field service representative to inspect preparation and application work for at least 3 hours on first day to ensure that manufacturer's "best practices" for preparation and application are being followed.

3.04 CLEANING

A. As work progresses, clean spillage from adjacent surfaces using materials and methods recommended by manufacturer.
   1. Remove protective coverings from adjacent surfaces when no longer needed.

3.05 FIELD QUALITY CONTROL

A. Test Area: Before any water repellent application, perform the following field evaluation.
   1. Prepare a three foot by three foot area to be sprayed with the water repellent where directed by the Architect. Apply the water repellent at a rate of square foot per gallon as recommended by manufacturer to meet warranty requirements.
   2. After allowing five days for the sample to cure, run a RILEM uptake test on the treated area. Place one tube on the masonry and one tube on a mortar joint. Contact Architect at least one week prior to the application of the water repellent and the test.

B. Coverage Test: Conduct in the presence of Architect:
   1. Notify Architect seven days in advance of the dates and times when surfaces will be tested.
   2. Run random RILEM tests on each elevation of structure. Also, conduct splash tests in areas between RILEM tests to verify that the substrate is uniformly protected.
   3. After surfaces have adequately dried, recoat surfaces that show water absorption.

C. Manufacturer's Field Services: Furnish written certification that surface preparation method and final condition has manufacturer's approval and comply with warranty.
   1. Test Area: Furnish results of test area absorption on each type of substrate. Test results shall determine application rate.

D. Demonstration: Demonstrate to Owner's personnel correct procedures for removal of graffiti from building.

END OF SECTION

SECTION 07 21 00
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation at exterior wall behind metal panel wall finish and exterior wall behind masonry veneer wall finish.

B. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.

C. Minimally expanding foam insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

D. Minimally expanding foam sealant for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 04 20 00 - Unit Masonry: Coordination of installation of seismic veneer ties and insulation.

C. Section 05 40 00 - Cold-Formed Metal Framing: Board insulation as wall sheathing.

D. Section 07 25 00 - Weather Barriers: Separate air barrier and vapor retarder materials.

E. Section 07 42 13 - Metal Wall Panels: Z-furring supporting metal wall panels.

F. Section 07 53 00 - Elastomeric Membrane Roofing: Installation requirements for board insulation over low slope roof deck specified in this section.

G. Section 09 21 16 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

A. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

D. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.

E. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

F. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

G. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

H. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

J. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.

K. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C.

L. ASTM E2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

M. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

N. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, product limitations, and formaldehyde content.
   1. Provide documentation indicating levels of formaldehyde content and Greenguard Certification. Provide independent 3rd Party Verification.
   2. For exterior insulation specified to comply with NFPA 285, submit copy of ICC-ES Evaluation Report.

C. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer's Installation Instructions: Include information on installation techniques.

F. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

G. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.05 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:
   1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.
   2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.06 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

B. Do not expose foam-plastic board to sunlight except to necessary extent for period of installation and concealment.

C. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Thermal Insulation Manufacturers:
   1. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 APPLICATIONS

A. Insulation Inside Masonry Veneer Clad Walls, Continuous: Mineral fiber board.

B. Insulation Over Metal Stud Framed Walls, Continuous: Mineral fiber board.

C. Insulation Inside Metal Panel Clad and Fiber Cement Clad Exterior Walls, Continuous: Mineral fiber board.

D. Insulation in Metal Framed Walls: Batt insulation with separate vapor retarder.

E. Insulation in Wood Framed Walls: Batt insulation with separate vapor retarder.

F. Insulation in Wood Framed Ceiling Structure: Batt insulation with separate vapor retarder.

2.03 FOAM BOARD INSULATION MATERIALS

A. Expanded Polystyrene (EPS) Board Insulation: Complies with ASTM C578.

1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
3. Complies with fire resistance requirements indicated on drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
4. Board Size: 48 inch by 96 inch.
5. Board Thickness: 1-1/2 inch.
6. Board Edges: Square.
7. Type and Compressive Resistance: Type XI, 5 psi (35 kPa), minimum.
8. Type and Water Absorption: Type XI, 4.0 percent by volume, maximum, by total immersion.
9. Type and Thermal Resistance, R-value: Type XI, 3.1 (0.55) per 1 inch thickness at 75 degrees F mean temperature.
10. Manufacturers:
    a. AFM Corp: www.r-control.com/#sle.
    b. Diversifoam Products: www.diversifoam.com/#sle.
    c. InsulFoam LLC: www.insulfoam.com/#sle.
    d. Substitutions: See Section 01 60 00 - Product Requirements.

B. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
1. Type: ASTM C578, Type IV.
2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
3. Locations of Use:
    a. Perimeter foundation walls.
    b. Exterior walls behind masonry veneer and metal wall panels.
4. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
5. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88) per 1 inch thickness at 75 degrees F mean temperature.
6. Complies with fire resistance requirements indicated on drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
7. Test Standard: For insulation installed in exterior walls, provide products tested in wall assemblies tested in accordance with and in compliance with the acceptance criteria of NFPA 285 and in compliance with and labeled in accordance with Section 2603.5 of the Oregon Structural Specialty Code.
8. Board Edges: Square.
9. Type and Water Absorption: Type IV, 0.3 percent by volume, maximum, by total immersion.
10. Thermal Resistance:
    a. Foundations: R of 7.5.
    b. Masonry Veneer, Metal Wall Panel, and Fiber Cement Clad Walls: R of 7.5.
11. Compressive Resistance: 25 psi.
12. Products:
    a. DiversiFoam Products; Product Certifoam 25 SE: www.diversifoam.com.
    b. Dow Chemical Company; Product Styrofoam Square Edge: www.dow.com.
    c. Owens Corning Corp; Product Foamular 250 Square Edge: www.owenscorning.com.
    d. Substitutions: See Section 01 60 00 - Product Requirements.
13. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/#sle.
    a. Substitutions: See Section 01 60 00 - Product Requirements.

C. Extruded Polystyrene (XPS) Continuous Insulation (CI) Board: Complies with ASTM C578, and manufactured using carbon black technology.
1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.

2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
4. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
5. Complies with fire resistance requirements indicated on drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
6. Board Size: 48 inch by 96 inch.
7. Board Thickness: 1-3/4 inch.
8. Board Edges: Shiplap, at long edges.
9. Type and Water Absorption: Type IV, 0.3 percent by volume, maximum, by total immersion.
10. Manufacturers:
    a. DuPont de Nemours, Inc; STYROFOAM Brand Ultra SL (Shiplap): www.building.dupont.com/#sle.
    b. Substitutions: See Section 01 60 00 - Product Requirements.

D. Expanded Graphite Polystyrene (GPS) Board Insulation: Complying with ASTM C578, Type I.
1. Flame Spread Index (FSI): Class B - 26 to 75, when tested in accordance with ASTM E84.
2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
3. Complies with fire resistance requirements indicated on drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
4. Board Edges: Square.
5. Water Absorption: 1.1 percent by volume, maximum.
6. Type and Compressive Resistance: Type I, 10 psi (69 kPa), minimum.
7. Thermal Resistance: R-value of Type I, 3.6 (0.63) per 1 inch at 75 degrees F mean temperature.
8. Manufacturers:
    a. BASF Corporation; Neopor Plus GPS: www.neopor.basf.us/#sle.
    b. Substitutions: See Section 01 60 00 - Product Requirements.

E. Polyisocyanurate (ISO) Board Insulation with Facers Both Sides: Rigid cellular foam, complying with ASTM C1289.
1. Classifications:
    a. Type I: Faced with aluminum foil on both major surfaces of core foam.
        1) Class 2 - Glass fiber reinforced or non-reinforced core foam.
        2) Compressive Strength: 16 psi, minimum.
        3) Thermal Resistance, R-value: At 1-1/2 inch thick; 9.0 at 75 degrees F.
    b. Type II:
        1) Class 1 - Faced with glass fiber reinforced cellulosic felt facers on both major surfaces of core foam.
        2) Compressive Strength: Classes 1-2-3, Grade 1 - 16 psi (110 kPa), minimum.
        3) Thermal Resistance, R-value: At 1-1/2 inch thick; Class 1, Grades 1-2-3 - 8.4 (1.48) at 75 degrees F.
2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.

F. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
1. Complies with fire resistance requirements indicated on drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
    a. Dow Chemical Company; STYROFOAM HIGHLOAD 40: www.dowbuildingsolutions.com/#sle.
2. Kingspan Insulation LLC; GreenGuard XPS Type IV, 25 psi: www.kingspan.com/#sle.
3. Manufacturers:
4. Board Size: 48 inch by 96 inch.

5. Board Thickness: 1 inch.
6. Thermal Resistance: R-value of _____.
7. Board Edges: Square.
8. Manufacturers:
   a. Atlas Roofing Corporation; ACFoam-II Polyiso Roof Insulation: www.atlasroofing.com/#sle.
   b. Carlisle Coatings & Waterproofing, Inc; R2+ Matte: www.carlisleccw.com/#sle.
   c. DuPont de Nemours, Inc; THERMAX Brand _____: www.building.dupont.com/#sle.
   d. GAF; EnergyGuard Polyiso Insulation: www.gaf.com/#sle.
   e. GAF; EnergyGuard Perlite Roof Insulation: www.gaf.com/#sle.
   f. Hunter Panels; Xci Foil (Class A): www.hunterpanels.com/#sle.
   g. Johns Manville; AP Foil-Faced: www.jm.com/#sle.
   h. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 FIBERBOARD INSULATION MATERIALS

A. Mineral Fiberboard Insulation: Rigid or semi-rigid mineral fiber, ASTM C612 or ASTM C553; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
   1. Where indicated, provide foil facing on one side; with flame spread index of 25 or less, when tested in accordance with ASTM E84.
   2. Where indicated, provide fiberglass reinforced polypropylene facing on one side; with flame spread index of 25 or less, when tested in accordance with ASTM E84.
   3. Where indicated, provide black, non-woven fiberglass facing on one side; with flame spread index of 25 or less, when tested in accordance with ASTM E84.
   4. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
   5. Board Size: 16 by 48 inches.
   6. Locations of Use: Behind masonry veneer.
   7. Board Thickness: 2 inches.
   8. Thermal Resistance: R-value of 4.2 degrees F hr sq ft/Btu per inch at 75 degrees F, minimum, when tested according to ASTM C518.
   9. Thermal Resistance: R-value of 8.4.
   10. Maximum Density: 4.5 pounds per cubic foot.
   11. Products:
      a. Johns Manville; CladStone Water & Fire Block Insulation: www.jm.com/#sle.
      b. ROCKWOOL (ROXUL, Inc); CAVITYROCK: www.rockwool.com/#sle.
      c. Thermafiber, Inc; RainBarrier 45: www.thermafiber.com
      d. Substitutions: See Section 01 60 00 - Product Requirements.

B. Mineral Fiber Board Insulation: Rigid mineral fiber, ASTM C612 or ASTM C553; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
   1. Where indicated, provide foil facing on one side; with flame spread index of 25 or less, when tested in accordance with ASTM E84.
   2. Where indicated, provide fiberglass reinforced polypropylene facing on one side; with flame spread index of 25 or less, when tested in accordance with ASTM E84.
   3. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
   4. Board Size: 24 by 48 inches.
   5. Locations of Use:
      a. Behind metal wall panels.
      b. Behind fiber cement panels.
   6. Board Thickness: 2 inches.
   7. Thermal Resistance: R-value of 8.4.
   8. Maximum Density: 8.0 lb/cu ft.
   9. Products:
      a. Johns Manville International, Inc.; MinWool Safing: www.jm.com.
      b. ROXUL ComfortBoard 80: www.roxul.com.
      c. Thermafiber, Inc; RainBarrier HD: www.thermafiber.com.

d. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 BATT INSULATION MATERIALS

A. Formaldehyde Free Products: Provide insulation products made with binders and adhesives containing no urea formaldehyde.

B. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.

C. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
   1. Locations of Use: Within stud cavity, covered with a separate sheet vapor barrier.
   2. Material: Glass or mineral fiber.
   3. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   4. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
   5. Combustibility: Non-combustible, when tested in accordance with ASTM E136.
   6. Formaldehyde Content: Zero or in compliance with Greenguard Children and Schools Program Certification. Provide formaldehyde free and bio-based binders wherever possible.
   7. Thermal Resistance: R-value of 13.
   8. Facing: Aluminum foil, one side.
   9. Products:
      a. CertainTeed Corporation; Product CertaPro AcoustaTherm Batts: www.certainteed.com.
      b. Guardian Building Products, Inc; Product Fiberglass Insulation with ecoGuard Technology: www.guardianbp.com.
      c. Johns Manville Corporation; Product Formaldehyde-Free Fiber Glass Insulation Enhanced with Bio-Based Binder: www.jm.com.
      d. Knauf Insulation; Product EcoBatt Insulation with ECOSE Technology: www.knaufinsulation.us.
      e. Owens-Corning Corp; Product EcoTouch Pink Fiberglas Insulation with PureFiber Technology: www.owenscorning.com.
      f. Substitutions: See Section 01 60 00 - Product Requirements.
   10. Manufacturers:
      a. CertainTeed Corporation: www.certainteed.com/#sle.
      b. Johns Manville: www.jm.com/#sle.
      c. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: www.ocbuildingspec.com/#sle.

D. Foil-Faced Batt Insulation: ASTM C665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier; faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene, preformed batt; friction fit, conforming to the following:
   1. Locations of Use: At areas where not fully concealed behind gypsum board.
   2. Material: Glass or mineral fiber.
   3. Formaldehyde Content: Zero or in compliance with Greenguard Children and Schools Program Certification. Provide formaldehyde free and bio-based binders wherever possible.
   4. Thermal Resistance: R of 13.
   5. Facing: Foil scrim, foil-scrim kraft, or foil-scrim polyethylene, one side.
   6. Vapor Retarder Perm Rating: Maximum 1.0 perms when tested in accordance with ASTM E96/E96M.
   7. Products:
      a. CertainTeed Corporation; Product CertaPro Thermal FSK-25 Faced Batts: www.certainteed.com.
      b. Guardian Building Products, Inc; Product Fiberglass Insulation with ecoGuard Technology FS25: www.guardianbp.com.

c. Johns Manville Corporation; Product Formaldehyde-Free Fiber Glass Insulation Enhanced with Bio-Based Binder FSK-25 Faced: jm.com.
d. Knauf Insulation; Product EcoBatt Insulation with ECOSE Technology FSK-Faced: www.knaufinsulation.us.
e. Owens-Corning Corp; Product EcoTouch Flame Spread 25 Fiberglas Insulation with PureFiber Technology: www.owenscorning.com.
f. Substitutions: See Section 01 60 00 - Product Requirements.

E. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
1. Install with separate vapor retarder.
2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
3. Thermal Resistance: R-value of 7.5.
4. Products:
a. ROCKWOOL (ROXUL, Inc); COMFORTBATT: www.rockwool.com/#sle.
b. Thermafiber, Inc; FS-15: www.thermafiber.com.

2.06 FOAM SEALANT

A. Provide one of the following:
1. One-component, minimally expanding, low pressure-build, polyurethane foam sealant.
a. Locations of Use: At perimeter window and door shim spaces and crevices in exterior wall and roof.
b. Products: Great Stuff Pro.
1) Substitutions: See Section 01 60 00 - Product Requirements.
2. Closed cell, medium density spray applied polyurethane foam insulation and air barrier.
a. Locations of Use: At perimeter window and door shim spaces and crevices in exterior wall and roof.
b. Products: BASF Walltite ECO v.2: www.walltite.com.
1) Substitutions: See Section 01 60 00 - Product Requirements.

2.07 ACCESSORIES

A. Adhesives, Sealants and Primers - General: Provide only products having lower volatile organic compound (VOC) content than required by SCAQMD 1168.

B. Sheet Vapor Retarder: Specified in Section 07 25 00.

C. Sheet Vapor Retarder: Black polyethylene film for above grade application, 10 mil, 0.010 inch thick.

D. Interior Vapor Retarder: Modified polyethylene/polyacrylate (PE/PA) film reinforced with polyethylene terephthalate (PET) fibers, 12 mils, 0.012 inch thick.
1. Width: 4.9 feet.

E. Tape: Reinforced polyethylene film with acrylic pressure sensitive adhesive.
1. Application: Sealing of interior circular penetrations, such as pipes or cables.
2. Width: Are required for application.
3. Temperature Resistance: Minus 40 degrees F to 212 degrees F

F. Flashing Tape: Special reinforced film with high performance adhesive.
1. Application: Window and door opening flashing tape.
2. Width: As required for application.
3. Primer: Tape manufacturer's recommended product.

G. Sheet Vapor Retarder: ASTM C665, polyamide film vapor retarder for use with unfaced, vapor permeable glass fiber and mineral wool insulation in wall cavities.
1. Water Vapor Permeance:
a. ASTM E96/E96M, Dry Cup Method: 1.0 perms or less.
b. ASTM E96/E96M, Wet Cup Method: 10.0 perms.
2. Flame Spread Index: 20 or less when tested in accordance with ASTM E84.

3. Smoke Developed Index: 55 or less when tested in accordance with ASTM E84.

H. Vapor Retarder Tape: Self-adhering type, 2-inch wide of type recommended by vapor retarder manufacturer for sealing joints and penetrations in vapor retarder.

I. Sheet Vapor Retarder: ASTM C1136, flame retardant facing consisting of 0.00030 inch aluminum foil, fiberglass reinforcing and kraft paper laminated together with flame retardant adhesive.
   1. Water Vapor Transmission Rate: .02 perms or less when tested in accordance with ASTM E96/E96M.
   2. Flame Spread Index: Foil side 10 or less when tested in accordance with ASTM E84.
   3. Smoke Developed Index: Foil side 5 or less when tested in accordance with ASTM E84.

J. Vapor Retarder Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

K. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.

L. Insulation Fasteners: Lengths of unfinished, 13 gage, 0.072 inch high carbon spring steel with chisel or mitered tips, held in place by tension, length to suit insulation thickness and substrate, capable of securely supporting insulation in place.

M. Fiber Board Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
   1. At masonry veneer applications, provide manufacturer's recommended retaining clips for attachment to seismic veneer ties in addition to impaling clips.

N. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
   1. Length as required for thickness of insulation material and penetration of deck substrate.

O. Continuous Insulation (CI) Support Systems: Composite framing support (CFS) system consisting of insulated fiberglass reinforced plastic (FRP) girts that support CI and provide cladding attachment support integrated with metal wall panels or CMU veneer exterior wall cladding.
   1. Substrate: Attach CFS system components to exterior sheathing over metal stud framing, exterior sheathing over wood stud framing, or concrete masonry units (CMU).
   2. Depth of Girts: As required for thickness of insulation.
   3. Length: 6 inch for clips, and 96 inch for girts.
   4. Spacing of Girts: 16 inch on center, vertically.
   5. Manufacturers:
      a. Advanced Architectural Products, LLC; SMARTci Plus 3-in-1 System: www.smartcisystems.com/#sle.
      b. Substitutions: See Section 01 60 00 - Product Requirements.

P. Polystyrene Board Insulation Fasteners: Galvanized mechanical fastening devices for installing polystyrene board insulation with 2-inch square plates and self-locking washers.
   1. Fastener Length and Type: As applicable for insulation thickness and substrate.
   2. Available Product: Item IHSP Spindle as manufactured by Midwest Fasteners, Inc.
      a. Substitutions: See Section 01 60 00 - Product Requirements.

Q. Adhesive for Polystyrene Board Insulation: High strength, industrial grade spray adhesive, acceptable to insulation manufacturer.
   1. Available Product: 3M Polystyrene Foam Insulation 78 Spray Adhesive.
      a. Substitutions: See Section 01 60 00 - Product Requirements.

R. Insulation Seam Tape: Pressure sensitive, self-adhering seam tape recommended by insulation manufacturer that qualifies as a continuous air barrier material in accordance with ASHRAE 90.1 and complying with AAMA 711.

1. Available Product: JointSealR Foam Joint Tape manufactured by Owens Corning or equal.

S. Nails or Staples: Steel wire; electroplated or galvanized; type and size to suit application.

T. Wire Mesh: Galvanized steel, hexagonal wire mesh.

U. Protection Board for Below Grade Insulation: Cementitious, 1/4 inch thick.

V. Foam Adhesive: Type recommended by insulation manufacturer for application with demonstrated capability to bond insulation securely to substrates without damaging insulation or substrates and for sealing joints between insulation boards.
1. Available Product: Foam2Foam manufactured by Wind Lock; www.wind-lock.com.
a. Substitutions: See Section 01 60 00 - Product Requirements.

W. Adhesive: Gun grade, interior and exterior, and compatible with insulation and substrates; complies with ASTM C557.
1. Application Temperature: 40 to 100 degrees F at contact surfaces.
2. Volatile Organic Content (VOC): Less than 7 percent by weight.
3. Manufacturers:
a. Liquid Nails, a brand of PPG Architectural Coatings; LN-903 Heavy Duty Construction Adhesive, 10 fl oz: www.liquidnails.com/#sle.
b. Substitutions: See Section 01 60 00 - Product Requirements.

X. Adhesive: Vapor retarder type, trowel consistency; fire retardant, compatible with insulation and substrate, complying with the following:
1. Initial Set: ____ hours.
2. Cured Full Set: ____ hours at ____ degrees F.
3. Moisture Vapor Permeance: _____ perms measured in accordance with ASTM E96/E96M, Procedure E.
4. Bond Strength: ____ lbs.
5. Service Temperature: ____ to _____ degrees F at contact surfaces.

Y. Seals and Sealants: Chemically and physically compatible with adjacent materials at locations to eliminate uncontrolled air leakage.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT EXTERIOR WALLS

A. Adhere a 6 inch wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
1. Tape seal joints between sheets.
2. Extend sheet full height of joint.

B. Apply adhesive to back of boards:
1. Three continuous beads per board length.
2. Full bed 1/8 inch thick.

C. Install rigid insulation directly to steel studs or exterior grade sheathing at 16 inches on center with manufacturer recommended mechanical fasteners, and tape joints with manufacturer's minimum 4 inch wide sealant tape; comply with ASTM E2357.

D. Install boards horizontally on walls.
1. Place boards to maximize adhesive contact.
2. Install in running bond pattern.
3. Butt edges and ends tightly to adjacent boards and to protrusions.

E. Extend boards over expansion joints, unbonded to wall on one side of joint.

F. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

G. Place 6 inch wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames, and tape seal in place to ensure continuity of vapor retarder and air seal.

H. Tape insulation board joints.

3.03 FOAM BOARD INSTALLATION AT CAVITY WALLS BEHIND METAL WALL PANELS

A. Coordinate placement of insulation panels with cladding supports. Install insulation in two layers with joints offset where feasible. Refer to Section 07 42 13 - Metal Wall Panels.

B. Install first layer of first row of insulation mechanically attached and all other layers adhesively attached. Seal all joints with tape.
   1. Install fasteners at insulation manufacturer's recommended spacing.

C. Apply 2 inch diameter daubs of adhesive spaced approximately 12 inches on center both ways on inside face of insulation board.

D. Butter all edges of insulation board with adhesive to limit bulk water entry.

E. Fit insulation between obstructions with joints staggered and edges butted tightly.
   1. Press units firmly against inside substrate.
   2. Make insulation continuous. Fill all voids.

F. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.04 FIBER BOARD INSTALLATION AT CAVITY WALLS BEHIND METAL WALL PANELS

A. Coordinate placement of insulation panels with cladding supports. Refer to Section 07 42 13 - Metal Wall Panels.

B. Install insulation mechanically attached. Install fasteners at insulation manufacturer's recommended spacing. Align fasteners with studs in substrate.
   1. Where fasteners miss studs, do not remove the fastener. Install additional fasteners as required.

C. Fit insulation between obstructions with edges tightly butted.
   1. Press units firmly against substrate.
   2. Make insulation continuous. Fill all voids.

D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.05 FOAM BOARD INSTALLATION AT CAVITY WALLS BEHIND MASONRY VENEER

A. Apply insulation in two layers with joints staggered where feasible. Coordinate with placement of seismic veneer ties.

B. Secure impale fasteners to substrate at following frequency:

C. Adhere a 6 inch wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.

D. Apply adhesive to back of boards:

E. Install boards to fit snugly between wall ties.

F. Install boards horizontally on walls.
   1. Install in running bond pattern.
   2. Butt edges and ends tightly to adjacent boards and to protrusions.

G. Install first layer of first row of insulation mechanically attached and all other layers adhesively attached. Seal all joints with tape.
   1. Install fasteners at insulation manufacturer's recommended spacing.

H. Butter all edges of insulation board with adhesive to limit bulk water entry.

I. Fit insulation between obstructions with joints staggered and edges butted tightly.
   1. Press units firmly against inside substrate.

2. Make insulation continuous. Fill all voids.

J. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

K. Place 6 inch wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames, and tape seal in place to ensure continuity of vapor retarder and air seal.

3.06 BOARD INSTALLATION USING COMPOSITE FRAMING SUPPORT (CFS) SYSTEM

A. Install CFS system in accordance with manufacturer's installation instructions.

B. Install CFS system in compliance with system orientation, sizes, and locations as indicated on drawings.

C. Install CFS system to fill-in exterior wall spaces without gaps or voids, and do not compress insulation boards.

D. Trim insulation neatly to fit spaces, and insulate miscellaneous gaps and voids with approved expandable foam sealant.

3.07 FIBER BOARD INSTALLATION BEHIND MASONRY VENEER

A. Coordinate with placement of seismic veneer ties.
   1. Refer to Section 04 20 00 - Unit Masonry.

B. Install boards to fit snugly between wall ties.

C. Install boards horizontally on walls.
   1. Butt edges and ends tightly to adjacent boards and to protrusions.
   2. Place manufacturer's recommended retaining clips installed to seismic veneer ties.
   3. Provide supplemental impaling pins as recommended by insulation manufacturer to retain insulation snug to substrate.

D. Fit insulation between obstructions with joints staggered and edges butted tightly.
   1. Press units firmly against inside substrate.
   2. Make insulation continuous. Fill all voids.

E. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.08 BATT INSTALLATION

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.

B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.

C. Install insulation inside box headers and similar closed framing members. Coordinate with Work of Section 05 40 00 - Cold-Formed Metal Framing.

D. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

E. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
   1. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

F. Install with factory applied vapor retarder membrane facing warm side of building spaces. Lap ends and side flanges of membrane over framing members and seal.
   1. A separate sheet vapor barrier as specified can be provided in lieu of a factory applied vapor retarder.

G. At wood framing, place vapor retarder on warm side of insulation by stapling at 6 inches on center. Lap and seal sheet retarder joints over member face.
   1. Turn up foundation gasket installed as Work of Section 06 10 00 - Rough Carpentry. Lap under vapor retarder and adhere to bottom edge of vapor barrier for an air tight seal.

H. At metal framing, place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over member face.

I. Tape seal tears or cuts in vapor retarder.
   1. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
   2. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

J. Extend vapor retarder tightly to full perimeter of adjacent window and door frames (seal to self-adhered membrane flashing) and other items interrupting the plane of the membrane. Tape seal in place.

K. Seal vapor retarder at penetrations, and perimeter floor, wall and ceiling terminations to eliminate uncontrolled air leakage.

L. Coordinate work of this section with requirements for vapor retarder specified in Section 07 25 00.

M. Coordinate work of this section with construction of water-resistive barrier (WRB) specified in Section 07 25 00.

3.09 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

3.10 INSTALLATION OF FOAM SEALANT/INSULATION

A. Install foam sealant/insulation at perimeters of doors and windows and shim spaces and crevices in exterior wall and roof.
   1. Isolate foam sealant from building interior with a layer of gypsum board or other thermal barrier as applicable to conditions of installation,

3.11 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 25 00
WEATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water-Resistive Barrier (WRB): Under exterior wall cladding, over sheathing substrate.
   1. WRB-1: Vapor Permeable.
   2. WRB-2: Vapor Impermeable.

1.02 RELATED REQUIREMENTS

A. Section 01 40 00 - Quality Requirements: Mock-up requirements.

B. Section 07 21 00 - Thermal Insulation: Vapor retarder installed in conjunction with batt insulation.

C. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with water-resistive barriers.

D. Section 07 92 00 - Joint Sealants: Sealing building expansion joints.

1.03 DEFINITIONS

A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.

B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.

C. Vapor Retarder: Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
   1. Water Vapor Permeance: For purposes of conversion, 57.2 ng/(Pa s sq m) = 1 perm.

1.04 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.

B. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

C. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

D. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.

E. ASTM E1186 - Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems.

F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.

G. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials.

H. ICC-ES AC212 - Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers over Exterior Sheathing; ICC Evaluation Service, Inc.

I. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

1.05 ASSEMBLY PERFORMANCE

A. Construct the building envelope to provide a continuous air and vapor barrier assembly that has an air permeability not to exceed 0.004 cfm per sq. ft. under a pressure differential of 0.3 inch water (1.57 psf) when tested in accordance with ASTM E2178. Assembly shall perform as a

liquid drainage plane flashed to discharge condensation or water penetration to the exterior. Assembly shall accommodate movements of building materials by providing expansion and control joints as required, with accessory air and vapor seal materials as such locations, changes in substrate and perimeter conditions.

1. Assembly shall be capable of withstanding combined positive and negative design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure.
2. Assembly shall not displace adjacent materials under full load.
3. Assembly shall be joined in an airtight and flexible manner to the air barrier material of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations and creep, and anticipated seismic movement.

B. Connections to Adjacent Materials: Provide connections to prevent air leakage and vapor migration at the following locations:

1. Foundation and walls, including penetrations, ties and anchors.
    a. Walls, windows, curtain walls, storefronts, louvers or doors.
    b. Different wall assemblies, and fixed openings within those assemblies.
    c. Wall and roof connections and penetrations.
    d. Floors over unconditioned space.
    e. Walls, floor and roof across construction, control joints.
    f. Walls, floors and roof to utility, pipe and duct penetrations.
    g. Expansion joints.
    h. All other leakage pathways in the building envelope.

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on material characteristics.

1. If materials and accessories are not all provided as a system from one manufacturer, provide certification of compatibility between products and with substrates. Certification may be from the manufacturer of each product, or may be documented through independent testing. Provide certifications at no added cost to Owner.
2. Include statements that materials are compatible with adjacent materials proposed for use.
3. Submit reports indicating that field peel-adhesion test on all materials to which sealants are adhered have been performed and the changes made, if required, to other approved materials, in order to achieve successful adhesion.

C. Shop Drawings: Provide drawings of special joint conditions.

1. Include shop drawings of proposed mock-ups showing plans, elevations, isometric details, installation sequence and connections to the test apparatus.

D. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

E. International Code Council Evaluation Services Reports.

F. Fire Testing: From a qualified testing agency, documentation that the water-resistive barrier system as a component of a wall assembly has been tested and passed NFPA 285.

G. Warranty:

1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
2. Submit installer's certification that installation complies with all warranty conditions for the water-resistive barrier.

1.07 PREINSTALLATION CONFERENCE

A. Preinstallation Meeting: Convene a meeting at least one week prior to starting work; require attendance of affected installers; invite Architect and Owner.

1. Attendees shall include manufacturer's representative as required to meet warranty requirements.
2. Meeting shall include review of integrated exterior mock-up to confirm installation procedures as required to provide a warrantable assembly.
3. Establish requirements for other trades for patching and repairing any penetrations or damage to water-resistive barrier caused by those trades and material required for use for such repairs.
4. Review requirements for Air Barrier Testing specified in Section 01 40 00 - Quality Requirements.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer, with a record of successful installations on projects of similar scope.

B. Single Source Responsibility: Obtain water-resistive barrier materials from a single manufacturer regularly engaged in manufacturing the product.

C. Mock-Up Tests for Air and Water Infiltration: Test mock-up for air and water infiltration in accordance with ASTM E1186 and ASTM E1105. Use smoke tracer to locate sources of air leakage. If deficiencies are found, repair or modify mock-up and retest until satisfactory results are obtained. Deficiencies include air leakage beyond values specified, uncontrolled water leakage and unsatisfactory workmanship.
   1. Perform the air leakage tests and water penetration test of mock-up prior to installation of cladding and trim but after installation of all fasteners for cladding and trim and after installation of other penetrating elements. For fasteners which would normally only be installed with cladding, install representative fasteners without cladding; intent is to perform testing with all types of penetrations in place.

D. Mock-Up Tests for Adhesion: Test mock-up of fluid-applied and sheet applied materials for adhesion in accordance with ASTM D4541 using a Type 1 pull tester except that the disk used shall be 100 mm in diameter and the membrane shall be cut through to separate the material attached to the disk from the surrounding material. Perform test after curing period recommended by the manufacturer. Record mode of failure and area which failed in accordance with ASTM D4541. When the air barrier material manufacturer has established a minimum adhesion level for the product on the particular substrate, the inspection report shall indicate whether this requirement has been met. Where the manufacturer has not declared a minimum adhesion value for their product/substrate combination, then the inspector shall simply record the value.

E. Air Barrier Testing: Comply with requirements specified in Section 01 40 00 - Quality Requirements for air leakage testing of the completed building.

1.09 MOCK-UP

A. Mock-ups: Provide water-resistive barriers with related materials as required to complete integrated exterior mock-ups as specified in Section 01 40 00 - Quality Requirements and other Sections.
   1. Demonstrate complete installation of water-resistive barrier and treatment of internal and external corners, openings and sill flashings.
   2. Perform mock-up tests for air and water infiltration.
   3. Perform mock-up tests for adhesion.
   4. Establish requirements for patching and repairing any penetration or damage to water-resistive barrier caused by Work of other Sections and material required for use for such repairs.
   5. Obtain water-resistive barrier manufacturer's acceptance of barrier installation, including flashing installation.

1.10 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

B. Do not install water-resistive barrier in snow, rain, fog, or mist without temporary protection and supplemental heat as required. Do not install water-resistive barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the manufacturer. Apply membrane to a surface dry substrate, or in accordance with manufacturer's recommendations.

C. Moisture test wood stud framing at openings and confirm moisture content is less than specified for framing material in Section 06 10 00 - Rough Carpentry. Do not commence installation until moisture content of framing is within tolerances.

1.11 WARRANTY

A. Provide manufacturer's warranty for flashing and water-resistive barrier systems.
   1. Manufacturer to pay for the cost of the materials and labor to completely resolve problems, including, but not limited to, failure of product to perform to manufacturer's published specifications.
   2. Warranty Period: Ten years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 WEATHER BARRIER ASSEMBLIES

A. Water-Resistive Barrier: Provide on exterior sheathed walls under exterior cladding or masonry veneer.
   1. On outside surface of sheathing of exterior walls behind masonry veneer and metal wall panels, use water-resistive barrier coating.

2.02 WATER-RESISTIVE BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

A. Fluid-Applied Water-Resistive Barrier - Vapor Permeable WRB-1: Liquid applied, resilient, UV-resistant coating and associated joint treatment. Use regular or low-temperature formulation depending on site conditions, within temperature ranges specified by manufacturer. Provide related accessories including primer, seam tape, mastic, fluid and sealant recommended by manufacturer. Subject to compliance with requirements, provide one of the following:
   1. BASF MasterSeal AWB 660 (formerly Enershield-HP): www.master-builders-solutions.basf.us.
      a. Composition: One component, fluid-applied vapor permeable air/water-resistive barrier based on silica fortified rubber chemistry.
      b. Water-Based Primer for Flashing, Transition Strip and Detail Membrane: MasterSeal AWB 950 P Water-Based Primer or as recommended by manufacturer.
      c. Transition Membrane (SAM): Polyester-faced 30-mil thick self-sealing rubberized asphalt transition membrane.
         1) Product: MasterSeal AWB 970 FIB.
      d. Transition Aluminum Membrane (SAM):
         1) Product: As recommended by manufacturer.
      e. Flexible Membrane Through-Wall Flashing:
         1) Product: As recommended by manufacturer.
      f. Liquid Flashing Membrane: One-component elastomeric material.
         1) Product: MasterSeal AWB 900.
      g. Wet Film Thickness: 10 mils minimum at sheathing and concrete; 20 mils minimum at plywood sheathing and concrete masonry units.
      h. Water Vapor Permeance: 18 perm, maximum, when tested in accordance with ASTM E96/E96M.
      i. VOC Content: Less than 50 g/L when tested in accordance with 40 CFR 59, Subpart D.
      j. Code Acceptance: Comply with applicable requirements of ICC-ES AC212.
      k. Suitable for use on concrete, unit masonry, plywood, and gypsum sheathing.
      l. Joint Preparation Treatment: Coating manufacturer's recommended method, either tape or reinforcing mesh saturated with coating material.

2. GCP Applied Technologies Perm-A-Barrier VPL: www.gcpat.com.
   a. Composition: One-component, acrylic membrane
   b. Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Perm-A-Barrier WB Primer or Primer Plus.
   c. Transition Membrane (SAM): 36 mil self-adhesive rubberized asphalt bonded to 4 mil cross-laminated, high-density polyethylene film.
      1) Product: Perm-A-Barrier Detail Membrane.
   d. Transition Aluminum Membrane (SAM): 35 mil self-adhesive rubberized asphalt bonded to 5 mil aluminum film.
      1) Product: Perm-A-Barrier Aluminum Flashing.
   e. Flexible Membrane Through-Wall Flashing: 32 mil self-adhesive rubberized asphalt bonded to 8 mil cross-laminated, high-density polyethylene film.
      1) Product: Perm-A-Barrier Wall Flashing.
   f. Liquid Applied Membrane: Two component, elastomeric, liquid applied detailing compound.
      1) Product: Bituthene Liquid Membrane.
   g. Wet Film Thickness: 68 mils, minimum.
   h. Water Vapor Permeance: 15 perm, when tested in accordance with ASTM E96/E96M.
   i. VOC Content: Less than 30 g/L when tested in accordance with 40 CFR 59, Subpart D.
   j. Code Acceptance: Comply with applicable requirements of ICC-ES AC212.
   k. Suitable for use on concrete, unit masonry, plywood, and gypsum sheathing.
   l. Joint Preparation Treatment: Coating manufacturer's recommended method, either tape or reinforcing mesh saturated with coating material.
3. Henry Company Air-Bloc 31MR: www.henry.com.
   a. Composition: One-component water-based elastomeric emulsion, trowel or spray applied.
   b. Water-Based Primer for Flashing, Transition Strip and Detail Membrane.
      1) Product: Aquatac.
   c. Transition Membrane (SAM): 40 mil SBS modified bitumen, self-adhering sheet membrane.
      1) Product: Blueskin SA, LT or HT.
   d. Transition Aluminum Membrane (SAM): 45 mil SBS modified bitumen, self-adhering membrane with surface layer of metallic aluminum film.
      1) Product: HE200 AM Metal Clad.
   e. Flexible Membrane Through-Wall Flashing: 40 mil SBS modified bitumen, self-adhering sheet membrane.
      1) Product: Blueskin TWF.
   f. Liquid Applied Membrane: Single component STPe liquid-applied flashing membrane.
      1) Product: Air-Bloc LF
   g. Wet Film Thickness: 70 mils minimum over gypsum sheathing or concrete; 90 mils minimum over concrete masonry units.
   h. Water Vapor Permeance: 21 perm, when tested in accordance with ASTM E96/E96M.
   i. VOC Content: Less than 15 g/L when tested in accordance with 40 CFR 59, Subpart D.
   j. Code Acceptance: Comply with applicable requirements of ICC-ES AC212.
   k. Suitable for use on concrete, unit masonry, plywood, and gypsum sheathing.
   l. Joint Preparation Treatment: Coating manufacturer's recommended method, either tape or reinforcing mesh saturated with coating material.
4. Tremco ExoAir 230: www.tremcosealants.com.
   a. Composition: Elastomeric, modified bituminous or synthetic polymer membrane.

b. Primer for Flashing, Transition Strip and Detail Membrane.
   1) Product: ExoAir Primer.
c. Transition Membrane (SAM): 22 mil butyl with HDPP facer, self-adhering sheet membrane.
   1) Product: ExoAir 110AT.
d. Transition Aluminum Membrane (SAM): Self-adhering membrane with surface layer of metallic aluminum film.
   1) Product: As recommended by manufacturer.
e. Flexible Membrane Through-Wall Flashing: 32 mil SBS rubberized asphalt laminated to an 8 mil cross-laminated high density polyethylene film, self-adhering sheet membrane.
   1) Product: ExoAir TWF.
f. Wet Film Thickness: 48 mils, minimum on exterior sheathing, 70 mils, minimum on porous substrates.
g. Water Vapor Permeance: 11.7 perm, when tested in accordance with ASTM E96/E96M.
h. VOC Content: Less than 50 g/L when tested in accordance with 40 CFR 59, Subpart D.
i. Code Acceptance: Comply with applicable requirements of ICC-ES AC212.
j. Suitable for use on concrete, unit masonry, plywood, and gypsum sheathing.
k. Joint Preparation Treatment: Coating manufacturer's recommended method, either tape or reinforcing mesh saturated with coating material.

5. Joint Filler: As recommended by coating manufacturer and suitable to the substrate.

2.03 WATER-RESISTIVE BARRIER - VAPOR RETARDER MATERIALS (AIR BARRIER AND WATER-RESISTIVE)

A. Fluid-Applied Air and Vapor Barrier Coating - Vapor Impermeable WRB-2: Liquid applied, resilient, UV-resistant coating and associated joint treatment. Use regular or low-temperature formulation depending on site conditions, within temperature ranges specified by manufacturer. Provide related accessories including primer, seam tape, mastic, fluid and sealant recommended by manufacturer. Subject to compliance with requirements, provide one of the following:

1. BASF MasterSeal AWB 660 I (formerly Enershield I): www.master-builders-solutions.basf.us.
   a. Composition: One component, water based silica fortified rubber chemistry, Class 1 Vapor retarder.
   b. Water-Based Primer for Flashing, Transition Strip and Detail Membrane: MasterSeal AWB 950 P or as recommended by manufacturer.
   c. Transition Membrane (SAM): Polyester-faced 30-mil thick self-sealing, rubberized asphalt transition membrane.
      1) Product: MasterSeal AWB 970 FIB.
   d. Transition Aluminum Membrane (SAM):
      1) Product: As recommended by manufacturer.
   e. Flexible Membrane Through-Wall Flashing:
      1) Product: As recommended by manufacturer.
   f. Liquid Flashing Membrane: One-component elastomeric material.
      1) Product: MasterSeal AWB 900.
   g. Wet Film Thickness: 26 mils, minimum.
   h. Water Vapor Permeance: 0.09 perm, maximum, when tested in accordance with ASTM E96/E96M.
   i. VOC Content: Less than 50 g/L when tested in accordance with 40 CFR 59, Subpart D.
   j. Code Acceptance: Comply with applicable requirements of ICC-ES AC212.
   k. Suitable for use on concrete, unit masonry, plywood, and gypsum sheathing.

l. Joint Preparation Treatment: Coating manufacturer's recommended method, either tape or reinforcing mesh saturated with coating material.

2. GCP Applied Technologies Perm-A-Barrier Liquid: www.gcpat.com.
   a. Composition: Two-component, self-curing, synthetic rubber based material free of solvents, isocyanates and bitumen.
   b. Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Perm-A-Barrier WB Primer or Primer Plus.
   c. Transition Membrane (SAM): 36 mil self-adhesive rubberized asphalt bonded to 4 mil cross-laminated, high-density polyethylene film.
      1) Product: Perm-A-Barrier Detail Membrane.
   d. Transition Aluminum Membrane (SAM): 35 mil self-adhesive rubberized asphalt bonded to 5 mil aluminum film.
      1) Product: Perm-A-Barrier Aluminum Flashing.
   e. Flexible Membrane Through-Wall Flashing: 32 mil self-adhesive rubberized asphalt bonded to 8 mil cross-laminated, high-density polyethylene film.
      1) Product: Perm-A-Barrier Wall Flashing.
   f. Liquid Flashing Membrane: Two component, elastomeric, liquid applied detailing compound.
      1) Product: Bituthene Liquid Membrane.
   g. Wet Film Thickness: 60 mils, minimum.
   h. Water Vapor Permeance: 0.08 perm, maximum, when tested in accordance with ASTM E96/E96M.
   i. VOC Content: Less than 75 g/L when tested in accordance with 40 CFR 59, Subpart D.
   j. Code Acceptance: Comply with applicable requirements of ICC-ES AC212.
   k. Suitable for use on concrete, unit masonry, plywood, and gypsum sheathing.
   l. Joint Preparation Treatment: Coating manufacturer's recommended method, either tape or reinforcing mesh saturated with coating material.
3. Henry Company Air-Bloc 32MR: www.henry.com.
   a. Composition: One-component elastomeric membrane, trowel or spray applied.
   b. Water-Based Primer for Flashing, Transition Strip and Detail Membrane.
      1) Product: Aquatac.
   c. Transition Membrane (SAM): 40 mil SBS modified bitumen, self-adhering sheet membrane.
      1) Product: Blueskin SA, LT or HT.
   d. Transition Aluminum Membrane (SAM): 45 mil SBS modified bitumen, self-adhering membrane with surface layer of metallic aluminum film.
      1) Product: HE200 AM Metal Clad.
   e. Flexible Membrane Through-Wall Flashing: 40 mil SBS modified bitumen, self-adhering sheet membrane.
      1) Product: Blueskin TWF.
   f. Liquid Applied Flashing: Single component STPe liquid-applied flashing membrane.
      1) Product: Air-Bloc LF.
   g. Wet Film Thickness: 75 mils minimum over gypsum sheathing or concrete; 110 mils minimum over concrete masonry units.
   h. Water Vapor Permeance: 0.08 perm, maximum, when tested in accordance with ASTM E96/E96M.
   i. VOC Content: Less than 100 g/L when tested in accordance with 40 CFR 59, Subpart D.
   j. Code Acceptance: Comply with applicable requirements of ICC-ES AC212.
   k. Suitable for use on concrete, unit masonry, plywood, and gypsum sheathing.
   l. Joint Preparation Treatment: Coating manufacturer's recommended method, either tape or reinforcing mesh saturated with coating material.
4. Tremco ExoAir 130: www.tremcosealants.com.

a. Composition: Water-based elastomeric, single-component, UV-resistant synthetic membrane.
b. Primer for Flashing, Transition Strip and Detail Membrane.
    1) Product: ExoAir Primer.
c. Transition Membrane (SAM): 36 mil SBS rubberized asphalt, self-adhering sheet membrane.
    1) Product: ExoAir 110AT.
d. Transition Aluminum Membrane (SAM): SBS modified bitumen, self-adhering membrane with surface layer of metallic aluminum film.
    1) Product: As recommended by manufacturer.
e. Flexible Membrane Through-Wall Flashing: 32 mil SBS rubberized asphalt laminated to an 8 mil film, self-adhering sheet membrane.
    1) Product: ExoAir TWF.
f. Wet Film Thickness: 70 mils, minimum.
g. Water Vapor Permeance: 1 perm, maximum, when tested in accordance with ASTM E96/E96M.
h. VOC Content: Less than 50 g/L when tested in accordance with 40 CFR 59, Subpart D.
i. Code Acceptance: Comply with applicable requirements of ICC-ES AC212
j. Suitable for use on concrete, unit masonry, plywood, and gypsum sheathing.
k. Joint Preparation Treatment: Coating manufacturer's recommended method, either tape or reinforcing mesh saturated with coating material.

5. Joint Filler: As recommended by coating manufacturer and suitable to the substrate.

2.04 ACCESSORIES

A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.
    1. At penetrations, provide sealant recommended by membrane manufacturer.
        a. Available Products:
            1) BASF; MasterSeal NP 150.
            2) GCP Applied Technologies; S100 Sealant.
            3) Henry Company; HE925B - BES Sealant.
            4) Tremco Inc; Spectrum 1 Ultra Low-Modulus Silicone Joint Sealant.
            5) Substitutions: See Section 01 60 00 - Product Requirements.
    2. Primers, Cleaners, and Other Sealant Materials: As recommended by sealant manufacturer, appropriate to application, and compatible with adjacent materials.

B. Flashing Panels:
    1. Flashing Panels: Provide flashing panels to weatherproof plumbing and electrical penetrations in exterior walls.
        a. Manufacturer: Quickflash Weatherproofing Products, Inc, 4129 Wagon Trail Avenue, Las Vegas, Nevada 89118. Phone: 702.614.6100.
        b. Plumbing Flashing Panels:
            1) Materials:
                (a) Panel: Combination of high-density polyethylene (HDPE) and low density polyethylene (LDPE).
                (b) Weatherproof Seal: Thermoplastic elastomer.
            2) Products: As required for project conditions.
        c. Electrical Flashing Panels:
            1) Material: Thermoplastic elastomer.
            2) Products: As required for project conditions.

C. Fasteners: As recommended by water-resistive barrier manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas and conditions under which water-resistive barrier assemblies will be applied, with Installer present, for compliance with requirements. Verify that surfaces and conditions are ready to accept the Work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Do not proceed with installation until after minimum concrete and mortar curing period recommended by water-resistive barrier manufacturer.

C. Verify that the following conditions are met:
   1. Surfaces are sound, dry, even and free of oil, grease, dirt, excess mortar or other contaminants.
   2. Concrete surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions.
   3. Masonry joints are flush and completely filled with mortar and all excess mortar sitting on masonry ties has been removed.

D. Verify substrate is surface dry. Test for capillary moisture by plastic sheet method according to ASTM D4263 and take suitable measures until substrate passes moisture test. Surface dry is an acceptable substrate condition if acceptable to the manufacturer.

E. Verify sealants used in sheathing are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.

3.02 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

B. All surfaces must be dry, sound, clean and free of oil, grease, dirt, excess mortar or other contaminants detrimental to the adhesion of the water-resistive barrier membrane and flashings. Fill voids and gaps in substrate greater than 1/4 inch in width to provide an even surface.

C. Clean and prime substrate surfaces to receive sealants, fluid-applied water-resistive barriers, and self-adhered membranes in accordance with manufacturer's instructions. Mask off adjoining surfaces to prevent overspray and spillage.

D. Prime substrate for application of sheet membrane transition strips as recommended by manufacturer.
   1. Prime masonry and concrete substrates with conditioning primer.
   2. Prime gypsum sheathing with an adequate number of coats to achieve required bond, with adequate drying time between coats.
   3. Prime metal and painted substrates with primer.
   4. Prepare, treat and seal vertical and horizontal surfaces at terminations and penetrations through water-resistive barrier and at protrusions.

E. Prime substrate for application of fluid-applied water-resistive membrane if recommended by manufacturer.

F. Verify that window and door rough openings and all other through-wall penetrations are flashed in accordance with water-resistive barrier manufacturer's recommendations and that all sheet metal flashing work to be installed as Work of other Sections is complete, including any self-adhering membrane, where indicated.

3.03 INSTALLATION

A. Applications:
   1. Water-Resistive Barrier: Install water-resistive barrier behind metal wall panels and masonry veneer over sheathed, masonry, and concrete walls.
      a. Provide WRB-1 at walls with interior insulation within a framed wall.

b. Provide WRB-2 at masonry or concrete walls without interior insulation within a framed wall.

B. Install transition strip materials and fluid-applied water-resistive barrier to provide continuity throughout the building envelope.

C. Install materials in accordance with manufacturer's instructions.

D. Water-Resistive Barrier (WRB): Install continuous air-tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces. Lap and seal to interior vapor retarder.

E. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.

F. Self-Adhered Membrane (SAM):
1. Prepare substrate in manner recommended by membrane manufacturer; fill and tape joints in substrate and between dissimilar materials.
2. Lap sheets shingle-fashion to shed water and seal laps air-tight. Provide minimum 3-inch edge and 5-inch end laps. Stagger vertical joints.
3. At wide joints, provide extra self-adhered membrane allowing joint movement.

G. Fluid-Applied Water-Resistive Barrier: Install materials in accordance with manufacturer's instructions and as follows, unless manufacturer recommends other procedures in writing based on project conditions or particular requirements of their recommended materials:
1. Apply primer for transition strips at rate recommended by manufacturer. Allow primer to dry completely before transition strip application. Apply as many coats as necessary for proper adhesion.
2. Apply primer for fluid-applied water-resistive barrier as recommended by manufacturer. Based on manufacturer’s recommendation, no primer may be required for the fluid-applied materials.
3. Apply fluid-applied water-resistive barrier using equipment and methods recommended by manufacturer, to achieve a dry film thickness as recommended by the manufacturer and as specified.
4. Apply fluid-applied water-resistive barrier and transition strips to shed water naturally without interception by a sheet edge, unless that edge is sealed with permanently flexible termination mastic.
5. Position subsequent sheets of transition strips applied above so that membrane overlaps the membrane sheet below by a minimum of 2 inches, unless greater overlap is recommended by manufacturer. Roll into place with roller.
6. Overlap horizontally adjacent pieces of transition strips a minimum of 2 inches, unless greater overlap is recommended by manufacturer. Roll seams with roller.
7. Seal around all penetrations with termination mastic, extruded silicone sealant, membrane counterflashing or other procedure in accordance with manufacturer’s recommendations.
   a. Provide Transition Aluminum Membrane (SAM) where adhesion to silicone sealants is required.
8. Connect water-resistive 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 and other intersection conditions and perform sealing of penetrations, using accessory materials and in accordance with the manufacturer’s recommendations.
9. At changes in substrate plane, provide transition material (bead of sealant, mastic, extruded silicone sealant, membrane counterflashing or other material recommended by manufacturer) under membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
10. Provide mechanically fastened non-corrosive metal sheet to span gaps in substrate plane and to make a smooth transition from one plane to the other. Membrane shall be continuously supported by substrate or as recommended by the manufacturer.
11. At through-wall flashings, provide an additional 6 inch wide strip of manufacturer’s recommended membrane counterflashing to seal top of through-wall flashing to

membrane or as recommended by manufacturer. Seal exposed top edge of strip with bead of mastic or as recommended by manufacturer.

12. At deflection and control joints, provide backup for the membrane to accommodate anticipated movement.
13. At expansion joints provide transition to the joint assemblies.
14. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and as recommended by the manufacturer.
15. At end of each working day, seal top edge of the self-adhered membrane to substrate with termination mastic.
16. Do not allow materials to come in contact with chemically incompatible materials.
17. Do not expose membrane to sunlight longer than as recommended by the manufacturer.
18. Inspect installation prior to enclosing assembly and repair punctures, damaged areas and inadequately lapped seams with a patch of membrane lapped as recommended by manufacturer.
19. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
20. Use flashing to seal to adjacent construction and to bridge joints.

H. Openings and Penetrations in Exterior Water-Resistive Barriers:
   1. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with self-adhered membrane at least 4 inches wide; do not seal sill flange.
   2. At openings to be filled with non-flanged frames, seal water-resistive barrier to all sides of opening framing, using self-adhered membrane at least 9 inches wide, covering entire depth of framing. Lap jamb flashing into sill pans.
   3. At head of openings, install self-adhered membrane under water-resistive barrier extending at least 2 inches beyond face of jamb flashing; seal barriers to flashing.
   4. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
   5. Service and Other Penetrations: Form self-adhered membrane or use a flashing panel around penetrating item and seal to water barrier surface.
      a. Install flashing panels in strict accordance with manufacturer's instructions.
   6. Install sealants at required locations to limit air infiltration through the water-resistive barrier at membrane terminations at window and door frames, at penetrations and dissimilar material transitions and terminations, including, but not limited to, brick veneer ties, insulation fasteners and similar items.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Coordination of ABAA Tests and Inspections:
   1. Provide testing and inspection required by ABAA QAP.
   2. Notify ABAA in writing of schedule for air barrier work, and allow adequate time for testing and inspection.
   3. Cooperate with ABAA testing agency.
   4. Allow access to air barrier work areas and staging.
   5. Do not cover air barrier work until tested, inspected, and accepted.

C. Do not cover installed water-resistive barriers until required inspections have been completed.

D. Obtain approval of installation procedures by the water-resistive barrier manufacturer based on integrated exterior mock-up, prior to proceeding with remainder of installation.

E. Notify manufacturer's designated representative to obtain periodic observations of water-resistive barrier assembly installation as required for manufacturer to provide specified warranty.

F. Take digital photographs of each portion of the installation prior to covering up.

3.05 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by water-resistive barrier manufacturer.

END OF SECTION

SECTION 07 42 13
METAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured metal panels for exterior wall panels, with related flashings and accessory components.

1.02 RELATED REQUIREMENTS

A. Section 05 40 00 - Cold-Formed Metal Framing: Wall panel substrate.

B. Section 06 10 00 - Rough Carpentry: Wall panel substrate.

C. Section 07 21 00 - Thermal Insulation.

D. Section 07 25 00 - Weather Barriers: Water-resistive barrier under wall panels.

E. Section 07 92 00 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

F. Section 09 00 01 - Finish Legend: Colors for metal wall panels.

G. Section 09 21 16 - Gypsum Board Assemblies: Exterior sheathing.

1.03 REFERENCE STANDARDS

A. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

C. SMACNA (ASMM) - Architectural Sheet Metal Manual.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate dimensions, layout, joints, construction details, trim, and methods of anchorage.
   1. Shop drawings must reflect architectural detailing and conditions shown on the Drawings. Manufacturer's standard catalog-type details are not acceptable.

C. Delegated Design Submittal: For metal wall panels indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparations.
   1. Submit submittals as "Deferred Submittals" in accordance with Section 01 30 00 - Administrative Requirements. Transmit a copy of each submittal indicating agency approval to the Architect for record.

D. Product Data: Manufacturer's data sheets on each product to be used.

E. Samples: Submit two samples of wall panel and soffit panel, 6 inch by 6 inch in size illustrating finish color, sheen, and texture.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

B. Installer Qualifications: Company specializing in installing products of the type specified in this section with minimum five years of documented experience.

C. Designer Qualifications: Design metal wall panel systems, including support framing under direct supervision of a Professional Engineer experienced in design of this Work and licensed in the State of Oregon.

1.06 PREINSTALLATION CONFERENCE

A. Preinstallation Meeting: Convene a meeting at least one week prior to starting work; require attendance of affected installers; invite Architect and Owner.
   1. Meeting shall include review of integrated exterior mock-up to confirm installation procedures.
   2. Establish requirements for patching and repairing any penetrations or damage to water-resistive barrier caused by Work of this Section and material required for use for such repairs.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

B. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.

C. Prevent contact with materials that may cause discoloration or staining of products.

1.08 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Materials Manufacturer Warranty: Repair or replace defective materials for a period of 2 years from Date of Substantial Completion.

C. Finish Warranty: Provide manufacturer's special warranty covering failure of factory-applied exterior finish on metal wall panels and agreeing to repair or replace panels that show evidence of finish degradation, including significant fading, chalking, cracking, or peeling within specified warranty period of 20 years from Date of Substantial Completion.

D. Warrant steel panel core substrate against rupture, structural failure or perforation due to exposure to normal atmospheric corrosion within a 25 year period from Date Substantial Completion.

E. Installer Warranty: Repair or replace products or components which fail due to faulty workmanship for a period of 2 years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers:
   1. AEP Span: www.aepspan.com.
   2. The Bryer Company
   3. Taylor Metal Products: www.taylormetal.com.

2.02 MANUFACTURED METAL PANELS

A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
   1. Provide exterior panels.
   2. Delegated Design: Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall as calculated in accordance with IBC. Design pressure as indicated on Structural Drawings.
   3. Maximum Allowable Deflection of Panel: L/180 for length(L) of span.
   4. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
   5. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
   6. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
   7. Corners: Factory-fabricated in one continuous piece with minimum 2 inch returns.

B. Exterior Wall Panels:
   1. Profile: Vertical; style as indicated.
   2. Side Seams: Double-interlocked, tight-fitting, sealed with continuous gaskets.
   3. Material: Precoated steel sheet, 22 gage, 0.0299 inch minimum thickness.
   4. Panel Width: ___ inches.
   5. Color: As indicated in Section 09 00 01 - Finish Legend.

C. Thermal Spacers: One component clip with integral molded thermal pad for thermally broken and structural attachment for metal wall cladding systems indicated.
   1. Fabricate clip from galvanized steel with punched slots to allow subgirt adjustment.
   2. Depth: As required to fit specified insulation thickness.
   3. Basis-of-Design Product:
      a. Northern Facades; Iso Clip: www.northernfacades.com.
      b. Other Available Manufacturers:
         1) Cascadia Windows, Inc; Cascadia Clip: www.cascadiaclip.com.
         2) GreenGirt Clip; The SMARTci System: www.smartcisystems.com.
         3) Nvelope: www.nvelope.us.
   4. Provide clips, attachment angles, all attachment devices and fasteners as recommended by spacer manufacturer for a complete system.

D. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.

E. Expansion Joints: Same material, thickness and finish as exterior sheets; ___ gage, ___ inch thick; manufacturer's standard brake formed type, of profile to suit system.

F. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.
   1. Provide base trim with factory-drilled drainage holes; minimum 3/16-inch ovals at maximum 24-inches on center. Drill before applying factory finish coatings.

G. Anchors: Stainless steel.

2.03 MATERIALS

A. Precoated Steel Sheet: Aluminum-zinc alloy-coated steel sheet, ASTM A792/A792M, Commercial Steel (CS) or Forming Steel (FS), with AZ50/AZM150 coating; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

2.04 PANEL FINISH

A. Fluoropolymer Coating System: Manufacturer’s standard multi-coat thermocured coating system, including minimum 70 percent fluoropolymer color topcoat with minimum total dry film thickness of 0.9 mil; color and gloss as indicated.

B. Concealed Finish: Manufacturer's standard finish.

C. Colors: As indicated in Section 09 00 01 - Finish Legend.

2.05 ACCESSORIES

A. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant.

B. Concealed Sealants: Non-curing butyl sealant or tape sealant.

C. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
   1. Seam Sealant: Factory-applied, non-skinning, non-drying type.
   2. Color: To match metal panel color where visible.

D. Insect Screen: Charcoal colored fiberglass screening comprised of an 18 x 16 woven mesh.

E. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized. Fastener cap same color as exterior panel.

F. Field Touch-up Paint: As recommended by panel manufacturer.

G. Bituminous Paint: Asphalt base.

H. Self-Adhered Membrane (SAM): Self-adhesive sheet flashing, ASTM D1970/D1970M.
   1. Self-Adhered Membrane: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.036 inch.
      a. Verify material selection with Work of Section 07 25 00 - Weather Barriers for compatibility of materials.
      b. Available Products:
         1) BASF MasterSeal; MasterSeal AWB 920 FIB.
         2) Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
         3) Henry Company; Blueskin SA.
         4) Tremco Inc; ExoAir 110 or ExoAir 110 LT.
         5) Substitutions: See Section 01 60 00 - Product Requirements.

2.06 FABRICATIONS

A. Form sections true to shape, accurate in size, square and free from distortion or defects.

B. Form pieces in longest practical lengths.
   1. Factory fabricate all components for field assembly.
   2. Comply with indicated profiles, dimensions and structural requirements.

C. Fabricate corners in one continuous piece with minimum 18 inch returns.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building framing members, including furring members are in alignment and within wall panel manufacturer's tolerances, ready to receive panels.

B. Verify that water-resistive barrier has been installed over substrate completely and correctly.
   1. Install a 6-inch by 6-inch diamond shaped patch of self-adhered membrane behind each fastener through water-resistive barrier.
   2. Install strips of self-adhered membrane behind Z-Furring in lieu of diamond patches at Contractor's option.

C. Verify that insulation has been properly installed.

3.02 PREPARATION

A. Locate studs behind water-resistive barrier marking stud locations on water-resistive barrier prior to installing thermal spacers.

B. Install thermal spacers in accordance with spacer manufacturer's recommendations. Coordinate placement of thermal spacers with installers of exterior insulation.
   1. Pre-punch or pre-drill holes in Z-furring or hat channels and tracks to accommodate fasteners.
   2. Position Z-furring or hat channels directly over thermal spacers.

C. Install Z-Furring horizontally behind metal wall panels as indicated. Coordinate spacing and layout of Z-Furring with installers of exterior insulation.
   1. Install at 16 inches on center, unless otherwise indicated.
   2. Refer to applicable wall types for maximum spacing.
   3. Install shims as required to provide plumb and square application of metal wall panels.

D. Completely install spacers, screws and sub-framing prior to installing insulation.

E. Prior to installing insulation, verify that all holes in water-resistive barrier related to installing thermal spacers and/or Z-furring/hat channel have been sealed.

F. Friction fit insulation in place in accordance with insulation manufacturer's recommendations. Verify that insulation is tightly fitted with sides of insulation slightly compressed at each spacer.

1. Mechanically attach insulation with insulation manufacturer's recommended clips or pins.
2. Comply with requirements specified in Section 07 21 00 - Thermal Insulation.

3.03 INSTALLATION

A. Remove strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions.

B. Install panels on walls and soffits in accordance with manufacturer's instructions.

C. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.

D. Fasten panels to structural supports; aligned, level, and plumb. Provide gaskets between panels and framing for thermal break at all fasteners.

E. Locate joints over supports.

F. Use concealed fasteners unless otherwise approved by Architect.

G. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.
   1. Coordinate with other trades to ensure that panels, weather seals and flashing are properly installed where wall panels interface with Work of other Sections.

H. Install insect screen at openings to prevent insect intrusion.

I. Install wall panel edge trim as detailed. Ensure that weep holes and drainage channel in lower trim pieces are free of obstructions, dirt, debris, and sealant.
   1. Install in accordance with SMACNA (ASMM) and manufacturer's recommendations

3.04 TOLERANCES

A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch.

B. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch.

3.05 CLEANING

A. Remove site cuttings from finish surfaces.

B. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water, unless recommended otherwise by manufacturer. Maintain in a clean condition during construction.

END OF SECTION

SECTION 07 53 00
ELASTOMERIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Elastomeric roofing membrane (EPDM), fully adhered.

B. Deck level rigid insulation.

C. Cover board.

D. Substrate board.

E. Flashings.

F. Walkway pads.

G. Safety warning lines.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - “Rough Carpentry” for wood curbs, nailers, and sheathing.

B. Section 07 01 50.19 - “Preparation for Re-Roofing” for methods of existing roof tear-off procedures and requirements.

C. Section 07 62 00 - “Sheet Metal Flashing and Trim” for sheet metal flashing and trim integral with roofing.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

F. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.

G. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings.

K. NRCA ML104 - The NRCA Roofing and Waterproofing Manual.

L. UL 790 - Standard for Standard Test Methods for Fire Tests of Roof Coverings.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of associated counterflashings installed under other sections.

1.05 PREINSTALLATION CONFERENCE

A. Preinstallation Meeting: Convene a preinstallation meeting prior to start of roofing operations.
   1. Meet with Owner, Architect, Consultant, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, and installers whose work interfaces with or affects roofing.
   2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
   3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
   5. Review structural loading limitations of roof deck during and after roofing.
   6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
   7. Review governing regulations and requirements for insurance and certificates if applicable.

8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, fasteners, and cover board.

C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, setting plan for tapered insulation at roof drain sumps and scuppers, mechanical fastener layout, and walkway layout.
   1. Include fastening patterns for corner, perimeter and field-of-roof locations.

D. Selection Samples: Manufacturer's full range of available colors for walkway pads.

E. Samples for Verification: Submit two samples 6 by 6 inches in size illustrating the following:
   1. Sheet roofing of color required.
   2. Walkway pads of color required.
   3. Pre-fabricated flashing accessories.

F. Manufacturer's Certificate: Provide certificate signed by membrane manufacturer. Certify that products meet or exceed specified requirements.
   1. Submit evidence of compliance with performance requirements.
   2. Submit manufacturer's system specific assembly letter.

G. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.

H. Product Test Reports: For components of roofing system, tests performed by manufacturer and witnessed by a qualified testing agency.

I. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.

J. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.
   1. Manufacturer's warranty is evidence of satisfactory inspection. Report shall be submitted if warranty cannot be issued because of improper workmanship, or if manufacturer's inspection noted any conditions requiring correction.

K. Sample Warranties: For Manufacturer's and Installer's special warranties.

L. Warranty: Submit manufacturer and installer warranties and ensure forms have been completed in Owner's name and registered with manufacturer.

1.07 QUALITY ASSURANCE

A. Perform work in accordance with NRCA ML104 and manufacturer's instructions.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum twenty years of documented experience.
   1. The roofing membrane manufacturer must be an actual manufacturer of products used, no "Private Label" material, in which one company's name goes on a product manufactured by other is acceptable for this project.
   2. Manufacturer warranty shall be provided directly by the membrane manufacturer. Manufacturer must submit proof of Warranty Reserve Fund. No third party insurance backed warranties will be allowed.

C. Installer Qualifications: Company authorized and trained by the membrane manufacturer to install the specified roof system and acquire the specified warranty, and specializing in performing the work of this section with minimum ten years of documented experience. Manufacturer to provide documentation stating that bidding contractors meet this qualification.

1. The installer shall be thoroughly experienced and be able to provide evidence of having at least ten years successful experience installing single ply EPDM roofing systems similar to the specified system(s).
2. Installer shall, upon request, provide a reference list with owner contact information of at least five projects of comparable size and scope within a 50 mile radius of this project, having been completed within the last 12 months, which may be observed by representatives of the Owner.
3. Installing contractor must have installed a minimum one million square feet of warranted roof systems by the submitted manufacturer. Manufacturer to provide documentation that bidding contractors meet this qualification.
4. Crew Experience and Supervision: Provide adequate number of experiences workers regularly engaged in this type of work who are skilled in the application techniques of the materials specified. Provide at least one thoroughly trained and experienced foreman/superintendent on the job at all time roofing is in progress.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact, labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency marking, and directions for storing and mixing with other components.

B. Store products in weather protected environment, clear of ground and moisture. Protect stored liquid material from direct sunlight.
   1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.09 FIELD CONDITIONS

A. Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

B. Have necessary waterproof temporary coverings readily available in case of emergency. The Contractor will be held liable for any damage to building interior due to Contractor's negligence.

C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be waterproofed in the same day.

E. Adhesive applied roofing materials shall not be applied when dirt, dust, debris, oil, contaminants, etc. are present on the substrate being adhered to.

1.10 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
   1. Special warranty shall include all components of roof assembly, including membrane, base flashings, roof insulation, fasteners and plates, cover boards, substrate boards, roofing accessories, adhesives, sealants and other applicable components.
   2. Pro-Rated System Warranties will not be accepted.
   3. Warranty Period: 20 years from Date of Substantial Completion.

C. Special Project Warranty: Submit roofing Installer's warranty, signed by Installer, covering Work of this Section, including all components of roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, and walkway pads for the specified warranty period.
   1. Warranty Period: Two years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.
   1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
   2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D3746/D3746M or ASTM D4272/D4272M.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. Basic Wind Speed Design Criteria: The completed membrane roofing system shall meet or exceed Oregon Structural Specialty Code, Basic Wind Speed Design Criteria of 103 mph, 3 second gust duration, Exposure B, urban and suburban area. Uplift pressures shall be calculated in accordance with ASCE 7-16 “Minimum Design Loads for Buildings and Other Structures, but not less than the following un-factored ultimate wind loads:
   1. Interior Field-of-Roof: -15 psf
   2. Perimeter Zone 1: -26 psf
   3. Perimeter Zone 2: -34 psf
   4. Corner Zone 3:: -47 psf

D. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

E. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.02 SYSTEM DESCRIPTION

A. Roof Assembly at Roof Areas A2, B, D, E, F, G2, H, I, J, K, M, N, P1, P2
   1. Fully adhered EPDM roofing system adhered to glass mat gypsum substrate board which is mechanically attached structure with screws and plates.

B. Roof Assembly at Roof Areas A1, C, G1:
   1. Fully adhered EPDM roofing system adhered to cover board. Cover board is adhered to top layer rigid insulation with urethane insulation adhesive. Rigid insulation consists of 2-layers polyisocyanurate insulation with staggered joints. First layer of insulation is mechanically attached to the structure with screws and plates and the second layer is adhered with urethane insulation adhesive.

2.03 MANUFACTURERS

A. EPDM Membrane Materials:
   1. Carlisle SynTec Systems, Inc; Sure-Seal EPDM: www.carlisle-syntec.com.
   2. Firestone Building Products, LLC; EPDM: www.firestonebpco.com.
   3. Johns Manville; JM EPDM NR: www.jm.com.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Elastic Sheet Membrane: Ethylene-propylene-diene-terpolymer (EPDM); non-reinforced; complying with minimum properties of ASTM D4637/D4637M.
   1. Thickness: 0.060 inch (60-mil), nominal.
   2. Color: Black.

B. Seaming Materials:
   1. Field Seams: Minimum 6-inch splice tape.
   2. Base Flashing Seams: Minimum 3-inch splice tape.

C. Elastic Sheet Membrane Flashing: EPDM sheet; conforming to the following:
   1. Thickness: 0.060 inch 60-mil, nominal.
   2. Color: Black.

2.05 SUBSTRATE BOARDS AND COVER BOARDS

A. Plywood Wall Substrate Board: As specified in Section 06 10 00 - Rough Carpentry.

B. Cover Board and Substrate Board: Glass mat faced gypsum panels, ASTM C1177/C1177M, fire resistant type, 1/2 inch thick.
   1. Products:
      a. Georgia-Pacific; DensDeck Prime
      b. USG Securock; Glass-Mat Roof Board:
      c. National Gypsum Company: Dexcell
   2. Panel Factory Dimensions:
      a. Substrate Board: 4-foot by 8-foot.
      b. Cover Board: 4-foot by 4-foot.
   3. Method of Attachment:
      a. Substrate Board: Roofing manufacturer approved screws and plates.
      b. Cover Board: Roofing manufacturer approved urethane foam insulation adhesive.

2.06 INSULATION

A. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C1289, Type II, Class 2, coated glass fiber mat at both faces; Grade 2, and with the following characteristics:
   1. Compressive Strength: 20 psi
   2. Board Size: 48 by 96 inch for mechanically attached applications only (base layer).
   3. Board Size: 48 by 48 for adhered applications (top layer).
   4. Board Edges: Square.
   5. Board Thickness: 1-1/2-inch (base and top layer).
   6. Base Layer Method of Attachment: Mechanically fastened with membrane manufacturer approved fasteners and plates.
   7. Top Layer(s) Method of Attachment: Adhered in membrane manufacturer approved urethane foam adhesive.
   8. Insulation Manufacturer: As approved by membrane manufacturer.
   9. Provide preformed saddles, crickets, tapered edge strips and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

B. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4-inch per 12-inches, at locations indicated on Drawings.

C. Provide preformed saddles, crickets, tapered edge strips and other insulation shapes as indicated on Drawings for sloping to drain.

D. Tapered Edge Strip: Rigid polyisocyanurate board of 24-inch wide, tapering from 0-inch to 2-inch thickness. Stack units to achieve required thickness as indicated on Drawings.

2.07 ACCESSORIES

A. General: Provide auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

B. Insulation Fasteners: Factory-coated steel fasteners and metal plates complying with corrosion-resistance provisions of FM Global 4470, designed for fastening substrate board, insulation panels to roof deck and acceptable to roofing system manufacturer.

C. Membrane Fasteners: Factory coated steel fasteners for wood and steel substrates and threaded anchors for concrete and masonry substrates. Fasteners shall comply with corrosion-resistance provisions of FM Global 4470. Drive pin type impact fasteners not approved.

B. Self-Adhered Elastic Sheet Membrane Flashing: Semi-cured EPDM flashing membrane factory laminated to cured seam tape.

C. Self-Adhered Uncured Elastic Sheet Membrane Flashing: Uncured EPDM flashing membrane factory laminated to splice tape.

E. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer, butyl splice tape with release film. Minimum 6-inch wide at field seams, and minimum 3-inch wide at base flashing seams.

F. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.

G. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

H. Membrane Adhesive: Manufacturer’s standard solvent based adhesive.

I. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.

J. Insulation Adhesive: As recommended by insulation manufacturer.

K. Metal Termination Bars: Manufacturer's standard, predrilled aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

L. Miscellaneous Accessories: Provide preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips and other accessories.

M. Walkway Pads: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads, approximately 3/16 inch thick and acceptable to roofing system manufacturer.
   1. Size: Membrane manufacturer’s standard size.
   2. Surface Color: Black.

N. Safety Warning Line: Self-adhered 6-inch wide nominal 30-mil thick yellow unsupported TPO membrane compatible with EPDM membranes.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify substrate is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify substrate surfaces are dry and free of snow or ice.

E. Verify that necessary wall sheathing and plywood substrate board has been installed and securely attached.

F. Verify that roof openings, curbs, and penetrations through roof are solidly set, and roof drain bodies are in place.

G. Verify that all curbs, wall surfaces, equipment supports and other roof penetrations that will receive roofing materials will allow the installation of full height flashings. Verify heights of all penetrations which are located within crickets and slope upgrades; extend penetrations where necessary.

H. 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.

I. Prepare existing roof system in accordance with requirements specified in Section 07 01 50.19 - Preparation for Re-Roofing.

3.02 PREPARATION

A. Clean substrate of dust, debris, moisture and other substances detrimental to roofing installation according to roofing manufacturer's written instructions. Remove sharp projections.
   1. Moisture includes rain, dew, ice, frost, snow and the like.
   2. Dust and debris includes dirt, oil, and other materials inherent in the substrate.

B. Prevent materials from entering and clogging conductors and from spilling or migrating onto surfaces of other construction.

C. Inspect all substrates for irregularities and defects that prohibit the proper installation of new roofing materials. Notify the Architect of all defects for proper correction, prior to installation of new materials.

D. Substrates shall be clean and dry, smooth, free of fins, raised edges, sharp edges, protruding or loose nails, and free of foreign material.

E. Prepare all surfaces and details in accordance with manufacturer's printed instructions and the Contract Documents.

F. Protect building surfaces and equipment from damage and contamination from roofing work.

G. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

H. Prepare existing roof system in accordance with requirements specified in Section 07 01 50.19 - Preparation for Re-Roofing.

3.03 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
   1. Fasten substrate board to plywood sheathing to resist uplift pressures at corners, perimeter, and field of roof according to roofing system manufacturer’s written instructions.

3.04 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Roof level insulation assembly units that become wet or damaged shall be removed from the project site. Any wet or damaged insulation units which are installed must be removed.

D. Provide dimensional lumber stops and nailers at flanged penetrations and edges, including ridges and as otherwise shown on the Drawings. Provide additional stops as recommended by the manufacturer of the roofing materials.

E. Mechanically Fastened and Adhered Insulation:
   1. Install first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
   2. Set each subsequent layer(s) of insulation in ribbons of membrane manufacturer’s approved urethane foam insulation adhesive pressing and maintaining insulation in place. Provide temporary ballast to weigh down individual boards in order to achieve flush seams until board has fully bonded.
   3. Secure insulation to resist specified uplift pressure at corners, perimeters and field of roof according to roofing system manufacturer's written instructions.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
   1. Offset joints of insulation below a minimum of 6 inches in each direction.
   2. Cut and fit insulation within 1/4 inch of nailers, projections and penetrations.

G. Install tapered insulation under area of roofing to conform to slope as indicated on the Drawings.

H. Trim surface of insulation where necessary to achieve a flush finished condition that does not restrict flow of water.

3.03 COVER BOARD INSTALLATION

A. Install cover board over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and adhere to insulation below.
   1. Adhere cover boards in ribbons of membrane manufacturer’s approved urethane foam adhesive pressing and maintaining insulation in place. Provide temporary ballast to weigh down individual boards in order to achieve flush seams until board has fully bonded.
   2. Secure cover board to resist specified uplift pressure at corners, perimeters and field of roof according to roofing system manufacturer's written instructions.

3.04 MEMBRANE APPLICATION

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Adhere roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions.
   1. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

D. Accurately align roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer and allow to partially dry before installing roofing. Do not apply to splice area of roofing.

F. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations and perimeters.

G. Apply roofing with side laps shingled with slope of roof deck where possible.

H. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape and firmly roll side and end laps of overlapping roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing terminations.

I. Coordinate installation of roof drains and sumps and related flashings.
   1. Spread sealant over deck-drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

J. Repair tears, voids and lapped seams in roofing that do not comply with requirements.

K. Adhere protection sheet over membrane roofing at locations indicated.

3.06 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrate according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply seam tape and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.07 FINISHING SURFACES

A. Install walkway pads. Space pad joints to permit drainage.
   1. Avoid installation of walkway pads over drainage ways in a manner that prevents water from evacuation the roof.

B. Safety Warning Line: Install safety warning line where indicated.
   1. Layout temporary markings on surface of new roof membrane with dimension of 10'-0" from leading edges. Lines shall be straight and accurate with a tolerance of 1/2-inch in 10'-0".
   2. Clean surface of roof membrane and prime as required by material manufacturer.
   3. Align and adhere safety warning line membrane as indicated and per temporary markings with same tolerance. Butt all seams; do not overlap.

3.08 DAILY SEAL

A. On phased roofing, when the completion of flashings and terminations is not achieved by the end of the work day, provide a daily seal to temporarily close the membrane to prevent water infiltration.

B. Seal all tie-offs to prevent moisture from flowing under new work.

3.09 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for field quality control and inspection.

B. Require site attendance of roofing material manufacturers weekly during installation of the Work.

C. Technical Representative of material manufacturer shall perform the following services:
   1. Periodically observe work in progress.
   2. Be present to observe deck preparation, general installation procedures and final completion; submit documentation of manufacturer's final acceptance.
   3. Perform a punch list inspection upon Substantial Completion of the project indicating all items in need of attention, including conformance to manufacturer's published installation instructions and the Contract Documents.

D. Final Roof Inspection: Upon completion of the installation, arrange for an inspection to be made by a non-sales technical representative of the membrane manufacturer in order to determine whether or not corrective work will be required before the warranty will be issued. Notify the Owner and Architect seventy-two hours prior to the manufacturer's final inspection.

E. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

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

3.10 CLEANING

B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.

C. Repair or replace defaced or damaged finishes caused by work of this section.

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.

END OF SECTION

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, and other items indicated in Schedule.

B. Stainless steel flashings with soldered seams.

C. Sealants for joints within sheet metal fabrications.

1.02 RELATED REQUIREMENTS

A. Section 04 20 00 - Unit Masonry: Through-wall flashings in masonry.

B. Section 06 10 00 - Rough Carpentry: Wood nailers for sheet metal work.

C. Section 07 01 50.19 - Preparation for Re-Roofing: Methods of existing roof tear-off procedures and requirements.

D. Section 07 53 00 - Elastomeric Membrane Roofing: Roofing systems and related parapet copings.

E. Section 07 92 00 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.

1.03 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.

B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

C. ASTM B32 - Standard Specification for Solder Metal.

D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

E. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

F. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.

G. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.

H. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

I. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.

J. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.

K. ASTM D4479/D4479M - Standard Specification for Asphalt Roof Coatings - Asbestos-Free.

L. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free.

M. SMACNA (ASMM) - Architectural Sheet Metal Manual.

N. SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.

1.04 PREINSTALLATION CONFERENCE

A. Preinstallation Conference: Convene one week before starting work of this section. Conference shall be held in conjunction with conferences specified in Section 07 01 50.19 - Preparation for Re-Roofing and Section 07 53 00 - Elastomeric Membrane Roofing.

1. Insure that all parties whose work interfaces with roof system application are in attendance. These parties include, but are not limited to, the following:
   a. Owner.
   b. Architect.

c. Building enclosure consultant.
d. Contractor.
e. Contractor's superintendent.
f. Sheet metal contractor.
g. Roofing installer.
h. Roofing manufacturer's representative.

1.05 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Design, fabricate and install flashings at roof edges in accordance with SPRI ES-1, except with basic wind speed of 130 mph.

C. Water Infiltration: Provide sheet metal flashing and trim that does not allow water infiltration to building interior.

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
1. Identification of material, thickness, weight and finish for each item and location in Project.
2. Roof plan indicating layout of radius coping including lengths between individual pieces.
3. Details for forming sheet metal flashing and trim, including profiles, shapes, seams and dimensions.
4. Details for joining, supporting and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, saddles and other attachments. Include pattern of seams.
5. Details of termination points and assemblies, including fixed points.
6. Details of special conditions.
7. Details of connections to adjoining work.
8. Detail formed flashing and trim at a scale of not less than 3 inches per 12 inches.

C. Samples: Submit two samples 6 by 6 inch in size illustrating metal finish color.

D. Warranties: Special warranties specified in this Section.

1.07 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) requirements and standard details, except as otherwise indicated.

B. Fabricator andInstaller Qualifications: Company specializing in sheet metal work with ten years of documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

1.09 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Special Project Warranty: Submit Installer's warranty, on Installer's standard or customized form, signed by Installer, covering the Work of this Section, including all components of flashing and sheet metal against defects in materials and workmanship, for the following warranty period:
1. Warranty Period: Two years from date of Substantial Completion.

C. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, (0.0239 inch) thick base metal.

B. Pre-Finished Galvanized Steel: Provide aluminum-zinc alloy-coated steel according to ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; pre-painted by coil-coating process to comply with ASTM A 755/A 755M; minimum 24 gage (0.0239 inch) thick base metal.
   1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605 <http://www.aamanet.org/general.asp?sect=2&id=45>; multiple coat, thermally cured fluoropolymer finish system.
   2. Color: As chosen by Owner from manufacturer’s standard color offerings.

C. Aluminum: ASTM B209 (ASTM B209M); 20 gage, (0.032 inch) thick; anodized finish of color as selected.

D. Lead: ASTM B749, 4 lb/sq ft thick, unless otherwise indicated.

E. Stainless Steel: ASTM A666, Type 304, soft temper, 22 gage (0.034 inch) inch thick; smooth No. 4 finish.

F. Copper: ASTM B370, cold rolled 16 oz/sq ft (24 gage) (0.0216 inch) thick; natural finish.

2.02 FABRICATION

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA (ASMM) that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
   1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
   2. Obtain field measurements for accurate fit before shop fabrication.
   3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
   4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Shop Forming Requirements:
   1. Fabricate sheet metal flashing and wall liners as detailed and in accordance with reviewed shop drawings. Use the SMACNA Architectural Sheet Metal Manual as a guide and basis for fabrication wherever applicable.
   2. Provide for thermal movement of sheet metal.
   3. Angle bottom edges of exposed vertical surfaces to form hemmed drip edge.
   4. Fabricate to dimensions indicated on shop drawings.
   5. Fabricate sheet metal with lines, brakes and angles sharp and true, and surfaces free from oil canning, wave, warp or buckle.
   6. Fold exposed edges of sheet metal back to form 1/2-inch wide hem on side concealed from view.
   7. Provide galvanic protection in areas where dissimilar metals are adjacent to each other.
   8. Spring Locks: Provide flashing pieces fabricated to spring lock where indicated on the Drawings.

C. Field verify dimensions prior to fabrication.

D. Form sections true to shape, accurate in size, square, and free from distortion or defects.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal. Fabricate in sizes recommended by SMACNA (ASMM) for application, but not less than thickness of metal being secured.
   1. Provide continuous cleats on outside face of copings.

F. Form pieces in longest possible lengths.

G. Hem exposed edges on underside 1/2 inch; miter and seam corners.

H. Form material with standing seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams. Comply with SMACNA Manual details (Figures 3-2 and 3-3 and other Figures as applicable to specific installation). Orient seams properly for direction of water flow.
   1. Standing Seams: 1-inch high with sealant at folded corners. Fold the ends over to form watertight, 45 degree finished ends. All cap flashing is to have standing seams.
   2. Solder-Lap Seams: 1-inch finish width; sweat full with solder.
   3. Double S Lock Seams: Form 1-1/4 inch with S shaped seam on each edge of flashing sheet for concealed fastening.
   4. Solder lap seams around roof scuppers. Solder exposed gutter and downspouts seams. Finish not less than 1-inch wide.

I. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant. Solder galvanized steel that is not prefinished. Do not solder prefinished steel.
   1. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

J. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

K. Fabricate flashings to allow toe to extend 4 inches over roofing. Return and break edges.

2.03 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Continuous Hanging Gutters: Fabricate to cross section complete with end pieces, outlet tubes, and other accessories as required. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.
   1. Gutter Style: Continuous, seamless “6-K” style hanging gutter.
   2. Expansion Joints: Butt type with cover plate.
   3. Sheet Metal: Pre-coated galvanized steel as specified in this section.
   4. Sheet Metal Color: As selected by Owner from manufacturer’s standard color offerings.
   5. Attachment: Gutter brackets and hangers
      a. Hangers: Hangfast Gutter Hangers manufactured Raytec LLC.
      b. Brackets: As indicated on Drawings.
   6. Sealant: Aluminum Pigmented SBR Rubber Sealant
      a. Henkel Corporation; OSI Gutter Seal
      b. Tremco Incorporated; Gutter Seal
      c. Alcoa; Gutter Seal

B. Downspouts: Fabricate rectangular downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
   1. Fabricated Hanger Style: Fig 1-35B according to SMACNA’s “Architectural Sheet Metal Manual”.
   2. Sheet Metal: Pre-coated galvanized steel as specified in this section.
   3. Sheet Metal Color: As selected by Owner from manufacturer’s standard color offerings

2.04 ACCESSORIES

A. General: Provide materials and types of fasteners, solder, protective coatings, sealant and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal, unless otherwise indicated.

B. Roof Related Fasteners: Wood screws, flat head screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and appropriate for the substrates encountered.
   1. Exposed Fasteners: Stainless steel hex head with EPDM bonded washers.
   2. Unexposed Fasteners: Stainless steel flat head.
   3. Blind Fasteners: High-strength stainless steel rivets suitable for metal being fastened.
   4. Masonry and Concrete Screw Anchors: Threaded stainless steel anchors with flat or hex heads. Impact driven fasteners are not acceptable. Provide EPDM bonded washers and finish to match color of metal being fastened where exposed to view.

C. Other Fasteners: Stainless steel, with soft neoprene washers.

D. Water Resistive Barrier (vertical surfaces): Water resistive / air barrier membrane; 26-mil thick, triple layer polypropylene fabric sheet; maximum permeance rating of 50 perm; self-adhering.
   1. Henry Company, Blueskin VP 160
   2. VaporShield, WrapShield SA
   3. GCP Applied Technologies; Perma-A-Barrier VPS

E. Self-Adhering, High-Temperature Sheet (SAHTS): Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene film coated on one side with a layer of butyl rubber adhesive.
   1. Service Temperature: 300 degrees F per ASTM D1204.
   2. Low-Temperature Flexibility: Unaffected at -20 degrees F per ASTM D1970/D1970M.
   3. Products:
      a. GCP Applied Technologies; Grace Ultra
      b. Protecto Wrap Company; Jiffy Seal Ice & Water Guard HT BUTYL
      c. Tremco Incorporated; ExoAir 110AT
      d. Substitutions: See Section 01 60 00 - Product Requirements.
   4. Locations of Use: Below sheet metal copings at parapet walls, behind fascia flashing, and where indicated on Drawings.

F. Primer: Zinc chromate type.

G. Protective Backing Paint: Asphaltic mastic, ASTM D4479 Type I.

H. Concealed Sealants: Non-curing butyl sealant.

I. Sealant to be Concealed in Completed Work: Single-Component, Solvent-Release, Butyl Rubber Sealant, Polyisobutylene Plasticized, Heavy Bodied: ASTM C1311 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM%20C1311>.
   1. Products:
      a. Pecora Corporation; BC-158.
      b. Tremco Incorporated; Butyl Sealant.
      c. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Locations of Use:
      a. As indicated in Drawings.

J. Sealant to be Exposed in Completed Work: Single-Component, Nonsag, Fast-Curing, Silyl-Terminated Polyether Sealant: ASTM C920, Type X, Grade NS, Class 50, for Use NT, M, A, G and O.
   1. Products:
      a. BASF Building Systems; MasterSeal NP 150.
      b. Tremco Incorporated; Dymonic FC.
      c. ChemLink; M-1.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

K. Plastic Cement: ASTM D4586/D4586M, Type I.

L. Reglets: The following types, galvanized steel:
   1. Surface mounted: Provide with slotted holes for fastening to substrate with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.

2. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
3. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
4. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
5. Accessories:
   a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
   b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

M. Solder: ASTM B32; Sn50 (50/50) type.

N. Stainless Steel Clamping Bands: Sizes as dictated by condition, screw type tightening system.

O. Strom Collars: 24 gage (0.025 inch) stainless steel.
1. Basis of Design: SBC Industries, Model UMB or UMB-Bell.
2. Or approved.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not proceed with Work until construction to receive the Work is completed.

B. Examine substrates and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected. Surfaces to receive sheet metal shall be clean, even, smooth, dry and free from defects and projections that might adversely affect the application. Verify slope prior to installation.

C. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

D. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Verify that surfaces to receive sheet metal have been covered with flashing membrane specified in Section 07 53 00 - Elastomeric Membrane Roofing. Notify Contractor is this has not been installed.
1. Refer to Drawings for membrane and sheet metal application.

B. Install starter and edge strips, and cleats before starting installation.

C. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.

D. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.03 INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA (ASMM). Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Install Work watertight and weathertight, without oil canning, buckles, tool marks, fastening stresses, distortion or defects which impair strength or mar appearance.

C. Roof-Edge Flashings: Secure metal flashings at roof edges according to Section 1504.5 of the Oregon Structural Specialty Code.

D. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection.

E. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
   1. Coat back side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet.

F. Insert flashings into reglets to form tight fit; secure in place with lead wedges; seal flashings into reglets with sealant.

G. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.

H. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

I. Install high-temperature self-adhered membrane (SAHTS) flashing where indicated. Install under all copings except where roof membrane extends under the full width of coping. Apply primer if required by manufacturer. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days or as required by underlayment manufacturer.

J. Seal metal joints watertight.

K. Solder metal joints for full metal surface contact, and after soldering wash metal clean with neutralizing solution and rinse with water.
   1. Clean and flux metals prior to soldering.
   2. Perform soldering with a heavy soldering copper of blunt design, properly tinned for use.
   3. Perform soldering slowly with a wall heated surface and fill with solder.
   4. Do not solder coil-coated galvanized sheet steel.

L. Cleating at Seams: For size and spacing, refer to Drawings and SMACNA (ASMM). Secure one end with two fasteners and fold the cleat over the fastener heads. Unless otherwise indicated, use 2-inch by 3-inch long cleats of the same material and thickness of metal being installed.

M. Continuous Flashing Cleats: Secure cleats with annular threaded or ring-shank nails long enough to penetrate the wood nailer at least 1-1/4 inches. Nail heads to be at least 3/16-inch in diameter. Alternatively, cleats may be secured with minimum No. 8 screws long enough to penetrate the nailer 3/4-inch or penetrate metal 3/8-inch. Provide fasteners at 6 inches on center or closer. Fastener frequency should be doubled in the building corner regions.

N. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane. Install face plate as indicated on Drawings.

O. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

P. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant. Secure in a waterproof manner by means of snap-in installation and sealant or lead wedges and sealant.

Q. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

R. Opening Flashings in Frame Construction: Install continuous head, sill, jamb and similar flashings to extend 4 inches beyond wall openings.

S. Wall Flashing: Fabricate and install with interlocking seams at bottom as indicated in SMACNA Figure 3-9 with alternate fastening method. Provide 24 inch wide panels with flat seams (Alternate Section A-A).

T. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

U. Connect gutters to downspouts with leaders. Seal connection watertight.

V. Set splash pads under downspouts as indicated on the Drawings.

3.04 ROOF-DRAINAGE SYSTEM INSTALLATION

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

B. Hanging Gutters: Provide continuous gutters profiled as indicated on Drawings. Provide for thermal expansion. Attach gutters at fascia to firmly anchor into position. Provide end closures and seal watertight with sealant. Slope to downspouts.
   1. Anchor gutters with gutter hangers and brackets as indicated on Drawings.

C. Downspouts: Join sections with 1-1/2-inch telescoping joints.
   1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c.
   2. Connect downspouts to underground drainage system.
   3. Provide clean-out at connection to underground storm drainage system as indicated on Drawings.

3.05 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

3.06 SCHEDULE

A. Fabricate sheet metal flashing and trim from the following materials of the minimum thicknesses indicated, unless otherwise required on the Drawings or to meet performance requirements.

B. Gutters:
   1. Pre-Finished Galvanized Steel: 24 gage (0.028 inch) thick.

C. Parapet Wall Scupper Sleeves: Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch- wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Make provisions for tapered sump and associated cant strip as detailed.
   1. Stainless Steel: 24 gage (0.025 inch) thick.
   2. Joint Style: Soldered.

D. Scupper Face Plate: Fabricate to profiles indicated on Drawings.
   1. Pre-Finished Galvanized Sheet: 24 gage (0.0239 inch) thick.
   2. Joint Style: Lapped, riveted and sealed.

E. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape indicated complete with outlet tubes, exterior flange trim and built-in overflows.
   1. Pre-Finished Galvanized Steel: 24 gage (0.028 inch) thick.

F. Copings: Fabricate in minimum 96-inch-long, but not exceeding 10-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.
   1. Pre-Finished Galvanized Steel: 22 gage (0.034 inch) thick.

2. Joint Style: Standing seam.
3. Refer to Section 07 53 00 - Elastomeric Membrane Roofing for parapet copings provided by roofing manufacturer.

G. Saddles: Fabricate concealed saddles fully welded.
1. Stainless Steel: 22 gage (0.031 inch) thick where in contact with masonry.
2. Joint Style: Soldered.

H. Cleats:
1. Galvanized Steel: 22 gage (0.034 inch) thick.
2. Joint Style: Butt.

I. Base Flashing:
1. Galvanized Steel: 24 gage (0.028 inch) thick.

J. Counterflashing:
1. Galvanized Steel: 24 gage (0.028 inch) thick.
2. Joint Style: Lapped and sealed with interlocking hems.

K. Reglet Flashing:
1. Galvanized Steel: 22 gage (0.034 inch) thick.
2. Joint Style: Lapped and sealed with interlocking hems.

L. Drip Edge Metal:
1. Galvanized Steel: 24 gage (0.028 inch) thick.
2. Joint Style: Lapped and sealed with interlocking hems.

M. Rake Edge Metal:
1. Galvanized Steel: 24 gage (0.028 inch) thick.
2. Joint Style: Lapped and sealed with interlocking hems.

N. Raised Edge Metal:
1. Galvanized Steel: 24 gage (0.028 inch) thick.
2. Joint Style: Lapped and sealed with interlocking hems.

O. Sleeper Cap Flashing:
1. Stainless Steel: 22 gage (0.027 inch) thick.

P. One or Two Piece Storm Collar Flashing with Hose Clamp:
1. Stainless Steel: 26 gage (0.016) thick.
2. Joint Style: Soldered.
3. Basis of Design: SBC Industries; UMB or UMB-BELL

Q. Flashing Receivers:
1. Galvanized Steel: 26 gage (0.022 inch) thick.

R. Roof-Penetration Flashing:
1. Galvanized Steel: 24 gage (0.028 inch) thick.

S. Roof-Drain Flashing:
1. Stainless Steel: 28 gage (0.0156 inch) thick.
2. Lead: 4 lb/sq. ft.

T. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot- long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings. Form with 45 degree cant as profiled in Drawings and with 2-inch-high end dams where flashing is discontinuous.
1. Stainless Steel: 24 gage (0.022 inch) thick.
2. Joint Style: Lapped and sealed with interlocking hems.
3. Coordinate with Work of Section 04 20 00 - Unit Masonry.

U. Wall Flashing:
1. Pre-Finished Galvanized Steel: 24 gage (0.028 inch) thick.

2. Joint Style: S-lock at 48 inches on center.
3. Provide cross breaks in sheet metal panels to control oil canning.

V. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams.
1. Pre-Finished Galvanized Steel: 26 gage (0.022 inch) thick.
2. Joint Style: Lapped and sealed with interlocking hems.

W. Fascia:
1. Pre-Finished Galvanized Steel: 20 gage (0.040 inch) thick.
2. Joint Style: S-lock at 48 inches on center.

X. Sloped Head Closure Flashing with Cant:
1. Pre-Finished Galvanized Steel: 22 gage (0.034 inch) thick.
2. Joint Style: Lapped and sealed with interlocking hems.

Y. Door Sill Pans: Fabricate door sill pan flashings, and soldered closure flashing (saddles) for deck-to-column intersections with all corners soldered 100 percent watertight.
1. Stainless Steel: 20 gage (0.038 inch) thick.

Z. Window and Storefront Sill Pans: Fabricate storefront sill pan flashings with end and back dams and all corners sealed watertight.
1. Pre-Finished Galvanized Steel: 22 gage (0.034 inch) thick.

AA. Equipment Support Flashing:
1. Galvanized Steel: 24 gage (0.028 inch) thick.

AB. Splash Pans: Stainless Steel: 22 gage (0.031 inch) thick.
1. Joint Style: Soldered.

AC. Miscellaneous Flashings: Fabricate with profiles as shown on Drawings and from sheet metal materials as indicated.

END OF SECTION

SECTION 07 72 00
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof top pipe supports.

B. Roof hatch.

C. Roof hatch railing system.

D. Ladder safety post.

1.02 RELATED REQUIREMENTS

B. Section 07 53 00 - Elastomeric Membrane Roofing: Roofing systems to receive roof accessories.

C. Section 07 62 00 - Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.

1.03 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Field Measurements: Where handrails and railings are indicated to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.

C. Shop Drawings for Ladder Safety Posts: Show profiles, accessories, location, dimensions and interface with ladder. Show interface with ladders specified in Section 05 50 00 - Metal Fabrications.

D. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.

E. Samples: Submit manufacturer’s samples of each size of rooftop pipe support specified.

F. Warranty Documentation:
   1. Submit manufacturer warranty.
   2. Ensure that forms have been completed in Owner's name and registered with manufacturer.

G. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals. Submit manufacturer’s maintenance instructions, describing semi-annual visual inspection of rooftop pipe supports and realignment as necessary.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 ROOFTOP PIPE SUPPORTS

A. Supports small rooftop pipes with engineered, prefabricated pipe supports.

B. Installs without roof penetrations or damage to membrane roofing.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. OMG Roofing Products
      a. Model: Height Adjustable Strut.
      b. Material: Smooth, flexible, black, EPDM rubber.
      c. Protects roof system from damage due to movement.
      d. UV stable
      e. First Strut Channel: Low profile, 1-5/8-inch, galvanized steel, accepts standard strut clamps placed on top of base support.
      f. Second Strut Channel:
      g. Low profile, placed above first strut channel, 1-5/8-inch, galvanized steel, accepts standard strut clamps.
      h. Height: Adjustable with 2, zinc-plated threaded rods and nuts.
      i. Supports sit freely on roof.
      j. Pipe Support Heights: Adjustable from 4 inches (after removing second strut channel or setting it above pipes) to 10 inches.
      k. Width at Top: 10 inches.
      l. Accommodates single or multiple pipes.
      m. Supports Nominal Pipe Size: Single pipe up to 6 inches.
      n. Maximum Load Capacity per Support: 160 lbs.
   2. Or approved.

2.02 ROOF HATCHES AND VENTS

A. Roof Hatch Manufacturers:
   1. Bilco Company: www.bilco.com/#sle.
   2. Substitutions: Not permitted.

B. Roof Hatches, General: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
   1. Style: Provide flat metal covers unless otherwise indicated.
   2. Mounting Substrate: Provide frames and curbs suitable for mounting on flat roof deck sheathing with insulation.
   3. For Ladder Access RH-1: Single leaf; 30 by 36 inches.

C. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
   1. Material for Roof Hatches: Mill finished aluminum, 11 gage, 0.0907 inch thick.
   2. Insulation: Manufacturer's standard; 1 inch rigid fiberboard, located on outside face of curb.
   3. Curb Height: 12 inches from surface of roof deck, minimum.

D. Metal Covers: Flush, insulated, hollow metal construction.
   1. Capable of supporting 40 psf live load.
   2. Material for Roof Hatches: Mill finished aluminum; outer cover 11 gage, 0.0907 inch thick, liner 0.04 inch thick.
   3. Insulation: Manufacturer's standard 1 inch rigid glass fiber.
   4. Gasket: Neoprene, continuous around cover perimeter.

E. Safety Railing System: Manufacturer's standard accessory safety rail system mounted directly to curb.
   1. Comply with 29 CFR 1910.23, with a safety factor of two.
   2. Manufacturers:

a. BILCO Company; Bil-Guard 2.0: www.bilco.com/#sle.
b. Substitutions: Not permitted.

F. Hardware: Type 316 stainless steel, unless otherwise indicated or required by manufacturer.
1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
2. Hinges: Heavy duty pintle type.
3. Hold open arm with vinyl-coated handle for manual release.
4. Latch: Upon closing, engage latch automatically and reset manual release.
5. Manual Release: Pull handle on interior.
6. Locking: Provide latch with interior tee handle and with flush or recessed exterior keyed cylinder (dead bolt). Dead bolt shall be keyed to match building locks: Schlage Interchangeable Core (IC) cylinder.

2.03 ROOF HATCH RAILING SYSTEM

A. Railing System: Provide manufacturer's standard railing system that directly attaches to hatch curbs.

B. Characteristics:
1. Safety yellow color.
2. Railing system shall attach to cap flashing of the roof hatch and shall not penetrate any roofing material.
3. Meet the requirements of OSHA 29 CFR 1910.23 and OSHA strength requirements with a factor of safety of no less than two.
4. Provide self-closing gate.
5. Posts and Rails: Round reinforced fire retardant fiberglass treated with a UV inhibitor.
6. Hardware:
a. Mounting Brackets: 1/4 inch thick hot dip galvanized steel.
b. Hinges and Post Guides: 6063-T5 aluminum.
c. Fasteners: Type 316 stainless steel.

C. Basis-of-Design Product: Bil-Guard 2.0 Hatch Safety Railing System Model RL2 sized for roof hatch manufactured by Bilco Company.

2.04 LADDER SAFETY POSTS

A. Ladder Safety Post: Provide pre-assembled safety post at each vertical ladder serving a roof access hatch.

B. Performance Characteristics:
1. Tubular post which shall lock automatically when fully extended.
2. Have controlled upward and downward movement.
3. Have a release lever to disengage the post to allow it to be returned to its lowered position.
4. Have adjustable mounting brackets to fit ladder rung spacing indicated and clamp brackets to accommodate ladder rungs of size indicated.
a. Refer to Section 05 50 00 - Metal Fabrications and drawings for ladders.
5. Fabricate safety post to comply with OSHA 1910.27 for fixed ladders. Must support 200 pound load.

C. Post: High strength square tubing. Provide a pull up loop at the upper end of the post to facilitate raising the post.

D. Finish: Powder coat paint, Safety Yellow.

E. Balancing Spring: Stainless steel spring balancing mechanism to provide smooth, easy, controlled operation when raising and lowering the safety post.

F. Hardware: Type 316 stainless steel.

G. Material:
1. Hot-dipped galvanized steel.

H. Basis-of-Design Product:
   1. Model LU-2 LadderUp Safety Post manufactured by Bilco Company.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Verify substrate openings are coordinated with frame sizes before proceeding with installation.

C. Field verify as-built conditions and sizes and profiles of ladders for accuracy to fit ladder safety posts prior to fabrication.

D. Examine rooftop and membrane roofing to receive rooftop pipe supports.

E. Notify Architect of conditions that would adversely affect installation or subsequent use.

F. Do not begin installation until unacceptable conditions are corrected.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

C. Clear membrane roofing of debris to allow base of each rooftop pipe support to sit flat and roofing.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

B. Install rooftop pipe supports in accordance with manufacturer’s instructions at location indicated on the Drawings.

C. Spacing of rooftop pipe supports:
   1. Pipe Diameters 2 inches to 5 inches: Maximum 10 feet apart.
   2. Pipe Diameter 1-1/2 inches: Maximum 8 feet apart.
   3. Pipe Diameters less than 1-1/2 inches: Maximum 6 feet apart.
   4. Place 1 additional support at every union and source and along with 1 at side of junctions.

3.04 SAFETY

A. Drawings and specifications do not include design or construction details or instructions relating to contractor's safety precautions or to means, methods, techniques, sequences or procedures required for contractor to perform Work.

B. Contractor shall provide necessary shoring, railing, barricades, protective devices, safety instructions and procedures to perform Work safely and to comply with safety requirements of the governing authorities.

3.05 CLEANING

A. Clean installed work to like-new condition.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Protect installed rooftop pipe supports to ensure that, except for normal weathering, supports will be without damage or deterioration at time of Substantial Completion.

C. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Joint sealants.

B. Joint backings and accessories.

C. Precompressed foam sealants.

D. Precompressed gaskets.

1.02 RELATED REQUIREMENTS

A. Section 07 21 00 - Thermal Insulation: Foam insulation and sealant.

B. Section 07 25 00 - Weather Barriers: Sealants required in conjunction with air barriers and vapor retarders.

C. Section 08 80 00 - Glazing: Glazing sealants and accessories.

D. Section 09 21 16 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

1.03 REFERENCE STANDARDS

A. ASTM C834 - Standard Specification for Latex Sealants.

B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

D. ASTM C1193 - Standard Guide for Use of Joint Sealants.

E. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants.

F. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.

G. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness.

H. OSSC - Oregon Structural Specialty Code, Section 1811, Radon Control Methods Public Buildings.

I. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

J. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168.

K. SWRI (VAL) - SWR Institute Validated Products Directory.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following:

1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
2. List of backing materials approved for use with the specific product.
3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
4. Substrates the product should not be used on.
5. Substrates for which use of primer is required.
6. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
7. Sample product warranty.
8. SWRI Validation: Provide currently available sealant product validations as listed by SWRI (VAL) for specified sealants.

C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

D. Joint-Sealant Schedule: Include the following information:
   1. Joint-sealant application, joint location, and designation.
   2. Joint-sealant manufacturer and product name.
   3. Joint-sealant formulation.
   4. Joint-sealant color.

E. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

F. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

G. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

H. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

I. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section and with at least five years of documented experience.

C. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

E. Preinstallation Field Adhesion and Compatibility Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate (substrates to include, but are not limited to, roofing membrane and all types of self-adhered membrane), except interior acrylic latex sealants, and include the following for each tested sample.
   1. Identification of testing agency.
   2. Name(s) of sealant manufacturers' field representatives who will be observing
   3. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
      a. Substrate; if more than one type of substrate is involved in a single joint, provide two entries on form, for testing each sealant substrate side separately.
      b. Test date.
      c. Location on project.
      d. Sealant used.
      e. Stated movement capability of sealant.
      f. Test method used.
      g. Date of installation of field sample to be tested.
      h. Date of test.
      i. Copy of test method documents.
      j. Age of sealant upon date of testing.
      k. Test results, modeled after the sample form in the test method document.
      l. Indicate use of photographic record of test.
   4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C1193 or Method A, Tail Procedure in ASTM C1521.
   1) For joints with dissimilar substrates, verify adhesion to each substrate separately, extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

F. Field Quality Control Plan:
   1. Visual inspection of entire length of sealant joints.
   2. Destructive field adhesion testing of sealant joints, except interior acrylic latex sealant.
      a. For each different sealant and substrate combination, allow for one test every 100 feet in the first 1000 linear feet, and one test per 1000 linear feet thereafter, or once per floor on each elevation.
      b. If any failures occur in the first 1000 linear feet, continue testing at frequency of one test per 500 linear feet at no extra cost to Owner.
   3. Field testing agency's qualifications.
   4. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.

G. Field Adhesion Test Procedures:
   1. Allow sealants to fully cure as recommended by manufacturer before testing.
   2. Have a copy of the test method document available during tests.
   3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
   4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
   5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
   6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

H. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
   1. Sample: At least 18 inch long.
   2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
   3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.

1.06 PREINSTALLATION CONFERENCE

A. Preinstallation Conference: Conduct a preinstallation meeting before starting work of this section. Require attendance by all affected installers.
   1. Conduct a preinstallation meeting specifically to address coordination, sequencing and constrctability of all components and trades relating to the junction of floor slab edge and curtainwall with particular reference to firestopping this junction.
   2. Review procedures required to comply with OSSC Section 1811 relative to Radon Control and sealing of joints in and penetrations through slabs-on-grade and foundation walls.
   3. Review procedures for inspection of construction joints, penetrations, cracks and other connections by governing agencies prior to covering.

1.07 MOCK-UP

A. Mock-Ups: Install sealant in mock-ups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section. Refer to Section 01 40 00 for mock-up requirements.
   1. Conduct preliminary pull tests on mock-up to confirm primer requirements.

1.08 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period for Silicone Sealants: 20 years from Date of Substantial Completion.
   2. Warranty Period for Polyurea Sealants: 1 year from Date of Substantial Completion.
   3. Warranty Period for All other Types of Sealants: 5 years from Date of Substantial Completion.

C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
      a. Wall expansion and control joints.
      b. Joints between door, window, storefront and other frames and adjacent construction.
      c. Joints between different exposed materials.
      d. Openings below ledge angles in masonry.
      e. Masonry control and expansion joints.
      f. Other joints indicated below.
   2. Interior Joints: Seal interior joints unless specifically indicated not to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
      a. Joints between door, window, storefront and other frames and adjacent construction.
      b. All joints between dissimilar materials.
      c. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
         1) Exception: Through-penetrations in sound-rated assemblies that are also fire-rated assemblies.
      d. Other joints indicated below.
   3. Do not seal the following types of joints.
      a. Intentional weepholes in masonry.
      b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
      c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
      d. Joints where installation of sealant is specified in another section.

2.02 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.
   1. Architectural Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

B. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

C. 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.

D. Colors: As selected by Architect from manufacturer's full range.

2.03 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 50, for Use NT.
   1. Products:
      a. DOWSIL; 795.
      b. Momentive Performance Materials; SilPruf SCS2000.
      c. Pecora Corporation; 864.
      d. Sika Corporation, Construction Products Division; Sikasil WS-295.
      e. Tremco Commercial Sealants & Waterproofing; Spectrem 2.
   2. Locations of Use:
      a. Control, expansion and isolation joints in steel or aluminum.

B. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 100/50, for Use NT.
   1. Products:
      a. DOWSIL; 756 SMS Building Sealant.
      b. Momentive Performance Materials; SilPruf LM SCS2700.
      c. Pecora Corporation; 890.
      d. Sika Corporation, Construction Products Division; Sikasil WS-290.
      e. Tremco Commercial Sealants & Waterproofing; Spectrem 1.
   2. Sanding of Joints: Provide sanded joints at joints occurring in masonry and concrete surfaces.
   3. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C1248.
   4. Locations of Use:
      a. Exterior joints in vertical and nontraffic surfaces, unless otherwise indicated.
      b. Vertical control and expansion joints on exposed interior surfaces of exterior walls.
      c. Interior perimeter joints of exterior openings.

C. Mildew-Resistant, Single-Component, Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 25, for Use NT.
   1. Products:
      a. DOWSIL; 786 Mildew Resistant Silicone Sealant.
      b. Momentive Performance Materials (formerly GE Advanced Materials); Sanitary SCS1700.
      c. Pecora Corporation; 898.
      d. Sika Corporation, Construction Products Division; Sikasil-GP.
      e. Tremco Commercial Sealants & Waterproofing; Tremsil 200 Sanitary or Tremsil 600.
   2. Locations of Use:
      a. Interior joints between plumbing fixtures and adjoining walls, floors and counters.
      b. Interior joints between cabinetry and counters and adjoining walls.

D. Single-Component, Silicone USDA Approved Joint Sealant: ASTM C920, Type S, Grade NS, Class 25, for Use NT.
   1. Products:
      a. DOWSIL; 786 Silicone Sealant.
      b. Momentive Performance Materials (formerly GE Advanced Materials); Sanitary SCS1002.
      c. Pecora Corporation; 898.

d. Sika Corporation, Construction Products Division; Sikasil-N-Plus.
e. Tremco Commercial Sealants & Waterproofing; Tremsil 600.

2. Locations of Use:
a. Interior joints in contact with food.

2.04 URETHANE JOINT SEALANTS

A. Multicomponent, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C920, Type M, Grade NS, Class 25, for Use T.
1. Products:
a. BASF Building Systems; MasterSeal NP 2.
b. Pecora Corporation; Dynatred.
c. Sika Corporation, Construction Products Division; Sikaflex - 2c NS.
d. Tremco Commercial Sealants & Waterproofing; Dymeric 240FC.
2. Locations of Use:
a. Interior ceramic tile expansion control and isolation joints in vertical surfaces.
b. Vertical joints on exposed surfaces of interior unit masonry and concrete walls.

B. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C920, Type M, Grade P, Class 25, for Use T and I.
1. Products:
a. BASF Building Systems; MasterSeal SL 2.
b. Pecora Corporation; Urexpan NR-200.
c. Sika Corporation, Construction Products Division; Sikaflex - 2c SL.
d. Tremco Commercial Sealants & Waterproofing; THC 901 or Vulkem 455 SL.
2. Locations of Use:
a. Interior ceramic tile expansion, control, construction and isolation joints in horizontal traffic surfaces.
b. Exterior paving joints.

C. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C920, Type S, Grade NS, Class 50, for Use NT.
1. Products:
a. BASF Building Systems, MasterSeal NP 100.
b. Sika Corporation, Construction Products Division; Sika Hyflex 150.
c. Tremco Commercial Sealants & Waterproofing; Dymonic 100.
2. Locations of Use:
a. Within the field of fiber cement siding.
b. Interior painted concrete and concrete masonry surfaces.

2.05 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
1. Products:
a. Pecora Corporation; AC-20+.
b. Tremco Commercial Sealants & Waterproofing; Tremflex 834.
2. Locations of Use: Perimeter joints between interior wall surfaces and frames of interior doors and elevator entrances.

2.06 POLYUREA JOINT SEALANTS

A. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, aromatic polyurea with a Type A shore durometer hardness range of 80 to 95 per ASTM D2240.
1. Products:
a. BASF Building Systems; MasterSeal CR 100.
b. Euclid Chemical Company, QUIKjoint 200.
c. L&M Construction Chemicals, Inc; Joint Tite 750.
d. Sika Corporation, Construction Products Division; Loadflex 524.

2. Locations of Use:
    a. Interior joints in floor slabs.

2.07 PREFORMED JOINT SEALANTS

A. Preformed Foam Joint Sealant: Manufacturer's standard preformed, precompressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.
    1. Products:
        a. Dayton Superior Specialty Chemicals; Polytite Standard.
        b. DOWSIL 123 Silicone Seal
        c. EMSEAL Joint Systems, Ltd; Emseal 25V.
        d. Sandell Manufacturing Co., Inc; Polyseal.
        e. Tremco Commercial Sealants & Waterproofing; Illmod 600.

B. Precompressed Gaskets: Preformed expanding foam sealant that provides watertight secondary sealing in application behind conventionally install sealant and backer rod. Seal shall be comprised of water-based, 100 percent acrylic, impregnated expanding foam sealant with internal laminations of closed cell foam. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated, coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.
    1. Locations of Use: Behind backer rod and sealant at precast panel joints.
    2. Basis-of-Design Product: EMSEAL Joint Systems, Ltd; Backerseal.
        a. Substitutions: See Section 01 60 00 - Product Requirements.

2.08 ACOUSTICAL JOINT SEALANTS

A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining 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:
        a. Pecora Corporation; AC-20 FTR
        b. Tremco Commercial Sealants & Waterproofing; Tremflex 834.
        c. Tremco Commercial Sealants & Waterproofing; Tremco Acoustical Sealant (where fully concealed from view).
        d. USG Corporation; SHEETROCK Acoustical Sealant or Firecode Smoke-Sound Sealant (where fully concealed from view).

2.09 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application. Oversize 30 to 50 percent larger than joint width.
    1. Manufacturers:
        a. Sof Rod manufactured by Nomaco Inc.
        b. MasterSeal 921 manufactured by BASF.
        c. Substitutions: See Section 01 60 00 - Product Requirements.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; non-staining. Confirm requirements based on preconstruction field testing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
   1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
   2. Notify Architect of date and time that tests will be performed, at least 7 days in advance.
   3. Arrange for sealant manufacturer's technical representative to be present during tests.
   4. Record each test on Preinstallation Adhesion Test Log as indicated.
   5. If any sample fails, review products and installation procedures, consult manufacturer, or take whatever other measures are necessary to ensure adhesion; re-test in a different location; if unable to obtain satisfactory adhesion, report to Architect.
   6. After completion of tests, remove remaining sample material and prepare joint for new sealant installation.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.
   1. Remove existing sealant residue as required to provide a solid bond with new sealants. Where necessary to expose clean, sound surfaces, use wire brush, grind, sandblast or solvent clean as recommended by sealant manufacturer.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
   1. Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction field tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Comply with requirements of OSSC Section 1811 relative to sealing of construction joints, penetrations, cracks and other connections through foundation walls and slabs-on-grade.

D. Seal all exposed joints of dissimilar materials and elsewhere as indicated

E. 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's written recommendations.

F. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.

G. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

H. Install bond breaker backing tape where backer rod cannot be used or where 3-sided adhesion may occur.

I. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

J. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

K. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

L. Seal bottoms of hollow metal frames to floor at resilient flooring.

M. Seal edges of wainscots to door jambs.

N. Seal thresholds in a full continuous bed of sealant.

O. Sanding Joint Sealants: At masonry surfaces and concrete wall surfaces, sand sealant joints full height of wall as follows:
1. Dry tool the sealant assuring a minimum sealant thickness of 1/4 inch in the middle of the joint.
2. Before the sealant has skinned, deposit the selected dry sand particles to the tacky sealant surface using whatever method is site appropriate (casting, tossing, air-blowing). Catch the excess particles, if possible, for reuse. Start at the lower levels and work up to minimize substrate contamination below.
3. Compress the particles into the surface of the un-skinned sealant to a depth of not greater than 1/16-inch, using a dry tool or other technique.
4. Allow the joint sealant to cure a minimum of seven days before testing the adhesion of the particles to the sealant or the sealant to the substrate.

P. 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.
1. Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

Q. Installation of Precompressed Gasket: Install in joints of precast panels in strict accordance with manufacturer's instructions at depth sufficient to allow installation of properly sized backer rod and sealant in front of gasket.

3.04 FIELD QUALITY CONTROL

A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

B. Destructive Adhesion Testing: If there are any failures in first 1000 linear feet, notify Architect immediately.

C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

D. Repair destructive test location damage immediately after evaluation and recording of results.

3.05 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

B. Protect sealants until cured.

3.06 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at low temperature in thermal cycle. Report failures immediately and repair.

END OF SECTION

SECTION 08 43 13
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

B. Aluminum windows/operable sashes.

C. Weatherstripping.

1.02 RELATED REQUIREMENTS

A. Section 07 25 00 - Weather Barriers: Sealing framing to weather barrier installed on adjacent construction.

B. Section 07 62 00 - Sheet Metal Flashing and Trim: Storefront sill pans and door sill pans.

C. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.

D. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

A. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefront, Curtain Walls and Sloped Glazing Systems.

B. AAMA 812 - Voluntary Practice for Assessment of Single Component Aerosol Expanding Polyurethane Foams for Sealing Rough Openings of Fenestration Installations.

C. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site.

D. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.

E. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.

F. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

G. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

H. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

J. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

K. ASTM C1193 - Standard Guide for Use of Joint Sealants.

L. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

M. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

N. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

O. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.

P. NFRC 100 - Procedure for Determining Fenestration Product U-factors.

Q. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.

R. NFRC 400 - Procedure for Determining Fenestration Product Air Leakage.

S. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168.

T. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic").

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Field Testing: Per AAMA 503.

1.05 PREINSTALLATION CONFERENCE

A. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers; review preparation, installation procedures, coordination, testing requirements and scheduling necessary for related work.
   1. Insure that all parties whose work interfaces with door, security and hardware systems are in attendance. These parties include, but are not limited to, the following:
      a. Owner.
      b. Architect.
      c. Building Envelope Consultant.
      d. Contractor.
      e. Contractor's superintendent.
      f. Hardware supplier.
      g. Architectural Hardware Consultant.
      h. Access control system contractor.

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product performance criteria, component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
   1. Shop Drawings shall reflect all detail conditions shown on Drawings including support framing and adjoining materials. Submittals which use manufacturer's standard catalog type details will be rejected.

D. Delegated-Design Submittal: For aluminum-framed storefront 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. Submit submittals as "Deferred Submittals" in accordance with Section 01 30 00 - Administrative Requirements. Transmit a copy of each submittal indicating agency approval to the Architect for record.
   2. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations.

E. Samples: Submit two samples 6 by 6 inches in size illustrating finished aluminum surface, glass, infill panels, glazing materials.

F. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.

G. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

H. Energy Performance Certificates: For aluminum-framed storefronts, accessories, and components, from manufacturer.
   1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed storefront and entrance system.

2. Provide a single certificate specifying glazing type, special coatings, spacers, gas fills, center-of-glass and overall U-factor and center-of-glass SHGC for every type of glass used.
3. Maintain a copy of these certificates on the jobsite and make available to authorities having jurisdiction.

I. Report of field testing for water leakage.

J. Warranty: Submit manufacturer and installer warranties as specified in this Section and ensure forms have been completed in Owner's name and registered with manufacturer. Provide sample warranty specimens with initial submittals prior to start of Work.

1.07 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in Oregon.

B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.

C. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience and approved by manufacturer.

D. Energy Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
1. Provide NFRC-certified aluminum-framed storefronts and entrance systems with an attached label.
2. Certification shall be by an accredited, independent laboratory and labeled and certified by the manufacturer.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.09 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide installer warranty to correct defective Work within a five year period after the Date of Substantial Completion.

D. Provide five year from Date of Substantial Completion manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aluminum-Framed Storefront and Doors:
1. EFCO Corporation: www.efcocorp.com/sle.
2. Kawneer North America: www.kawneer.com.
3. Oldcastle BuildingEnvelope: www.oldcastlebe.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
1. Basis-of-Design Products for Insulating Glazing at SF-1:
a. EFCO, a Pella Company; Series 403, Thermal Storefront Framing.

b. Kawneer North America; VG 451T with 451THPO37 Sill Flashing.
c. Oldcastle BuildingEnvelope; Series 3000 Thermal MultiPlane.

2. Glazing Rabbet for SF-1: For 1 inch insulating glazing for exterior applications and elsewhere as indicated.
3. Glazing Position: Centered (front to back).
4. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
   a. Provide a tubular section at all door frame jambs and heads.
5. Finish: Class I clear anodized.
   a. Factory finish all surfaces that will be exposed in completed assemblies.
6. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   a. Fabricate items such as sill pans and closure flashings as single continuous shapes. Factory-drill weep holes prior to finishing where exposed to view.
   b. Arrange fasteners and attachments to conceal from view.
7. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
8. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
9. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
10. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
11. Story Drift: Provide aluminum-framed systems that accommodate design displacement of adjacent stories indicated.
    a. Design Displacement: As indicated on Structural Drawings.
       1) Test Performance: Meet criteria for passing, based on building occupancy type, when tested according to AAMA 501.4 at design displacement.
12. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements:
1. Delegated Design: Design aluminum-framed storefronts, including comprehensive engineering analysis by a qualified professional engineer licensed in the State of Oregon, using performance requirements and design criteria indicated.
2. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
   a. Design Wind Loads: Comply with requirements of ASCE 7 and Structural Drawings.
   b. Member Deflection: Limit member deflection to 1/175 when subject to the design wind load and a maximum permanent set of 0.1 percent or 0.2 percent of span after testing to 150 percent of design wind load in any direction, with full recovery of glazing materials.
3. Water Penetration Resistance: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 10 psf. No reduction shall be taken in test pressures for field installation. Water penetration is defined as any water infiltrating the system or appearing on any interior surface from sources other than condensation. Water controlled by flashing and gutters that is drained to the exterior and cannot damage adjacent materials or finishes is not considered water leakage.
4. Air Leakage: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 or NFRC 400 at 6.27 psf pressure differential across assembly.

a. Limit air infiltration at entrance doors and operable windows to 1.00 cu ft/min/sq ft of door or operable window area at 1.57 pounds per square foot pressure differential.

5. Condensation Resistance Factor of Framing: 57 frame and 70 glass, minimum, measured in accordance with AAMA 1503.
6. Overall U-Value Including Glazing: 0.25 Btu/(hr sq ft deg F), maximum.
   a. Thermal Conductance: Provide thermally-broken aluminum-framed systems with fixed glazing and framing areas having specified U-Value when tested according to NFRC 100.
   b. Entrance Door Framing U-Value: 0.60 maximum.
   c. Operable Sashes U-Value: 0.55 Btu/(hr sq ft deg F) maximum.
7. Solar Heat Gain Coefficient: Provide systems with fixed and framing area having solar heat gain coefficient not to exceed the values indicated below when tested according to NFRC 200.
   a. Storefront SF-1: 0.33.
   b. Operable Sashes: 0.29.
   c. Entrance Doors: 0.40.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
   1. Framing members for interior applications need not be thermally broken.
   2. Glazing Stops: Flush.
   3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.

B. Glazing: As specified in Section 08 80 00.
   1. For Exterior Framing and Operable Windows: Type IT-1.

C. Operable Sash: Aluminum project-in hopper, project-out awning, single-hung, and casement; finished to match storefront; heavy duty 4-bar hinges, and cam turn handle latch.
   1. Provide limit stop integral to frame on all operable sashes to prevent sash from opening more than 4 inches.
   2. Provide insect screens at all operable sashes.
   3. Basis-of-Design Products for Awning Windows:
      a. EFCO, a Pella Company; WV410.
      b. Kawneer North America; GLASSvent UT Awning Windows.
      c. Oldcastle BuildingEnvelope; Zero Sightline Series 30P.

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.

C. Fasteners: Stainless steel.

D. Compensation Channel/Deflection Head: 0.032 inch thick aluminum sheet; finish to match framing members. Allow for minimum 1-inch vertical deflection.

E. Aluminum Sill Pan: Manufacturer's aluminum sill pan including end and back dams. Finish to match adjacent storefront.
   1. Coordinate with Work of Section 07 62 00 - Sheet Metal Flashing and Trim for installation of prefinished steel sill pans and door sill pans provided as Work of that Section.

F. Sill Attachment Angle: 0.032 inch thick aluminum sheet; finish to match framing members. Subset fastener heads to be flush with angle at interior conditions.
   1. Attachment Angle Cover: Aluminum to match frame color; L-shape, sized to conceal attachment angle. Install with silicone sealant.

G. Exposed Flashings: Aluminum sheet, 20 gage, 0.032 inch minimum thickness; finish to match framing members.

H. Concealed Flashings: Galvanized steel, 26 gage, 0.0179 inch minimum base metal thickness.

I. Sealants, General: Refer to Section 07 92 00 - Joint Sealants.
   1. Provide only products having lower volatile organic compound (VOC) content than required by SCAQMD 1168.
      a. Architectural Sealants: 250 g/L.
      b. Sealant Primers for Nonporous Substrates: 250 g/L.
      c. Sealant Primers for Porous Substrates: 775 g/L.

J. Structural Glazing Sealant: As specified in Section 08 80 00 - Glazing.

K. Sill Flashing Sealant: Elastomeric, silicone, compatible with flashing material.

L. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

M. Glazing Accessories: As specified in Section 08 80 00.

N. Jamb Fillers: Polyvinyl chloride (PVC).

O. Jamb and Head Caps: Configuration to match end of framing member.

P. Expanding Foam Sealers: Polyurethane per AAMA 812.

Q. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.05 HARDWARE

A. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

C. Clean aluminum surfaces free of dirt, grease, or oil from the factory to ensure that corner stops and applied flashings adhere properly.

3.02 INSTALLATION

A. Periodic Installation Review: Conduct periodic review of installed frames with Contactor and Installer present to confirm compliance with specified tolerances.
   1. Include readjustment of non-complying frames at no added cost to Owner.
   2. Review will cover minimum of 50 percent of frames as installation progresses.
   3. Review will include in-progress work of components such as sill pans and related flashing.

B. Carefully match exposed work to produce continuity of line and design with all joints. Raw edges visible at joints are not allowed.

C. Fit joints between aluminum components to produce hairline joints free of burrs and distortions. Rigidly secure non-movement joints.

D. Install wall system in accordance with manufacturer's instructions.

E. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

F. Provide sill attachment angle, jamb and head attachments, and shims to permanently fasten system to building structure.

G. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

H. Provide thermal isolation where components penetrate or disrupt building insulation.

I. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam. Slope sill flashings to the exterior.

J. Penetrations through sill flashings are not permitted without prior written acceptance by the Architect. When penetrations cannot be avoided and have been accepted by the Architect, make watertight by seating and sealing fastener heads to sill flashing.

K. Pack fibrous insulation in shim spaces at perimeter of assembly or use minimally expanding foam per AAMA 812 to maintain continuity of thermal barrier.

L. Install sealants in accordance with ASTM C1193 and manufacturer's recommendations. Refer to Section 07 92 00 - Joint Sealants.

M. Install operating sash in accordance with manufacturer's recommendations.

N. Install glass in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.

O. Install L-shaped attachment angle cover trim flush and in alignment with sill.

P. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

A. Testing to be done by an AAMA accredited testing lab, and cost for testing shall be included in the Contract Price.

1. Conduct four separate regimes of testing. For each regime, test a minimum of three installed aluminum-framed storefront units for water leakage in conformance with AAMA 503-modified requirements with the storefront manufacturer, Contractor, Architect, Building Enclosure Consultant and Owner present. AAMA 503 modified such that the definition of water penetration is the same as that provided under "Performance Requirements" of this Section. Water penetration tests shall be conducted at a static test pressure equal to that identified in the "Performance Requirements" (no reduction in field test pressures allowed). Locations will be randomly determined by the Architect.
   a. Regime test dates to be determined by Architect in coordination with Contractor.
      1) First Test: Testing of mock-up installation.
      2) Second Test: Take at initial installation.
      3) Third Test: Take at 50 percent completion.
      4) Fourth Test: Take at 80 percent completion.
   b. Test area shall extend beyond perimeter of glazing frame to include adjacent materials, flashing and sealants.
   c. Test areas shall not have interior finishes installed so as to permit visibility of test area.
   d. Tests shall be conducted in accordance with ASTM E1105 Procedure A, uniform pressure difference.
2. Testing pressure to be set at 10 psf Field test. No reduction shall be permitted.
   a. There shall be no uncontrolled water penetrating assemblies or water appearing on assemblies normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to exterior.
3. If unit(s) fail testing, correct assembly of failed unit and any other unit with the same problem at no additional cost to Owner. Re-test failed assemblies and perform additional test(s) until window assembly achieves a “pass” result from testing.
   a. In the event of a failed test, at the discretion of the Architect, two additional locations for testing will be selected by the Architect. (These two areas shall be in addition to a re-testing the failed location)
   b. Procedure will be repeated until all tested areas pass.

c. Additional testing from failed results shall be conducted at no extra cost to the Owner.

3.05 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 62 00
UNIT SKYLIGHTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Thermoformed plastic skylights with integral frame.

B. Integral insulated curb.

1.02 RELATED REQUIREMENTS

A. Section 07 62 00 - Sheet Metal Flashing and Trim: Skylight counterflashing.

1.03 REFERENCE STANDARDS

A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for windows, doors, and skylights.

B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide structural, thermal, and daylighting performance values.

C. Shop Drawings: Indicate configurations, dimensions, locations, fastening methods, and installation details.

D. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
   1. Evidence of AAMA Certification.
   2. Evidence of WDMA Certification.
   3. Evidence of CSA Certification.
   4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.

E. Manufacturer's Installation Instructions: Indicate special procedures.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than five years documented experience.

1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty, including coverage for leakage due to defective skylight materials or construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Unit Skylights:
   1. Bristolite Daylighting Systems, Inc; Bristol Acrylic: www.bristolite.com/sle.
   2. Sunoptics Prismatic Skylights; Product Double Glazed Signature Series Dome: www.sunoptics.com.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 UNIT SKYLIGHTS

A. Unit Skylights: Factory-assembled glazing in aluminum frame, free of visual distortion, and weathertight.
   1. Shape: Square dome.
   2. Glazing: Double.

3. Operation: None; fixed.
4. Nominal Size: As indicated.

2.03 PERFORMANCE REQUIREMENTS

A. Provide unit skylights that comply with the following:
1. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific skylight type:
2. Design to withstand live loads as calculated in accordance with IBC code.
3. Provide impact resistance as required for OSHA Impact Fall Protection.
4. Allow for expansion and contraction within system components caused by a cycling surface temperature range of 170 degrees F without causing detrimental effects to system or components.
5. U-Value: 0.60 maximum.
6. Solar Heat Gain Coefficient: Not to exceed 0.40

2.04 COMPONENTS

A. Double Glazing: Acrylic plastic; factory sealed.
1. Outer Glazing: Clear transparent.
2. Inner Glazing: Clear transparent.

B. Support Curbs: ASTM B209 (ASTM B209M) Sheet aluminum, sandwich construction; 1 inch thick, 12 inches high; glass fiber insulation; with integral flange for anchorage to roof deck.

2.05 ACCESSORIES

A. Anchorage Devices: Type recommended by manufacturer, exposed to view.

B. Counterflashings: Same metal type and finish as skylight frame.

C. Protective Back Coating: Zinc molybdate alkyd.

D. Sealant: Elastomeric, silicone, compatible with material being sealed .

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that openings and substrate conditions are ready to receive work of this section.

3.02 PREPARATION

A. Apply protective back coating on aluminum surfaces of skylight units that will be in contact with cementitious materials or dissimilar metals.

3.03 INSTALLATION

A. Install aluminum curb assembly, fastening securely to roof decking; flash curb assembly into roofing system.

B. Install skylight units and mount securely to curb assembly; install counterflashing as required.

C. Apply sealant to achieve watertight assembly.

3.04 CLEANING

A. Remove protective material from prefinished aluminum surfaces.

B. Wash down exposed surfaces; wipe surfaces clean.

C. Remove excess sealant.

END OF SECTION

SECTION 08 80 00
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units.

C. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealants for other than glazing purposes.

B. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing installed in storefront assembly but furnished as Work of this Section.

1.03 REFERENCE STANDARDS

A. ASTM C1193 - Standard Guide for Use of Joint Sealants.

B. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.

C. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.

D. GANA (GM) - GANA Glazing Manual.

E. GANA (SM) - GANA Sealant Manual.

F. GANA (LGRM) - Laminated Glazing Reference Manual.

G. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use.

H. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data on Insulating Glass Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

D. Shop Drawings: Provide complete shop drawings showing coordination with adjoining architectural finishes and items furnished as Work of other Sections for the following:

E. Glazing Schedule: For glazed openings, prepare a schedule that lists each type and thickness for each size opening and location.

F. Certificate: Certify that products of this section meet or exceed specified requirements.

G. Warranties: Sample of special warranties.

H. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), IGMA TM-3000, and IGMA TB-3001 for glazing installation methods. Maintain one copy on site.

B. Insulating Glass Fabricator: Company whose location and equipment are certified by coated glass manufacturer.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years documented experience.

1.06 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Primary Glass Manufacturers:
   1. Guardian Industries Corp: www.sunguardglass.com.
   2. Pilkington North America Inc: www.pilkington.com/na.
   3. Vitro Architectural Glass (formerly PPG Industries, Inc): www.vitroglazings.com.
   4. Substitutions: Refer to Section 01 60 00 - Product Requirements.

B. Commercial Glass Fabricators:
   1. Garibaldi Glass: www.garibaldiglass.com.
   2. Hartung Glass Industries: www.hartung-glass.com.
   3. Northwestern Industries: www.nwiglass.com.
   4. Oldcastle BuildingEnvelope: www.oldcastle.com.
   5. Viracon, Inc: viracon.com.
   6. Vitrum Industries: www.vitrumindustries.com.
   7. Substitutions: Refer to Section 01 60 00 - Product Requirements.

2.02 INSULATING GLASS UNITS

A. Manufacturers:
   1. As listed above.
   2. Fabricator whose location and equipment is certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.

B. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
   3. Warm-Edge Spacers:
      a. Spacer Width: As required for specified insulating glass unit.
      b. Products: As required to meet project fenestration U-factor, insulating glass construction and warranty requirements.
   4. Spacer Color: Black.
   5. Edge Seal:
      a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone sealant as secondary seal applied around perimeter.
      b. Color: Black.

C. Insulated Clear Tempered Safety Glass Units Type IT-1: Double pane with silicone sealant edge seal.
   1. Locations of Use: All exterior storefront, windows.
   2. Outer pane of 6 mm clear tempered float glass with glass, inner pane of 6 mm clear tempered float glass.
   3. Place low E coating on No. 2 surface within the unit.
   4. Interspace Content: Argon.

5. Durability: Certified by an independent testing agency to comply with ASTM E2190.
6. Total unit thickness of 1 inch.
7. Visible Light Transmittance: 68 percent minimum.
8. Winter Nighttime U-Factor: 0.31 maximum.
9. Solar Heat Gain Coefficient: 0.40 maximum.
10. Products:
    a. SunGuard Clear SN 68 manufactured by Guardian Industries.
    b. Solarban 60 (2) Clear manufactured by Vitro Architectural Glass.
    c. VE 1-2M manufactured by Viracon.

2.03 GLAZING COMPOUNDS

A. Sealants and Primers - General: Provide only products having lower volatile organic compound (VOC) content than required by SCAQMD 1168.

2.04 ACCESSORIES

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

B. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

C. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

D. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated.

E. Glazing Gaskets: Resilient EPDM extruded shape to suit glazing channel retaining slot; color black.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that the minimum required face and edge clearances are being provided.

C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

D. Verify that sealing between joints of glass framing members has been completed effectively.

E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. 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.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Provide spacers for glass lites where length plus width is larger than 50 inches.

E. Provide edge blocking where 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.

F. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 INSTALLATION - DRY GLAZING METHOD (TAPE AND TAPE)

A. Application - Interior Glazed: Set glazing infills from the interior of the building.

B. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.

C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

D. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.

E. Place glazing tape on free perimeter of glazing in same manner described above.

F. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

G. Carefully trim protruding tape with knife.

3.06 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove non-permanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.07 PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism during construction period prior to Date of Substantial Completion.

END OF SECTION

SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Gypsum sheathing.

B. Gypsum wallboard.

C. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Building framing and sheathing.

B. Section 07 92 00 - Joint Sealants: Acoustic sealants installed as Work of this Section.

1.03 REFERENCE STANDARDS

A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units.

B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units.

C. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.

D. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

E. ASTM C514 - Standard Specification for Nails for the Application of Gypsum Board.

F. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members.

G. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

H. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

I. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.

J. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.

K. 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.

L. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base.

M. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

N. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.

O. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing.

P. ASTM C1325 - Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units.

Q. ASTM C1396/C1396M - Standard Specification for Gypsum Board.

R. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.

S. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

T. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

U. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

V. ASTM E413 - Classification for Rating Sound Insulation.

W. GA-214 - Recommended Levels of Gypsum Board Finish.

X. GA-216 - Application and Finishing of Gypsum Board.

Y. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113.

Z. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate special details associated with acoustic sound isolation clips.

C. Product Data: Provide data on gypsum board, glass mat faced gypsum board, accessories, joint finishing system, and acoustic sound isolation clips.
   1. Indicate profiles and products for wall and ceiling trim accessories.

D. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum five years of experience.

B. Acoustic Assemblies: Construct walls indicated to receive acoustic insulation as acoustic 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.

1.06 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Moisture test wood stud framing and confirm moisture content is less than specified for framing material in Section 06 10 00 - Rough Carpentry. Do not commence installation until moisture content of framing is within tolerances.

D. Do not install panels that are wet, those that are moisture damaged, and those that are 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

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.

B. Interior Partitions: Provide completed assemblies with the following characteristics:

1. Acoustic Attenuation: 44 minimum calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90, unless otherwise indicated.

2.02 BOARD MATERIALS

A. Gypsum Board, General: Provide Type X or Type C as required for fire-resistant ratings indicated on Drawings.
   1. Lightweight gypsum wallboard is not allowed.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
      a. Moisture-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
   3. Thickness:
      a. Vertical Surfaces: 5/8 inch.
      b. Ceilings: 5/8 inch.
      c. Multi-Layer Assemblies: 5/8 inch, unless otherwise indicated on drawings.
   4. Edges: Tapered.
   5. Paper-Faced Products:
      a. American Gypsum Company; FireBloc Type X and FireBloc Type C Gypsum Wallboard.
      b. CertainTeed Corporation; ProRoc Brand Gypsum Board or CertainTeed Gypsum Board.
      c. Georgia-Pacific Gypsum; ToughRock, ToughRock Fireguard, and ToughRock FireGuard C Gypsum Wallboard.
      d. National Gypsum Company; Gold Bond Brand Gypsum Wallboard.
      e. USG Corporation; Sheetrock Brand Firecode and Firecode C Gypsum Panels.
      f. Substitutions: See Section 01 60 00 - Product Requirements.

C. Moisture Resistant Wallboard:
   1. Application: Walls and ceilings in kitchen areas, toilet rooms where not indicated to receive tile, custodial rooms, laundry rooms, adjacent to drinking fountains, and elsewhere as indicated.
   2. Thickness: 5/8 inch.
   3. Edges: Tapered.
   4. Mold Resistant Paper Faced Products:
      a. American Gypsum Company; M-Bloc.
      b. CertainTeed Corporation; ProRoc Brand Moisture & Mold Resistant Gypsum Board with M2 Tech or M2Tech Gypsum Board or AirRenew Gypsum Board with M2Tech.
      c. Georgia-Pacific Gypsum; ToughRock Mold-Guard and ToughRock Mold-Guard Type X Gypsum Wallboard.
      d. National Gypsum Company; Gold Bond Brand XP Gypsum Board.
      e. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
      f. Substitutions: See Section 01 60 00 - Product Requirements.
   5. Glass Mat Faced Products:
      a. Georgia-Pacific Gypsum; DensArmor Plus.
      b. National Gypsum Company; Gold Bond eXP Interior Extreme Gypsum Panel.
      c. USG Corporation; Sheetrock Brand Glass-Mat Panels Mold Tough Firecode X.
      d. Substitutions: See Section 01 60 00 - Product Requirements.
   6. Unfaced Products:
      a. USG Corporation; Fiberock Aqua-Tough Interior Panels.
      b. Substitutions: See Section 01 60 00 - Product Requirements.

D. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
   1. Application: Exterior sheathing, unless otherwise indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

3. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
4. Type X Thickness: 5/8 inch.
5. Edges: Square.
6. Glass Mat Faced Products:
   a. American Gypsum Company; M-Glass Exterior Sheathing.
   b. CertainTeed Corporation; GlasRoc Sheathing.
   c. Georgia-Pacific Gypsum; DensGlass Sheathing.
   d. National Gypsum Company; Gold Bond eXP Sheathing.
   e. USG Corporation; Securock Glass-Mat Sheathing.
   f. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness to fit wall cavity, unless otherwise indicated.

B. Mineral Fiber Insulation: 1.5 to 3.0 lb/cf glass or mineral fiber insulation for packing voids where indicated.

C. Acoustic Sealant: As specified in Section 07 92 00 - Joint Sealants.
   1. Sealants and Primers - General: Provide only products having lower volatile organic compound (VOC) content than required by SCAQMD 1168.
      a. Architectural Sealants: 250 g/L.
      b. Sealant Primers for Nonporous Substrates: 250 g/L.
      c. Sealant Primers for Porous Substrates: 775 g/L.

D. Spray Applied Acoustic Sealant: Acrylic latex spray suitable for application at static and minimally dynamic linear joints or gaps in smoke and sound rated barriers. Material shall be resilient and non-setting.
   1. Sealants and Primers - General: Provide only products having lower volatile organic compound (VOC) content than required by SCAQMD 1168.
      a. Architectural Sealants: 250 g/L.
   2. Products:
      a. Smoke and Acoustic Spray, CP 572 manufactured by Hilti Corporation.
      b. Smoke "N" Sound Acoustical Spray manufactured by Specified Technologies Inc.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

E. Water-Resistive Barrier: No. 15 asphalt felt.

F. Electric Outlet Box Pads: Provide pads to seal backs of outlet boxes penetrating acoustical walls.
   1. Products:
      a. SpecSeal Series SSP Putty Pads manufactured by STI Specified Technologies, Inc: www.stifirestop.com
      b. Lowry's Outlet Box Pads manufactured by Lowry's: www.halowry.com.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

G. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
   1. Cornerbead. Provide 1-1/4-inch minimum width flange at outside corners.
   2. L-Bead: L-shaped; exposed long flange receives joint compound.
   3. U-Bead: J-shaped; exposed short flange does not receive joint compound.
   4. Expansion (control) joint.
   5. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
      a. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B211, Alloy 6063-T5.
      b. Finish: Chemical conversion coat suitable for field painting.
      c. Types:
         1) Reveal Channel Screed: Fry Reglet DCS-625-50 for use at ceilings and at intermediate soffit joints.

2) Reveal Molding: Fry Reglet DRM-625-50 for use at walls.
3) "F" Reveal: Fry Reglet FDM-625-75 for use at perimeters of soffits.
4) Substitutions: See Section 01 60 00 - Product Requirements.

H. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
1. Tape: 2 inch wide, coated glass fiber tape for joints and corners.
2. Tape: 2 inch wide, creased paper tape for joints and corners.
3. Ready-mixed vinyl-based joint compound.
4. Chemical hardening type compound.

I. All paints and coating wet applied on the building interior must meet the applicable limits of SCAQMD 1113.

J. Basecoat/Surfacer: Flat latex basecoat for use on surfaces indicated to receive Level 4 and 5 finish. Basecoat/surfacer does not replace skim coating for Level 5. Basecoat is in addition to primer specified in Section 09 91 23 - Interior Painting.
1. Products:
a. "PrepRite High Build Interior Latex Primer/Surfacer", B28W601; Sherwin Williams.
b. "SHEETROCK Brand Primer-Surfacer, Tuff-Hide; USG Corporation.
c. Substitutions: See Section 01 60 00 - Product Requirements.

K. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

L. Nails for Attachment to Wood Members: ASTM C514.

M. Staples For Attachment of Base Ply of Two-Ply Assembly to Wood Members: Flattened galvanized wire type as specified in ASTM C840.

N. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

O. Isolation Strip at Exterior Walls: Provide one of the following:
1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), non-perforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence. Start of wall and ceiling system Work will indicate acceptance of surfaces and conditions within each area.

B. Protection: Provide temporary covering to eliminate splattering of joint compound onto adjacent surfaces.

3.02 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

B. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions. Press blankets firmly in place against the back of one of the layers of gypsum board. Tightly butt ends of blankets, leaving no voids.

C. Acoustic Sealant: Install in accordance with manufacturer's instructions.

1. Place two beads continuously on substrate before installation of perimeter framing members.
2. Place continuous bead at perimeter of each layer of gypsum board.
3. In non-fire-rated construction, seal around all penetrations by items such as conduit, pipe, ducts, and rough-in boxes.

D. Spray Applied Acoustic Sealant: Install spray applied acoustical sealant in accordance with manufacturer's instructions. Apply material continuously in multiple coasts resulting in a minimum thickness of 1/8 inch (maximum 1/4 inch) on both sides of partition where indicated.

E. Electrical Outlet Box Pads: Install pads to the back of installed electrical boxes, mold to box and fold around conduit cable entering the box.

3.03 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Non-Rated: Install gypsum board perpendicular to framing, with ends and edges occurring over firm bearing.

C. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.

D. Moisture Protection: Treat cut edges and holes in moisture-resistant gypsum board with sealant.

E. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
1. Seal joints, cut edges, and holes with water-resistant sealant.

F. Installation on Metal Framing: Use screws for attachment of gypsum board.

G. Installation on Wood Framing: For rated assemblies, comply with requirements of listing authority. For non-rated assemblies, install as follows:
1. Single-Layer Applications: Screw attachment.
2. Double-Layer Application: Install base layer using screws. Install face layer using screws.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated. In public areas, confirm locations with Architect for visual effect. Frame both sides of joints independently.
1. Not more than 30 feet apart on walls and ceilings over 50 feet long.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.
1. U-Bead: Use at exposed panel edges.
2. L-Bead: Use at all exposed terminations of gypsum board, at all floor joints and joints to receive sealants.

D. Aluminum Trim: Install in locations indicated.

3.05 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840 or GA-214, except as indicated below and as follows:
1. Level 5:
a. Locations of Use:
1) Commons stage wall and all walls that receive graphics.

b. Application of basecoat/surfacer will not constitute or substitute for application of a skim coat.
c. Primer and its application to surfaces are specified in Section 09 91 23 - Interior Painting.
d. At areas requiring use of impact-rated gypsum board, bed joint tape with setting type joint compound and fill and finish with heavy weight ready mixed vinyl-based joint compound. Apply a finish coat of basecoat/surfacer after application of skim coat.

2. Level 4:
   a. Locations of Use:
      1) Walls and ceilings at all public areas.
      2) Surfaces scheduled to receive wall coverings.
   b. Apply one coat of specified basecoat/surfacer to entire surface at manufacturer's recommended coverage rate of mil thickness.
   c. Primer and its application to surfaces are specified in Section 09 91 23 - Interior Painting and are in addition to basecoat/surfacer.
3. Level 2: In utility areas such as Janitors Closets, Electrical Closets and Storage Rooms, in areas behind cabinetry and on backing board to receive tile finish.
4. Level 1: Wall areas above finished ceilings and permanently concealed areas, whether or not accessible in the completed construction, except provide a higher level of finish as required to comply with fire resistance ratings and acoustical ratings.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

C. Fill and finish joints and corners of tile backing board as recommended by manufacturer.

3.06 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Acoustical units ACT-1, 2, and 3.

1.02 RELATED REQUIREMENTS

A. Section 13 48 53 - Seismic Anchorage Requirements.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

B. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.

C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

D. 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.

E. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

G. CHPS (HPPD) - High Performance Products Database.

H. CISCA - CISCA Seismic Zones 3-4 Guidelines for Seismic Restraint for Direct-Hung Suspended Ceiling Assemblies.

I. Northwest Wall and Ceiling Bureau, Technical Bulletin 401 - Suspension Systems for Acoustical Lay-in Ceilings.

J. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168.

K. UL (GGG) - GREENGUARD Gold Certified Products.

1.04 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.

1.05 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design acoustical ceiling suspension systems, including comprehensive engineering analysis by a qualified professional engineer licensed in the State of Washington, using the seismic standards indicated in the Quality Assurance Article.

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate grid layout and related dimensioning.
   1. Indicate coordination with Work of Section 09 84 30 - Sound-Absorbing Wall and Ceiling Units for installation of ceiling Diffusers CD-2.

C. Product Data: Provide data on suspension system components and acoustical units.

D. Delegated-Design Submittal: For ceiling suspension system, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Submit submittals as "Deferred Submittals" in accordance with Section 01 30 00 - Administrative Requirements. Transmit a copy of each submittal indicating agency approval to the Architect for record.

E. Samples: Submit three samples 6 by 6 inch in size illustrating material and finish of acoustical units.

F. Manufacturer's Installation Instructions: Indicate perimeter conditions requiring special attention.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

H. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor and fastener type.

I. Maintenance Data: For finishes to include in maintenance manuals.

1.07 QUALITY ASSURANCE

A. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E1264 for Class A materials as determined by testing identical products per ASTM E84:
   1. Smoke-Developed Index: 50 or less.

B. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
   1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E580/E580M.
   2. CISCA: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4."
   3. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
   4. Northwest Wall and Ceiling Bureau, Technical Bulletin 401 - Suspension Systems for Acoustical Lay-in Ceilings.

C. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

D. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.08 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Tiles/Panels:
   1. Armstrong World Industries, Inc: www.armstrong.com/#sle.
   2. CertainTeed Corporation: www.certainteed.com/#sle.
   3. USG: www.usg.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Suspension Systems:
   1. Armstrong World Industries, Inc: www.armstrong.com/#sle.
   2. CertainTeed Corporation: www.certainteed.com/#sle.
   3. USG: www.usg.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.
   1. 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 Tile ACT-1: Painted mineral fiber, ASTM E1264 Type III, Form 1, with the following characteristics:
   1. Size: 24 by 48 inches.
   2. Thickness: 3/4 inches.
   3. Composition: Water felted.
   4. Light Reflectance: 0.82 - 0.86, determined in accordance with ASTM E1264.
   5. NRC: 0.70, determined in accordance with ASTM E1264.
   6. Ceiling Attenuation Class (CAC): 30 - 35, determined in accordance with ASTM E1264.
   7. Edge: Square.
   8. Surface Color: White.
   9. Surface Pattern: Pattern E1 or CE.
   10. Products:
      a. Cirrus Square Lay-In Item No. 533 manufactured by Armstrong: www.armstrong.com.
      b. Cashmere Item No. CM-497 NRCP manufactured by CertainTeed Corporation: www.certainteed.com.
      c. Eclipse ClimaPlus Item No. 78575 manufactured by USG: www.usg.com.

C. Acoustical Tile ACT-2: Painted mineral fiber, ASTM E1264 Type III, Form 2, with the following characteristics:
   1. Size: 24 x 48 inches.
   2. Thickness: 3/4 inches.
   3. Composition: Water felted.
   4. Light Reflectance: 0.84 to 0.89, determined as specified in ASTM E1264.
   5. NRC Range: 0.55 - 0.60, determined as specified in ASTM E1264.
   6. Ceiling Attenuation Class (CAC): 35 - 38, determined as specified in ASTM E1264.
   7. Edge: Angled Tegular.
   8. Surface Color: White.
   9. Surface Pattern: Pattern C, E, K or C, D, E, K or CDK.
   10. Products:
      a. Fine Fissured Second Look Item No. 1761 manufactured by Armstrong: www.armstrong.com.
      b. Fine Fissured Customline Item FFCL-224 BIO manufactured by CertainTeed Corporation: www.certainteed.com.
      c. Radar ClimaPlus Illusion Item No. 2842 manufactured by USG: www.usg.com.

D. Acoustical Tile ACT-3: Acoustically transparent water-repellent membrane faced mineral fiber, ASTM E1264 Type IV, Form 2, with the following characteristics:
   1. Meets USDA/FSIS guidelines for use in food processing areas.
   2. Size: 24 x 48 inches.
   3. Thickness: 3/4 inches.
   4. Composition: Water felted.
   5. Light Reflectance: 0.86 to 0.90, determined as specified in ASTM E1264.
   6. NRC: 0.70 determined as specified in ASTM E1264.
   7. Ceiling Attenuation Class (CAC): 35, determined as specified in ASTM E1264.
   8. Edge: Square.
   9. Surface Color: White.
   10. Surface Pattern: E or E, G.
   11. Products:
      a. Ultima Health Zone Item No. 1938 manufactured by Armstrong: www.armstrong.com.
      b. Performa Rx Symphony m Item No. SYM M-1220-RXS-1 manufactured by CertainTeed Corporation: www.certainteed.com.
      c. Mars ClimaPlus Healthcare Item No. 88189 manufactured by USG: www.usg.com.

2.03 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
   1. Provide metal grid for acoustical convex diffusers specified in Section 09 84 30 - Sound-Absorbing Wall and Ceiling Units.

B. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; heavy-duty. Provide additional grid members as required to support light fixtures.
   1. Profile: Tee; 15/16 inch wide face.
   2. Construction: Double web.
   3. Finish: White painted.
      a. White at ACT-1, ACT-2, and ACT-3.
   4. Products:
      a. Prelude XL manufactured by Armstrong: www.armstrong.com.
      b. Seismic Secure 15/16 inch Classic Stab: www.certainteed.com.
      c. DX manufactured by USG: www.usg.com.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
   1. Wire Gage: 12 gage (0.1055-inch) minimum.

B. Perimeter Moldings: Same material and finish as grid. Provide type complying with seismic design requirements.
   1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.

C. Perimeter Moldings at ACT 1,2, and 3: Extruded aluminum trim.
   1. Color: To match suspension grid.
   2. Depth:
      a. Nominal 4 inches at ACT 1,2, and 3.
   3. Available Products:
      a. Axiom Classic Trim manufactured by Armstrong: www.armstrong.com.
      b. Attributes manufactured by CertainTeed Corporation: www.certainteed.com.
      c. Compasso Elite manufactured by USG: www.usg.com.

D. Sealants and Primers - General: Provide only products having lower volatile organic compound (VOC) content than required by SCAQMD 1168.

E. Acoustical Sealant For Perimeter Moldings: Non-hardening, non-skinning, for use in conjunction with suspended ceiling system.

F. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C 636/C 636M and seismic design requirements indicated, per manufacturer's written instructions, CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4" as modified by ASCE 7 and NWCB Technical Bulletin 401.
   1. Comply with restrictions of ASCE 7 on use of power actuated fasteners.
   2. Power actuated fasteners shall not be used for sustained tension loads or for brace applications unless approved for seismic loading, with the following exceptions:

a. Power actuated fasteners in concrete where the service load on any individual fastener does not exceed 90 lb.
b. Power actuated fasteners in steel where the service load on any individual fastener does not exceed 250 lb.

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. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

E. 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.

F. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.

G. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

H. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

I. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

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 of each corner, or support components independently.

L. Do not eccentrically load system or induce rotation of runners.

M. 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.

3.03 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. Fit border trim neatly against abutting surfaces.

D. Install units after above-ceiling work is complete.

E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

F. Cutting Acoustical Units:
1. Make field cut edges of same profile as factory edges.

G. Install hold-down clips on panels within 20 ft of an exterior door.

3.04 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.05 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections and prepare reports:
   1. Suspended ceiling system.
   2. Hangers, anchors and fasteners.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

C. Tests and Inspections: Testing and inspecting of completed installations of acoustical panel ceiling hangers and anchors and fasteners shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.
   1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
      a. Within each test area, testing agency will select 1 or every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 100 lbf of tension; it will also select 1 of every 2 postinstalled anchors used to attach bracing wires to concrete and will test them for 250 lbf of tension.
         1) When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
      b. Within each test area, testing agency will select 5 percent of power-actuated and post-installed anchors used to attach hangers to concrete over metal deck and will test them for a minimum 250 lbs for not less than 10 seconds. Test samples will be selected from dispersed locations.
         1) When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test a minimum of 6 anchors in the immediate vicinity of the failed anchor. In the event of any additional failure, all anchors placed on the same day will be tested.
      c. Replace all failed anchors.

D. Remove and replace acoustical panel ceiling hangers and anchors and fasteners that do not pass tests and inspections and retest as specified above.

END OF SECTION

SECTION 09 51 53
DIRECT-APPLIED ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Acoustic units ACT-4.

1.02 RELATED REQUIREMENTS

A. Section 09 51 00 - Acoustical Ceilings: ACT-1, 2, and 3.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.

C. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustic 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. Install acoustic units after interior wet work is dry.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on acoustic units.

C. Shop Drawings: Indicate tile layout and related junctions with other work or ceiling finishes, interrelation of mechanical and electrical items related to system.

D. Samples: Submit two samples, 6 by 6 inch in size, illustrating material and finish of acoustic units.

E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section with minimum five years of documented experience.

1.07 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Direct Applied Acoustical Ceilings:
   1. Armstrong World Industries, Inc; Fine Fissured Item No. 746: www.armstrong.com/#sle.
   2. USG; Radar Item No. 2990: www.usg.com/#sle.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS

A. Acoustic Tile ACT-4: ASTM E1264, Type III, Form 2; and in compliance with the following requirements.

1. Size: 12 by 12 inches.
2. Thickness: 5/8 inches.
3. Composition: Mineral.
4. Light Reflectance: 0.84 to 0.89, determined as specified in ASTM E1264.
5. NRC Range: 0.50 to 0.55, determined as specified in ASTM E1264.
6. Ceiling Attenuation Class (CAC): 35 to 40, determined as specified in ASTM E1264.
7. Surface Burning Characteristics: Flame spread index of 25, smoke developed index of 50, when tested in accordance with ASTM E84.
8. Edge: Beveled.
9. Surface Color: White.
10. Surface Finish: Non-directional fissured.

B. Adhesive: Type recommended by tile manufacturer.
   1. VOC Content: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.
      a. Panel Adhesives: 50 g/L.

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

A. Install system in accordance with manufacturer's instructions.

B. Center tile on room axis leaving equal border units, unless otherwise indicated.

C. Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.

D. Install acoustic units level in uniform plane.

3.03 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

END OF SECTION

SECTION 09 65 00
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient sheet flooring.

B. Resilient tile flooring.

C. Resilient base.

D. Installation accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

B. Section 09 00 01 - Finish Legend.

1.03 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.

B. ASTM F1516 - Standard Practice for Sealing Seams of Resilient Flooring Products by the Heat Weld Method (when Recommended).

C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

E. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

F. ASTM F970 - Standard Test Method for Static Load Limit.

G. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile.

H. ASTM F1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing.

I. ASTM F1861 - Standard Specification for Resilient Wall Base.

J. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

K. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute.

L. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, 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.

1. Provide product data for adhesives, including printed statement of VOC content and chemical components.

C. Shop Drawings: Indicate seaming plans and floor patterns.

D. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection for moldings and transition strips.

E. Verification Samples: Submit two samples, 8 by 8 inch in size illustrating color and pattern for each resilient flooring product specified.

F. Concrete Testing Standard: Submit a copy of ASTM F710.

G. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.

H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Flooring Material: 50 square feet of each type and color.
   3. Extra Wall Base: 10 linear feet of each type and color.
   4. Maintenance Products: One year's annual required maintenance products of type recommended by flooring manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store all materials off of the floor in an acclimatized, weather-tight space.

B. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

C. Protect roll materials from damage by storing on end.

D. Do not double stack pallets.

1.06 FIELD CONDITIONS

A. Store materials for not less than 72 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 68 degrees F.

B. Moisture Testing: Maintain temperatures and humidity expected during normal use for testing. If this is not possible, then the test conditions should be 75 +/- 10 deg F and 50 +/- 10 percent relative humidity. Maintain these conditions 48 hours prior to and during testing.

C. Close spaces to traffic during resilient flooring installation and for time period after installation recommended in writing by flooring manufacturer.

PART 2 PRODUCTS

2.01 SHEET FLOORING

A. Vinyl Sheet Flooring - SV-1: Color and pattern throughout wear layer thickness, with backing.
   1. Manufacturer: As indicated in Finish Legend.
      a. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Minimum Requirements: Comply with ASTM F1303, Type II, with Class A fibrous backing.
   3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
   4. Wear Layer Thickness: 0.050 inch minimum.
   5. VOC Content: Certified as Low Emission by one of the following:
      a. GreenGuard Gold Certification; www.greenguard.org.
      b. SCS Floorscore; www.scscertified.com.
   6. Total Thickness: 0.080 inch minimum.
   7. Sheet Width: 72 inch minimum.
   8. Static Load Resistance: 125 psi minimum, when tested as specified in ASTM F970.
   9. Seams: Heat welded.
   10. Integral coved base with cap strip.
   11. Color: As indicated in Finish Legend.

B. Welding Rod: Solid bead in material compatible with flooring, produced by flooring manufacturer for heat welding seams, and in color matching field color.

2.02 TILE FLOORING

A. Vinyl Composition Tile - VCT-1: Homogeneous, with color extending throughout thickness.
   1. Manufacturers: As indicated in Finish Legend.
      a. Substitutions: See Section 01 60 00 - Product Requirements.

2. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
4. Size: 12 by 12 inch.
5. VOC Content: Certified as Low Emission by one of the following:
   a. GreenGuard Gold Certification; www.greenguard.org.
   b. SCS Floorscore; www.scscertified.com.
6. Thickness: 0.125 inch.
7. Color: As indicated in Finish Legend.

2.03 RESILIENT BASE

A. Resilient Base B-1: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
   1. Manufacturers:
      a. Burke Flooring: www.burkeflooring.com.
      b. Flexco, Inc: www.flexcofloors.com.
      c. Johnsonite, a Tarkett Company: www.johnsonite.com.
      d. Roppe Corp: www.roppe.com.
      e. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
   3. Height: 4 inch.
   4. Thickness: 0.125 inch.
   5. Finish: Satin.
   6. Length: Roll.
   7. Color: As indicated in Finish Legend.

2.04 ACCESSORIES

A. Subfloor Filler: Portland cement based; type recommended by adhesive material manufacturer.

B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer. Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.
   1. VCT, Vinyl, and Linoleum Adhesives: Use adhesives that have a VOC content of not more than 50 g/L.

C. Moldings, Transition and Edge Strips: Rubber.
   1. Provide transitions and edge strips at all exposed edges of resilient flooring, carpet, and entry mat and at transitions from one material to another.
      a. Coordinate with Work of Section 09 30 00 - Tiling for transitions adjacent to tile.
   2. Color as selected by Architect from manufacturer's full range of available colors.

D. Integral-Flash-Cove-Base Accessories:
   1. Cove Strip: 1-inch radius provided or approved by manufacturer.
   2. Cap Strip: Square metal cap provided or approved by manufacturer.

E. Filler for Coved Base: Plastic.

F. Floor Polish: Provide protective liquid floor wax/polish products as recommended by manufacturer.
   1. Application of protective wax/polish by owner.

G. Floor Sealer: Protective liquid floor sealer.
   1. Product: Diversey Product LinoBase Linoleum Sealer.
   2. Application of Sealer by owner.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

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 resilient base.

C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
   1. Test in accordance with ASTM F710.
   2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

D. Verify that required floor-mounted utilities are in correct location.

E. Install resilient flooring material and accessories after other finishing operations, including painting, have been completed.

3.02 PREPARATION

A. Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI (RWP).

B. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings.

C. Concrete Substrates: Prepare according to ASTM F710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
      a. At areas where existing flooring was removed as Work of asbestos abatement, field test adhesion of floor coverings and, if necessary, take remedial action as required for proper adhesion.
   3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
   4. Moisture Testing: Perform the following tests: Proceed with installation only after substrates pass testing.
      a. Anhydrous calcium chloride test, ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours. Limit maximum moisture-vapor-emission rate to 5 lb. of water/1000 sq. ft. in 24 hours for linoleum.
      b. Perform additional tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

D. Relative Humidity Testing: Perform testing of relative humidity in concrete slabs for file tests in accordance with ASTM F2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
   1. The relative humidity measured from the center of the concrete slab should not exceed 75 percent.

E. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

F. Prohibit traffic until filler is fully cured.

G. Do not install floor coverings until they are same temperature as space where they are to be installed.
   1. Move floor coverings and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

H. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Unroll floor coverings and allow them to stabilize before cutting and fitting.

D. Lay out floor coverings as follows:
   1. Maintain uniformity of floor covering direction.
   2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in floor covering substrates.
   3. Match edges of floor coverings for color shading at seams.
   4. Avoid cross seams.

E. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.

F. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

G. Spread only enough adhesive to permit installation of materials before initial set.

H. Fit joints and butt seams tightly.

I. Set flooring in place, press with heavy roller to attain full adhesion.

J. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

K. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
   1. Resilient Strips: Attach to substrate using adhesive.

L. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

M. At movable partitions, install flooring under partitions without interrupting floor pattern.

3.04 INSTALLATION - SHEET FLOORING

A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.

B. Roll resilient flooring using 100 lb. roller as required by flooring manufacturer.

C. Cut sheet at seams in accordance with manufacturer's instructions.

D. Seal seams by heat welding.

E. Seamless Installation: Heat-Welded Seams: Comply with ASTM F1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.

F. Coved Base B-2: Install using coved strip as backing at floor to wall junction. Extend sheet flooring 6 inches vertically, and cover top edge with metal cap strip.

3.05 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

B. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half of a tile at perimeter

C. Lay tiles square with room axis, unless otherwise indicated. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures.
   1. Discard broken, cracked, chipped, or deformed tiles.

D. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.

E. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

F. Install square tile to quarter turn pattern. Allow minimum 1/2 full size tile width at room or area perimeter.

3.06 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

3.07 INSTALLATION - ACCESSORIES

A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece.
   1. Install reducer strips at edges of resilient flooring, carpet, and entry mat that would otherwise be exposed.
   2. Install transition strips at joints between one material to another.

3.08 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

C. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Perform initial maintenance on installed products in accordance with manufacturer's instructions, prior to owner's acceptance. Remove construction site debris from project site and legally dispose of debris.
   1. Remove visible adhesive and other surface blemishes using cleaning methods recommended by flooring manufacturer.
   2. Sweep vacuum floor after installation.
   3. Do not perform initial maintenance for a minimum of 5 days after installation has been completed to allow the adhesive the proper time to set.
   4. Damp mop flooring to remove black marks and soil.

3.09 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

B. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

C. Cover floor coverings until Substantial Completion.

END OF SECTION

SECTION 09 68 13
TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

B. Entry mat.

1.02 RELATED REQUIREMENTS

A. Section 01 74 19 - Construction Waste Management and Disposal: Reclamation/Recycling of new carpet tile scrap.

B. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

C. Section 09 00 01 - Finish Legend: Color selections.

D. Section 09 65 00 - Resilient Flooring: Rubber transition strips.

1.03 REFERENCE STANDARDS

A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials.

B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.

C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

D. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

E. CRI 104 - Standard for Installation of Commercial Carpet.

F. CRI (GLP) - Green Label Plus Testing Program - Certified Products; www.carpet-rug.org.

G. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

H. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
   1. For carpet tile and entry mat, provide documentation indicating compliance with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.
   2. For installation adhesive, include printed statement of VOC content.

C. Shop Drawings: Indicate layout of joints.

D. Samples: Submit two carpet tiles and entry mat illustrating color and pattern design for each color selected.

E. Manufacturer's Installation Instructions: Indicate special procedures.

F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Carpet Tiles and Entry Mat: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum five years documented experience.

B. Installer Qualifications: Company specializing in installing carpet tile with minimum five years documented experience.

1.06 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

B. Moisture Testing: Maintain temperatures and humidity expected during normal use for testing. If this is not possible, then the test conditions should be 75+/-10 deg F and 50+/-10 percent relative humidity. Maintain these conditions 48 hours prior to and during testing.

1.07 WARRANTY

A. Special Warranty for Carpet: Manufacturer's standard form 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, excess static discharge and delamination.
   3. Warranty Period: 10 years from date of Substantial Completion.

B. Special Warranty for Entry Mat: Manufacturer's standard form in which manufacturer agrees to repair or replace components of entry mat installation that fail in materials or workmanship within specified warranty period.
   1. Warranty does not include deterioration or failure of entry mat 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, excess static discharge and delamination.
   3. Warranty Period: 3 years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MATERIALS

A. Tile Carpeting, Type CPT-1, 2, 3: Tufted, manufactured in one color dye lot.
   1. Product: Art Style Collection manufactured by Mohawk Group.
   2. Tile Size: 12 by 36 inch, nominal.
   3. Color: As indicated in 09 00 01 Finish Legend.
   4. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
   5. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
   6. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.
   7. Fiber: Nylon yarn.
   8. Dye Method: Solution dyed
   9. Maximum Electrostatic Charge: 3.5 Kv. at 20 percent relative humidity.
   10. Stitches: 12 per inch.
   11. Pile Height: 0.085 inch.
   12. Primary Backing Material: EcoFlex NXT by Mohawk.

2.02 ENTRY MAT

A. Entry Mat EM-1, 2: 100 percent Asota solution-dyed UV stabilized polypropylene fibers backed with ExoDi composite rubber backing.
   1. Products:
      a. Super Nop 52 supplied by Connexus: www.connexusflooring.com.
      b. van Gelder; Inc; Product Champion Super Nop: www.vangelder-inc.com.

2. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.
3. Roll Size: 158 inches by 1220 inches.
4. Pile Height: 1/4 to 3/8 inch.
5. Total Height: 1/2 inch.
6. Pile Weight: 52 oz/sq yd.
7. Total Weight: 78 to 93 oz/sq yd as standard with manufacturer.
8. Color(s): As indicated in Section 09 00 01 - Finish Legend.

B. Entry Mat EM-3: Textured patterned loop, Type 6,6 nylon, solution dyed.
1. Products:
   a. Charge supplied by Mannington: www.manningtoncommercial.com.
2. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.
3. Pile Height: 0.185 inch.
4. Pile Weight: 36 oz/sq yd.
5. Color(s): As indicated in Section 09 00 01 - Finish Legend.

2.03 ACCESSORIES

A. Sub-Floor Filler: Portland cement based; type recommended by flooring material manufacturer.

B. Edge Strips: Rubber as specified in Section 09 65 00 - Resilient Flooring.

C. Adhesives:
1. VOC-Content for Adhesives, Including Flooring Adhesives: SCAQMD 1168.
2. Compatible with materials being adhered; maximum VOC content of 50 g/L; CRI (GLP) certified; in lieu of labeled product, independent test report showing compliance is acceptable.

D. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

E. Seam Adhesive for Entry Mat: Recommended by entry mat manufacturer.

F. Contact Adhesive for Entry Mat: Compatible with entry mat material; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.

C. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.

D. 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.
   a. At areas where existing flooring was removed as Work of asbestos abatement, field test adhesion of floor coverings and, if necessary, take remedial action as required for proper adhesion.
2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
4. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
5. Moisture Testing:

a. Engage an independent testing agency to perform anhydrous calcium chloride test, ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
b. Flooring installer shall perform additional tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.

C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

D. Vacuum clean substrate.

3.03 INSTALLATION

A. References to carpet apply equally to entry mat.

B. Starting installation constitutes acceptance of sub-floor conditions.

C. Install carpet tile in accordance with manufacturer's instructions and CRI 104 (Commercial).

D. Blend carpet from different cartons to ensure minimal variation in color match.

E. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

F. Locate change of color or pattern between rooms under door centerline.

G. Fully adhere carpet tile to substrate.

H. Trim carpet tile neatly at walls and around interruptions.

I. Coordinate installation of edge strips with Work of Section 09 65 00, concealing all exposed edges.

3.04 INSTALLATION ON STAIRS

A. Use one piece of carpet for each tread and the riser below. Apply seam adhesive to all cut edges.

B. Lay carpet with pile direction in the length of the stair.

C. Adhere carpet tight to stair treads and risers.

3.05 ENTRY MAT INSTALLATION

A. In addition to requirements indicated above, install in strict accordance with manufacturer's recommendations, using manufacturer's recommended adhesive suitable for project conditions.

B. Follow manufacturer's recommended seaming techniques.

C. Roll with appropriate roller for compete contact of adhesive to entry mat backing, rolling at least twice, once in each direction.

D. Coordinate installation of edge strips with Work of Section 09 65 00, concealing all exposed edges.

E. Keep all traffic off entry mat for 24 hours after installation. Wait 72 hours prior to initial cleaning.

3.06 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 68 16
SHEET CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet, direct-glued.

B. Removal of existing carpet.

C. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 01 74 19 - Construction Waste Management and Disposal: Reclamation/Recycling of new carpet scrap, new cushion scrap, removed carpet, and removed carpet cushion.

B. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied carpet.

C. Section 09 00 01 - Finish Legend: Color selections.

D. Section 09 65 00 - Resilient Flooring: Termination edging of adjacent floor finish.

E. Section 09 68 13 - Tile Carpeting.

1.03 REFERENCE STANDARDS

A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials.

B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.

C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

D. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

E. CRI 104 - Standard for Installation of Commercial Carpet.

F. CRI (GL) - Green Label Testing Program - Certified Products.

G. CRI (GLP) - Green Label Plus Testing Program - Certified Products; www.carpet-rug.org.

H. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

I. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
   1. Provide documentation indicating compliance with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.
   2. For installation adhesive, include printed statement of VOC content.

C. Shop Drawings: Indicate seaming plan, method of joining seams, direction of carpet pile and pattern, location of edge moldings and edge bindings.

D. Samples: Submit two samples 6 x 6 inch in size illustrating color and pattern for each carpet and entry mat material specified.

E. Manufacturer's Installation Instructions: Indicate special procedures.

F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional requirements.

2. Extra Carpet and Entry Mat: 5 percent of each type, color, and pattern installed.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet with minimum five years documented experience.

B. Installer Qualifications: Company specializing in installing carpet with minimum five years documented experience.

1.06 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

B. Maintain minimum 70 degrees F ambient temperature 24 hours prior to, during and 24 hours after installation.

C. Ventilate installation area during installation and for 72 hours after installation.

D. Moisture Testing: Maintain temperatures and humidity expected during normal use for testing. If this is not possible, then the test conditions should be 75+/-10 deg F and 50+/-10 percent relative humidity. Maintain these conditions 48 hours prior to and during testing.

1.07 WARRANTY

A. Special Warranty for Carpet: Manufacturer's standard form 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, excess static discharge and delamination.
   3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 CARPET

A. Carpet, Type CPT-1: Tufted, nylon.
   1. Product: As indicated in Section 09 00 01 - Finish Legend.
   2. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
   3. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
   4. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.
   5. Color: _____.
   6. Pattern: _____.
   7. Roll Width: ____ ft.
   8. Fiber: _____.
   9. Dye Method: _____
   10. Maximum Electrostatic Charge: 3 Kv. at 20 percent relative humidity (RH).
   11. Rows: ____ per inch.
   12. Gage: ____ inch.
   13. Stitches: ____ per inch.
   14. Yarn Size: _____ denier.
   15. Pile Height: _____ inch.
   16. Pile Weight: ____ oz/sq yd.
   17. Density Factor: ____ kilotex.
   18. Light Fastness: ____.
   19. Primary Backing:
      a. Material: Polypropylene.
      b. Weight: ____ oz/sq yd.
   20. Laminate:

a. Material: ____.
b. Weight: ____ oz/sq yd.

21. Secondary Backing:
a. Material: Jute.
b. Weight: ____ oz/sq yd.
c. Total Weight: ____ oz/sq yd.

2.02 ACCESSORIES

A. Sub-Floor Filler: Portland cement based; type recommended by flooring manufacturer.

B. Adhesives:
1. VOC-Content for Adhesives, Including Flooring Adhesives: SCAQMD 1168.
2. Compatible with materials being adhered; maximum VOC content of 50 g/L; CRI (GL) certified; in lieu of labeled product, independent test report showing compliance is acceptable.

C. Seam Adhesive: Recommended by carpet manufacturer.

D. Carpet Adhesive: Recommended by carpet manufacturer; releasable type.

E. Edge Strips: Rubber as specified in Section 09 65 00 - Resilient Flooring.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive carpet.

B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesives to sub floor surfaces.

C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and alkalinity (pH).
1. Test in accordance with ASTM F710.
2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

D. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.

E. 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. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
4. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
5. Moisture Testing:
a. Engage an independent testing agency to perform anhydrous calcium chloride test, ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
b. Flooring installer shall perform additional tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

3.02 PREPARATION

A. Remove existing carpet.

B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

C. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.

D. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

E. Clean substrate.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install carpetin accordance with manufacturer's instructions and CRI 104 (Commercial).

C. Verify carpet match before cutting to ensure minimal variation between dye lots.

D. Lay out carpet and locate seams in accordance with shop drawings.
   1. Locate seams in area of least traffic, out of areas of pivoting traffic, and parallel to main traffic.
   2. Do not locate seams perpendicular through door openings.
   3. Align run of pile in same direction as anticipated traffic and in same direction on adjacent pieces.
   4. Locate change of color or pattern between rooms under door centerline.
   5. Provide monolithic color, pattern, and texture match within any one area.

E. Install carpet tight and flat on subfloor, well fastened at edges, with a uniform appearance.

3.04 DIRECT-GLUED CARPET

A. Double cut carpet seams, with accurate pattern match. Make cuts straight, true, and unfrayed. Apply seam adhesive to cut edges of woven carpet immediately.

B. Apply contact adhesive to floor uniformly at rate recommended by manufacturer. After sufficient open time, press carpet into adhesive.

C. Apply seam adhesive to the base of the edge glued down. Lay adjoining piece with seam straight, not overlapped or peaked, and free of gaps.

D. Roll with appropriate roller for complete contact of adhesive to carpet backing.

E. Trim carpet neatly at walls and around interruptions.

F. Coordinate installation of edge strips with Work of Section 09 65 00, concealing all exposed edges.

3.05 CLEANING

A. Remove excess adhesive from floor and wall surfaces without damage.

B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 72 00
WALL COVERINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Wall covering and trim.

1.02 RELATED REQUIREMENTS

A. Section 09 00 01 - Finish Legend.

B. Section 09 21 16 - Gypsum Board Assemblies: Wall substrate.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on wall covering and adhesive.

C. Shop Drawings: Indicate wall elevations with seaming layout.

D. Selection Samples: Edge trim for _____ showing manufacturer's full range of available finishes.

E. Samples: Submit two samples of wall covering, 8 by 8 inch in size illustrating color, finish, and texture.

F. Test Reports: Indicate verification of flame and smoke ratings, when tested by UL.

G. Manufacturer's Installation Instructions: Indicate special procedures.

H. Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Inspect roll materials at arrival on site, to verify acceptability.

B. Protect packaged adhesive from temperature cycling and cold temperatures.

C. Do not store roll goods on end.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.

B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

C. Provide lighting level of 80 ft candles measured mid-height at substrate surfaces.

PART 2 PRODUCTS

2.01 WALL COVERINGS

A. General Requirements:

1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.

2. Color: As indicated in Section 09 00 01 - Finish Legend.
3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Wall Covering WC-_____.
1. Product: _____.
2. Material Content: _____.
3. Finish: _____.
4. Backing: _____.
5. Width: _____.
6. Durability: _____.
7. Flammability: _____.

C. Adhesive: Type recommended by panel manufacturer.
1. VOC Content: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.
a. Adhesives: 50 g/L.

D. Termination Trim: Manufacturer's recommended metal edge and corner trim for use at WC-_____, color as selected.

E. Trim: Flat aluminum trim, 3/8 inch wide by 1/16 inch thick, clear satin anodized aluminum.

F. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces to receive WC-_____ are prime painted and ready to receive work, and conform to requirements of the wall covering manufacturer.

B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.

C. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet nor vary at a rate greater than 1/16 inch/ft.

3.02 PREPARATION

A. Fill cracks in substrate and smooth irregularities with filler; sand smooth.

B. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

C. Surfaces: Correct defects and clean surfaces that affect work of this section.

D. Vacuum clean surfaces free of loose particles.

3.03 INSTALLATION

A. Apply adhesive and wall covering in accordance with manufacturer's instructions.

B. Apply adhesive to wall surface immediately prior to application of wall covering.

C. Use wall covering in roll number sequence.

D. Razor trim edges on flat work table. Do not razor cut on gypsum board surfaces.

E. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.

F. Horizontal seams are not acceptable.

G. Do not seam within 2 inches of internal corners or within 6 inches of external corners.

H. Install wall covering before installation of bases and items attached to or spaced slightly from wall surface.

I. Do not install wall covering more than 1/4 inch below top of resilient base.

J. Apply termination trim and flat trim where indicated to eliminate any exposed wall covering edges, mitering corners of trim.

K. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.04 CLEANING

A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.

B. Reinstall wall plates and accessories removed prior to work of this section.

3.05 PROTECTION

A. Do not permit construction activities at or near finished wall covering areas.

END OF SECTION

SECTION 09 91 13
EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paint systems indicated as "P" (Paint) on the following substrates:
   1. Wood.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 09 96 00 - High-Performance Coatings: Painting of metals with high-performance coatings indicated as "HPC" on Drawings.

1.03 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section.

B. Paint Gloss and Sheen: Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following MPI values:

Gloss Level	Description	Units @ 60 Degrees	Units @ 85 Degrees
G1	Matte or Flat Finish	0 to 5	10 maximum
G2	Velvet Finish	0 to 10	10 to 35
G3	Eggshell Finish	10 to 25	10 to 35
G4	Satin Finish	20 to 35	35 minimum
G5	Semi-Gloss Finish	35 to 70	
G6	Gloss Finish	70 to 85	
G7	High-Gloss Finish	85	

1.04 REFERENCE STANDARDS

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.

B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials.

C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.

D. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "acrylic enamel").
   2. Manufacturer's installation instructions.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Include printed statement of VOC content and chemical components.

D. Samples for Verification: For each color and material to be applied, provide three 8-inch by 10-inch color drawdowns with texture to simulate actual conditions, and representing color and sheen.

E. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

F. Manufacturer's Instructions: Indicate special surface preparation procedures and substrate conditions requiring special attention.

G. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
1. At project completion, provide an itemized list complete with manufacturer, paint type and color coding for all colors used for Owner's later use in maintenance.
2. Include color drawdowns and sample chips for each color and sheen.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 60 00 - Product Requirements, for additional provisions.
2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
3. Label each container with color and sheen in addition to the manufacturer's label.

1.06 PREINSTALLATION CONFERENCE

A. Preinstallation Conference: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers. Agenda items will include field conditions, substrate conditions, coordination of shop applied primers with finish coatings, application methods, and field quality control testing and inspection, schedule of painting applications and notifications to Owner of start of painting operations.
1. Bring copies of reviewed color draw-downs for all required colors.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum five years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years documented experience.

C. MPI Standards:
1. Preparation and Workmanship: Comply with requirements in MPI (APSM) - "Master Painters Institute Architectural Painting Specification Manual" and paint manufacturer's recommendations for products and paint systems indicated.

D. Surface Preparation: Obtain written confirmation of the specific surface preparation procedures and primers used for all fabricated steel items from the fabricator(s) to ascertain appropriate and manufacturer compatible finish coat materials to be used before painting any such work.

1.08 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, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Products: Provide one of the products listed in Part 2.

C. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in Part 2:
   1. Kelly-Moore Paints (Kelly).
   2. Miller Paint Co. (Miller).
   3. Rodda Paint / Cloverdale Paint Co. (Rodda).
   4. Sherwin-Williams Co. (S-W).

D. Substitutions: Not permitted.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. Supply each paint material in quantity required to complete entire project's work from a single production run.
   4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:
   1. All paints and coating wet applied on site must meet the applicable limits of the SCAQMD 1113. VOC shall not exceed the limits indicated below:
      a. Flat Paints: 50 g/L.
      b. Nonflat Paints: 50 g/L.
      c. Primers, Sealers and Undercoaters: 100 g/L
      d. Rust Preventative Coatings/Industrial Maintenance Coatings: 100 g/L.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Colors: Match existing.
   1. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.03 PAINT SYSTEMS - EXTERIOR

A. Smooth Wood: Provide the following finish systems over smooth wood siding and other smooth, exterior wood surfaces:
   1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a primer.
      a. Primer Over Existing Painted Surfaces:

1) Kelly: 295 Kel-Bond Universal Acrylic Primer.
2) Miller: 6060 Miller Prime All Purpose Acrylic Primer.
3) Rodda: First Coat 501601.
4) S-W: Multi-Purpose Latex Primer B51-450 Series.

b. Primer: Exterior, alkyd or latex, wood primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils.
1) Kelly: 255 Acry-Shield 100% Acrylic Exterior Wood Primer.
2) Miller: 7052 Acrilite Primer.
3) Rodda: First Coat Primer 501601.
4) S-W: A-100 Alkyd PrimerY24.

c. First and Second Coats: Semigloss, waterborne, exterior, acrylic enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.4 mils.
1) Kelly: 1215 Color Shield Exterior Acrylic Semi-Gloss Enamel.
2) Miller: 7500 Semi-Gloss Acrilite.
3) Rodda: Ecologic Semi-Gloss 70623.
4) S-W: A-100 Exterior Satin Latex A82.

B. Wood Trim: Provide the following finish systems over exterior wood trim:
1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a primer.
a. Primer Over Existing Painted Surfaces:
1) Kelly: 295 Kel-Bond Universal Acrylic Primer.
2) Miller: 6060 Miller Prime All Purpose Acrylic Primer.
3) Rodda: First Coat 501601.
4) S-W: Multi-Purpose Latex Primer B51-450 Series.

b. Primer: Exterior, acrylic-latex primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.4 mils.
1) Kelly: 255 Acry-Shield 100% Acrylic Exterior Wood Primer.
2) Miller: 7052 Acrilite Primer.
3) Rodda: First Coat Primer 501601.
4) S-W: PrepRite ProBlock Interior Exterior Latex Primer Sealer B51.

c. First and Second Coats: Semigloss, waterborne, exterior, acrylic-latex enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.4 mils.
1) Kelly: 1215 Color Shield Exterior Acrylic Semi-Gloss Enamel.
2) Miller: 7500 Semi-Gloss Acrilite.
3) Rodda: Ecologic Semi-Gloss 70623.
4) S-W: A-100 Exterior Satin Latex A82.

2.04 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

D. Test shop-applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

A. Comply with manufacturer's written instruction and recommendations in MPI (APSM) "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Previously Painted Surfaces: Comply with manufacturer's written instructions and recommendations in "Master Painters Institute Maintenance Repainting Manual" applicable to substrates indicated for existing painted surfaces.
   1. Follow general surface preparations guidelines. Remove loose or failing paint and spot prime bare areas or entire surface with appropriate primer. Sand or provide bonding primer for hard, glossy surfaces as necessary for bond.

C. Clean surfaces thoroughly and correct defects prior to application.

D. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

E. Remove or repair existing paints or finishes that exhibit surface defects.

F. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
   1. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating or nomenclature plates.

G. Seal surfaces that might cause bleed through or staining of topcoat.

H. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

I. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

J. High pressure water clean all exterior surfaces prior to repainting using pressures indicated below to ensure complete removal of all loose paint, stains, dirt and other foreign matter, with such work to be carried out only by qualified tradesmen experienced in high pressure water cleaning. The use of spray equipment such as water hose cleaning will not be considered satisfactory. Allow sufficient drying time and test all surfaces using an electronic moisture meter before commencing work.

Substrate	Pressure Range
Soft stone (sandstone, limestone, softwood)	100 - 600 psi @ 6 inches
Wood siding, stone, clay brick	600 - 1,500 psi @ 6 inches
Firm masonry, stone, brick, concrete	1,500 - 4,000 psi @ 6 to 12 inches

K. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior caulking compound after prime coat has been applied. Back prime concealed surfaces before installation.

3.03 APPLICATION

A. Apply paints according to manufacturer's written instructions.
   1. Use applicators and techniques suited for paint and substrate indicated.
   2. If spray equipment is utilized, a spray/backroll application is considered one coat of paint.

3. 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.
4. Continue paint finish behind all wall-mounted items.

B. 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.

C. Paint access doors, prime coated hardware, exposed piping and electrical panels to match adjacent surfaces in color, texture and sheen, unless otherwise noted or where pre-finished.
1. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

D. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.

E. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

F. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

G. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

H. Apply each coat to uniform appearance.

I. Regardless of number of coats specified, apply additional coats until complete hide is achieved.

J. Sand wood and metal surfaces lightly between coats to achieve required finish.

K. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

L. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection.

B. Painted surfaces shall be considered to lack uniformity and soundness if any of the following defects are apparent to Architect.
1. Brush/roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, or foreign materials in paint coatings.
2. Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners, reentrant angles or similar conditions.
3. Damage due to touching before paint is sufficiently dry or any other contributory cause.
4. Damage due to application on moist surfaces or caused by inadequate protection from the weather.
5. Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).

C. Painted surfaces shall be considered unacceptable if any of the following are evident:
1. Visible defects are evident on vertical or horizontal surfaces when viewed at normal viewing angles from a distance of not less than 39 inches.
2. Visible defects are evident on ceilings, soffits and other overhead surfaces when viewed at normal viewing angles.
3. When the final coat on any surface exhibits a lack of uniformity of color, sheen texture and hiding across full surface area.
4. Dry mil thicknesses do not meet manufacturer’s recommended thickness or specified thickness.

D. Owner may provide field inspection and testing.
1. Painted surfaces will be tested for dry mil thickness for each coat.
2. Shop primers and painted surfaces will be tested for adhesion.

3. Surfaces will be tested at frequency discussed in the preinstallation conference and as deemed appropriate by Owner.

E. Touch-up and restore painted surfaces damaged by testing.
1. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.06 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

3.07 SCHEDULE - PAINT SYSTEMS

A. Smooth Wood - Semigloss, Acrylic-Enamel Finish.

B. Wood Trim - Semigloss, Acrylic-Enamel Finish.

C. Refer to Section 09 96 00 - High-Performance Coating for ferrous metals not listed to be painted as Work of this Section.

D. Refer to Section 09 96 00 - High-Performance Coating for zinc-coated metals not listed to be painted as Work of this Section.

END OF SECTION

SECTION 09 91 23
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paint systems indicated as "P" (Paint) and "EP" (Epoxy) on the following substrates:
   1. Gypsum board.
   2. Wood.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
   2. Mechanical and Electrical:
      a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
         1) Protect sprinkler heads.
      b. In finished areas, paint shop-primed items.
      c. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
      d. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Acoustical materials, unless specifically indicated.
   6. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 05 50 00 - Metal Fabrications: Shop-primed items.

B. Section 09 00 01 - Finish Legend: Color selections.

C. Section 09 91 13 - Exterior Painting.

D. Section 09 96 00 - High-Performance Coatings: Painting of metals with high-performance coatings indicated as "HPC" on Drawings.

1.03 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section.

B. Paint Gloss and Sheen: Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following MPI values:

Gloss Level	Description	Units @ 60 Degrees	Units @ 85 Degrees
G1	Matte or Flat Finish	0 to 5	10 maximum
G2	Velvet Finish	0 to 10	10 to 35
G3	Eggshell Finish	10 to 25	10 to 35
G4	Satin Finish	20 to 35	35 minimum
G5	Semi-Gloss Finish	35 to 70	

G6	Gloss Finish	70 to 85
G7	High-Gloss Finish	85

1.04 REFERENCE STANDARDS

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.

B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials.

C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.

D. MPI - Master Painters Institute Repainting Manual.

E. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "acrylic enamel").
   2. Manufacturer's installation instructions.

C. Product List: For each product indicated, include the following:
   1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
   2. Include printed statement of VOC content and chemical components.

D. Samples for Verification: For each color and material to be applied, provide three 8-inch by 10-inch color drawdowns with texture to simulate actual conditions, and representing color and sheen.

E. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

F. Manufacturer's Instructions: Indicate special surface preparation procedures and substrate conditions requiring special attention.

G. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
   1. At project completion, provide an itemized list complete with manufacturer, paint type and color coding for all colors used for Owner's later use in maintenance.
   2. Include color drawdowns and sample chips for each color and sheen.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
   3. Label each container with color and sheen in addition to the manufacturer's label.

1.06 PREINSTALLATION CONFERENCE

A. Pre-installation Conference: Convene a pre-installation meeting one week before starting work of this section; require attendance by all relevant installers. Agenda items will include field conditions, substrate conditions, coordination of shop applied primers with finish coatings, application methods, and field quality control testing and inspection, schedule of painting applications and notifications to Owner of start of painting operations.
   1. Bring copies of reviewed color draw-downs for all required colors.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum five years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years documented experience.

C. MPI Standards:
   1. Preparation and Workmanship: Comply with requirements in MPI (APSM) - "Master Painters Institute Architectural Painting Specification Manual" and paint manufacturer's recommendations for products and paint systems indicated.

D. Surface Preparation: Obtain written confirmation of the specific surface preparation procedures and primers used for all fabricated steel items from the fabricator(s) to ascertain appropriate and manufacturer compatible finish coat materials to be used before painting any such work.

1.08 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, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.

D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

F. Lead Paint: Lead paint may be present in buildings and structures to be painted. A report on the presence of lead paint is included in Document 00 31 00 - Available Project Information. Examine report to become aware of locations where lead paint is present.
   1. Do not disturb lead paint or items suspected of containing hazardous materials except under procedures specified.
   2. Perform preparation for painting of substrates known to include lead paint in accordance with Section 02 26 26 - Lead Coated Surfaces.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Products: Provide one of the products listed in Part 2.

C. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in Part 2:
   1. Kelly-Moore Paints (Kelly).
   2. Miller Paint Co. (Miller).
   3. Rodda Paint / Cloverdale Paint Co. (Rodda).
   4. Sherwin-Williams Co. (S-W).

D. Substitutions: Not permitted.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.

1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
3. Supply each paint material in quantity required to complete entire project's work from a single production run.
4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:
1. All paints and coating wet applied on site must meet the applicable limits of the SCAQMD 1113. VOC shall not exceed the limits indicated below:
a. Dry Fog Coatings: 150 g/L.
b. Flat Paints: 50 g/L.
c. Nonflat Paints: 50 g/L.
d. Primers, Sealers and Undercoaters: 100 g/L
e. Rust Preventative Coatings/Industrial Maintenance Coatings: 100 g/L.
f. Clear Wood Finishes, Varnish: 275 g/L.
g. Clear Wood Finishes, Sanding Sealers: 275 g/L.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Colors: As indicated in Section 09 90 01 - Finish Legend.
1. Extend colors to surface edges; colors may change at any edge as directed by Architect.
2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.03 PAINT SYSTEMS - INTERIOR

A. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a primer.
a. Primer Over Existing Painted Surfaces:
1) Kelly: 295 Kel-Bond Universal Acrylic Primer.
2) Miller: 6060 Miller Prime All Purpose Acrylic Primer.
3) Rodda: First Coat Primer 501601.
4) S-W: Multi-Purpose Latex Primer B51-450 Series.
b. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
1) Kelly: 95-100 Pre-Cote Wallboard & Masonry Primer/Sealer.
2) Miller: 130010 Performance Plus Primer Sealer.
3) Rodda: Master Painter UL VOC Primer 503601.
4) S-W: Contractors Interior Latex Primer B28WF0162.
c. First and Second Coats: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils.
1) Kelly: 1050 KM Professional Acrylic Semi-Gloss Enamel.
2) Miller: 4580 Premium Semi-Gloss.
3) Rodda: Master Painter Ultra Low VOC Semi-Gloss 543601.
4) S-W: ProMar 200 Zero VOC Semi-Gloss, B20-2600 Series.
2. Semigloss, Water-Based Epoxy (EP): 2 finish coats over a primer.
a. Primer Over Existing Painted Surfaces:
1) Kelly: 295 Kel-Bond Universal Acrylic Primer.
2) Miller: 6060 Miller Prime All Purpose Acrylic Primer.
3) Rodda: First Coat Primer 501601.
4) S-W: Multi-Purpose Latex Primer B51-450 Series.

b. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.4 mils.
   1) Kelly: Sierra Performance S30 Griptec Sandable Primer.
   2) Miller: 130010 Performance Plus Primer Sealer.
   3) Rodda: Master Painter UL VOC Primer 503601.
   4) S-W: Contractors Interior Latex Primer B28WF0162.

c. First and Second Coats: Odorless, semigloss, interior water-based epoxy enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 3 mils.
   1) Kelly: Sierra Performance S-16 Epoxy Acrylic Semi-Gloss.
   2) Miller: 4200 Water Base Epoxy.
   3) Rodda: Rustoleum Sierra Performance S60/S62 WB Epoxy Coating.
   4) S-W: Pro Industrial Waterborne Catalyzed Epoxy, B73 Series.

C. Woodwork and Hardboard: Provide the following paint finish systems over new, interior wood surfaces:
   1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a primer or wood undercoater.
      a. Primer Over Existing Painted Surfaces:
         1) Kelly: 295 Kel-Bond Universal Acrylic Primer.
         2) Miller: 6060 Miller Prime All Purpose Acrylic Primer.
         3) Rodda: First Coat Primer 501601.
         4) S-W: Multi-Purpose Latex Primer B51-450 Series.
      b. Undercoat: Acrylic-latex-based, interior wood undercoater, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
         1) Kelly: 295 Kel-Bond Universal Acrylic Primer.
         2) Miller: 2840 Acrylic Enamel Undercoat.
         3) Rodda: Unique II 100% Acrylic Enamel Undercoater 502001.
         4) S-W: Multi-Purpose Int/Ext Latex Primer Sealer B51 Series.
      c. First and Second Coats: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils.
         1) Kelly: 1685 Dura-Poxy +100% Acrylic Semi-Gloss Enamel.
         2) Miller: 7200 Semi-Gloss Acrinamel.
         3) Rodda: Master Painter Ultra Low VOC Semi-Gloss 543601.
         4) S-W: Pro Industrial Acrylic Semi-Gloss, B66 Series.

D. Natural-Finish Woodwork: Provide the following natural finishes over new, interior woodwork:
   1. Waterborne, Satin Polyurethane Varnish Finish: 2 finish coats of a waterborne, clear-satin polyurethane varnish over a sanding sealer. Wipe wood filler before applying stain.
      a. Filler Coat: Paste-wood filler applied at spreading rate recommended by the manufacturer.
         1) Kelly: None required.
         2) Miller: None required.
         3) Rodda: None required.
         4) S-W: None required.
      b. Sealer Coat: Clear sanding sealer applied at spreading rate recommended by the manufacturer.
         1) Kelly: 2097 Kel-Thane II Waterborne Interior Clear Satin Finish.
         2) Miller: 1220 Acriclear Sanding Sealer.
         3) Rodda: Old Masters Int WB Sanding Sealer 75204 or Timberlox F/D Sanding Sealer 42114.
         4) S-W: Minwax Polycrylic Protective Finish 3333.
      c. First and Second Finish Coats: Waterborne, polyurethane varnish finish applied at spreading rate recommended by the manufacturer.

1) Kelly: 2097 Kel-Thane II Waterborne Interior Clear Satin Finish.
2) Miller: 1225 Acriclear Satin.
3) Rodda: Old Masters Water-Based Polyurethane Satin 755 or Cloverdale Timberlox WB Varnish Satin 59314.
4) S-W: Minwax Polycrylic Protective Finish 3333.

2.04 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

D. Test shop-applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
1. Gypsum Wallboard: 12 percent.
2. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in MPI (APSM) applicable to substrates indicated.

B. Previously Painted Surfaces: Comply with manufacturer's written instructions and recommendations in "MPI Maintenance Repainting Manual" applicable to substrates indicated for existing painted surfaces.
1. Follow general surface preparations guidelines. Remove loose or failing paint and spot prime bare areas or entire surface with appropriate primer. Sand or provide bonding primer for hard, glossy surfaces as necessary for bond.

C. Clean surfaces thoroughly and correct defects prior to application.

D. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

E. Remove or repair existing paints or finishes that exhibit surface defects.

F. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
1. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating or nomenclature plates.

G. Seal surfaces that might cause bleed through or staining of topcoat.

H. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

I. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease and incompatible paints and encapsulants.
1. Remove incompatible primers and re-prime substrate with compatible primers as required to produce paint systems indicated.

J. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair. Do not begin paint application until finishing compound is dry and sanded smooth.

K. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation. Prime edges, ends, faces, undersides and backsides of wood.

L. Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner. Prime edges, ends, faces, undersides and backsides of wood.

3.03 APPLICATION

A. Apply paints according to manufacturer's written instructions.
   1. Use applicators and techniques suited for paint and substrate indicated.
   2. If spray equipment is utilized, a spray/backroll application is considered one coat of paint.
   3. 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.
   4. Continue paint finish behind all wall-mounted items.
   5. Apply block filler to concrete masonry block at a rate to ensure complete coverage with pores filled (pinhole free).

B. 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.

C. Paint access doors, prime coated hardware, exposed piping and electrical panels to match adjacent surfaces in color, texture and sheen, unless otherwise noted or where pre-finished.
   1. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

D. When the color of a door frame changes from side to side, the change shall be made at the edge of the stop, where the transition is not visible when the door is in a closed position.

E. Back-prime and paint plywood service panels such as electrical, telephone and cable vision panels, as applicable, including edges, to match painted wall it is mounted on or white where mounted on unpainted wall.

F. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

G. Paint the inside of all ductwork behind louvers, grilles and diffusers for a minimum of 18 inches or beyond sightline, whichever is greater, using flat black (non-reflecting) paint.

H. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

I. Prime surfaces to receive cabinetry and similar items.
   1. Provide primer and all finish coats behind wainscots, wall coverings, markerboards, tackboards, and tack surfaces.

J. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

K. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

L. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

M. Regardless of number of coats specified, apply as many coats as necessary for complete hide.

N. Sand wood and metal surfaces lightly between coats to achieve required finish.

O. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

P. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

Q. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection.

B. Painted surfaces shall be considered to lack uniformity and soundness if any of the following defects are apparent to Architect.
   1. Brush/roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, or foreign materials in paint coatings.
   2. Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners, reentrant angles or similar conditions.
   3. Damage due to touching before paint is sufficiently dry or any other contributory cause.
   4. Damage due to application on moist surfaces or caused by inadequate protection from the weather.
   5. Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).

C. Painted surfaces shall be considered unacceptable if any of the following are evident under natural lighting source for exterior surfaces:
   1. Visible defects are evident on vertical or horizontal surfaces when viewed at normal viewing angles from a distance of not less than 39 inches.
   2. Visible defects are evident on ceilings, soffits and other overhead surfaces when viewed at normal viewing angles.
   3. When the final coat on any surface exhibits a lack of uniformity of color, sheen texture and hiding across full surface area.
   4. Dry mil thicknesses do not meet manufacturer’s recommended thickness or specified thickness.

D. Owner may provide field inspection and testing.
   1. Painted surfaces will be tested for dry mil thickness for each coat.
   2. Shop primers and painted surfaces will be tested for adhesion.
   3. Surfaces will be tested at frequency discussed in the pre-installation conference and as deemed appropriate by Owner.

E. Touch-up and restore painted surfaces damaged by testing.
   1. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.06 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

3.07 SCHEDULE - PAINT SYSTEMS

A. Gypsum Board - Semigloss, Acrylic-Enamel Finish.
   1. Provide primer without finish coats at areas indicated to receive fixed equipment, cabinetry and similar fixed items.
   2. Provide primer and all finish coats behind wainscots, wall covering, markerboards, tackboards, and tack surfaces.

B. Gypsum Board: Semigloss, Water-Based Epoxy:
   1. Walls and ceilings in kitchens, restrooms, food service areas, custodial/janitor closets.
   2. Locker room ceilings.
   3. Shower room ceilings.

C. Woodwork and Hardboard - Semigloss, Acrylic-Enamel Finish:
   1. Wood doors indicated to receive opaque finish.

D. Natural-Finish Woodwork - Waterborne, Satin Polyurethane Varnish Finish:
   1. Wood trim indicated to receive transparent finish.

E. Refer to Section 09 96 00 - High-Performance Coating for metals not listed to be painted as Work of this Section.

F. Steel Doors and Frames: As specified in Section 09 96 00 - High-Performance Coatings.

END OF SECTION

SECTION 09 96 00
HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. High performance coatings (HPC) for the following conditions:
   1. Exterior Substrates:
      a. Steel.
      b. Galvanized steel.
   2. Interior Substrates:
      a. Steel.
      b. Galvanized steel.

B. Surface preparation.

1.02 RELATED REQUIREMENTS

A. Section 05 50 00 - Metal Fabrications: Shop priming of metal substrates with primers specified in this Section.

B. Section 09 00 01 - Finish Legend.

C. Section 09 91 13 - Exterior Painting.

D. Section 09 91 23 - Interior Painting: Requirements for mechanical and electrical equipment surfaces.

1.03 REFERENCE STANDARDS

A. ASTM D3359 - Standard Test Method for Measuring Adhesion by Tape Test.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.

C. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113.

D. SSPC-PA 2 - Procedure For Determining Conformance To Dry Coating Thickness Requirements.

E. SSPC-SP 3 - Power Tool Cleaning.

F. SSPC-SP 6 - Commercial Blast Cleaning.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of all products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. Include printed statement of VOC content and chemical components for interior coatings.

C. Samples for Verification: For each type of coating system and in each color and gloss of finish coat indicated.
   1. Submit Samples on shop primed and galvanized steel, 8 inches square.

D. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and surface preparation requirements.

F. Maintenance Data: Include cleaning procedures and repair and patching techniques.
   1. At project completion, provide an itemized list complete with manufacturer, coating type and color coding for all colors used for Owner's later use in maintenance.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Coating Materials: 1 gallon of each type and color. All extra stock containers are to be new and unopened.
2. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.05 PREINSTALLATION CONFERENCE

A. Preinstallation Conference: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers. Agenda items will include field conditions, substrate conditions, coordination of shop applied primers with finish coatings, application methods, and field quality control testing and inspection.
   1. Bring copies of reviewed color draw-downs for all required colors.

1.06 QUALITY ASSURANCE

A. Master Painters Institute (MPI) Standards:
   1. Preparation and Workmanship: Comply with requirements in MPI (APSM) - "Master Painters Institute Architectural Painting Specification Manual" for products and coating systems indicated.

B. Surface Preparation: Obtain written confirmation of the specific surface preparation procedures and primers used for all fabricated steel items from the fabricator(s) to ascertain appropriate and manufacturer compatible finish coat materials to be used before painting any such work.

C. Comply with requirements of SSPC-PA 2 for measurement of coating thickness.

1.07 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 coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Coating Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the coating product manufacturer.

C. Do not install materials when temperature is below 55 degrees F or above 90 degrees F.

D. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

F. Restrict traffic from area where coating is being applied or is curing.

G. Lead Paint: Lead paint is present in buildings and structures to be painted. A report on the presence of lead paint is included in Document 00 31 00 - Available Project Information. Examine report to become aware of locations where lead paint is present.
   1. Do not disturb lead paint or items suspected of containing hazardous materials except under procedures specified.
   2. Perform preparation for painting of substrates known to include lead paint in accordance with Section 02 26 26 - Lead Coated Surfaces.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Products: Provide one of the products listed in Part 2.

B. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in Part 2:
   1. Kelly-Moore Paints (Kelly).
   2. Miller Paint Co. (Miller).
   3. Rodda Paint / Cloverdale Paint Co. (Rodda).
   4. Sherwin-Williams Co. (S-W).

C. Substitutions: Not permitted.

2.02 MATERIALS

A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated.
   1. For shop primed items, omit specified primer if shop primer is compatible with finish coats and in good condition as determined by finish coating manufacturer.

B. Material Compatibility: Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

C. Volatile Organic Compound (VOC) Content:
   1. All paints and coating wet applied on site must meet the applicable limits of the SCAQMD 1113. VOC shall not exceed the limits indicated below:
      a. Rust Preventative Coatings/Industrial Maintenance Coatings: 100 g/L.

D. Colors: As indicated on Finish Legend.

2.03 ACCESSORY MATERIALS

A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of coated surfaces.

2.04 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on appropriately shop-primed items.
   1. Semi-Gloss, Two-Component, Pigmented Aliphatic Acrylic Polyurethane: One finish coat, over intermediate coat and metal primer with total dry film thickness not less than 6.5 mils, unless noted otherwise.
      a. Prime: Manufacturer's recommended metal primer.
         1) Kelly: K-M 15 Chemical Mastic High Build Epoxy.
         2) Miller: PPG 95-242/249 Pitt-Guard Rapid Coat D-T-R Primer or 97-699 Durethane MCZ.
         3 Rodda: Precision Coatings DTM 1300v100 HB Epoxy Primer.
         4) S-W: Zinc Clad III HS (B59-100).
      b. Intermediate Coat:
         1) Kelly: K-M 15 Chemical Mastic High Build Epoxy.
         2) Miller: PPG 97-130 Series Aquapon High Build Semi-Gloss Epoxy.
         3) Rodda: Precision Coatings DTM 1300v100 HB Epoxy Primer.
         4) S-W: Macropoxy 646 FC Epoxy (B58-600).
      c. Finish Coat:
         1) Kelly: K-M 375 High Build Gloss Polyurethane Enamel.
         2) Miller: PPG 95-812 Series Pitthane Ultra Gloss Enamel.
         3) Rodda: Precision Coatings PC3v100 Acrylic Polyurethane Semi-Gloss.
         4) S-W: Hi-Solids Polyurethane S/G (B65-350).
      d. Topcoats: Manufacturer's recommended clear topcoat, it any, as required to assure colorfastness of final coating system.

B. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated (galvanized) metal surfaces:

1. Semi-Gloss, Two-Component, Pigmented Aliphatic Acrylic Polyurethane: One finish coat, over intermediate coat and metal primer with total dry film thickness not less than 6.5 mils, unless noted otherwise.
   a. Prime: Manufacturer's recommended metal primer.
      1) Kelly: K-M 15 Chemical Mastic High Build Epoxy.
      2) Miller: PPG 97-145 Series Pitt-Guard D-T-R Polyamide Epoxy
      3) Rodda: Precision Coatings DTM 1300v100 HB Epoxy Primer.
      4) S-W: Macropoxy 646 FC Epoxy (B58-600).
   b. Intermediate Coat:
      1) Kelly: K-M 15 Chemical Mastic High Build Epoxy.
      2) Miller: PPG 95-8800 Series Pitthane High Build Semi-Gloss Urethane.
      3) Rodda: None required.
      4) S-W: None required.
   c. Finish Coat:
      1) Kelly: K-M 375 High Build Gloss Polyurethane Enamel.
      2) Miller: PPG 95-8800 Pitthane High Build Semi-Gloss Urethane.
      3) Rodda: Precision Coatings PC3v100 Acrylic Polyurethane Semi-Gloss.
      4) S-W: Hi-Solids Polyurethane S/G (B65-350).
   d. Topcoats: Manufacturer's recommended clear topcoat, it any, as required to assure colorfastness of final coating system.
      1) S-W: DiamondClad Clear B65T105 1 to 2 mils.

2.05 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Ferrous Metal: Provide the following finish systems over interior ferrous metal. Primer is not required on appropriately shop-primed items.
   1. Semi-Gloss, Two-Component, VOC Compliant or Waterborne Pigmented Aliphatic Acrylic Polyurethane: One or two finish coats, of two-component, aliphatic acrylic polyurethane coating, over metal primer with total dry film thickness not less than 6.0 mils, unless noted otherwise.
      a. 1st Coat:
         1) Miller: PPG Aquapon WB Waterborne Epoxy Primer 98-46.
         2) Rodda: Precision Coatings DTM 1300v100 HB Epoxy Primer.
         3) S-W: Waterbased Tile Clad Epoxy Primer at 2 - 4 mils DFT.
      b. 2nd Coat:
         1) Miller: PPG Amershield VOC.
         2) Rodda: Precision Coatings PC3v100 Acrylic Polyurethane Semi-Gloss.
         3) S-W: Waterbased Acrolon 100 Polyurethane at 2 - 4 mils DFT.
      c. 3rd Coat:
         1) Miller: PPG Amershield VOC.
         2) Rodda: Precision Coatings PC3v100 Acrylic Polyurethane Semi-Gloss.
         3) S-W: Waterbased Acrolon 100 Polyurethane at 2 - 4 mils DFT.
   2. Metallic Acrylic Polyurethane: One or two finish coats, as required for full coverage, over metal primer with total dry film thickness not less than 6 mils, unless noted otherwise:
      a. Primer:
         1) PCI: Precision DTM 1300v100 Series at 2 to 6 mils.
         2) Tnemec: Series 27 FC Typoxy at 2 to 2.5 mils.
      b. Finish Coat(s):
         1) PCI: PC3v100 at 1 to 3 mils.
         2) Tnemec: Series 1077 Enduralume at 2 to 2.5 mils.

B. Zinc-Coated Metal: Provide the following finish systems over zinc-coated metal:
   1. Semi-Gloss, Two-Component, VOC Compliant or Waterborne Pigmented Aliphatic Acrylic Polyurethane: Two finish coats, of two-component, aliphatic acrylic polyurethane coating, over metal primer with total dry film thickness not less than 6.0 mils, unless noted otherwise.

a. 1st Coat:
   1) Miller: PPG Aquapon WB Waterborne Epoxy Primer 98-46.
   2) Rodda: Precision Coatings DTM 1300v100 HB Epoxy Primer.
   3) S-W: Waterbased Tile Clad Epoxy Primer at 2 - 4 mils DFT.
b. 2nd Coat:
   1) Miller: PPG Amershield VOC.
   2) Rodda: Precision Coatings PC3v100 Acrylic Polyurethane Semi-Gloss.
   3) S-W: Waterbased Acrolon 100 Polyurethane at 2 - 4 mils DFT.
c. 3rd Coat:
   1) Miller: PPG Amershield VOC.
   2) Rodda: Precision Coatings PC3v100 Acrylic Polyurethane Semi-Gloss.
   3) S-W: Waterbased Acrolon 100 Polyurethane at 2 - 4 mils DFT.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not begin application of coatings until substrates have been properly prepared.

C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

E. Test shop-applied primer for compatibility with subsequent cover materials.

F. Proceed with coating application only after unacceptable conditions have been corrected.
   1. Commencing coating application constitutes Contractor's acceptance of substrates and conditions.

3.02 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in MPI (APSM) applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
   1. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.

C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.
   2. At interior steel abrade the top layer of primer, unless otherwise required by coating manufacturer.
   3. At exterior steel, provide surface preparation equivalent to SSPC-SP 6 "Commercial Blast Cleaning."

D. Steel Substrates: Remove rust and loose mill scale.
   1. Prepare interior surfaces as recommended by coating system manufacturer and according to SSPC-SP 3 "Power Tool Cleaning."
   2. Blast steel surfaces clean as recommended by coating system manufacturer and according to SSPC-SP 6 "Commercial Blast Cleaning," unless otherwise recommended by manufacturer.
   3. Level of surface preparation specified is a minimum. If the coating manufacturer requires a higher degree of preparation, comply with the coating manufacturer's recommendations.

E. 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 coatings.

F. Remove finish hardware, fixture covers, and accessories and store.

G. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

3.03 PRIMING

A. Apply primer to unprimed surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

3.04 COATING APPLICATION

A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified. Use applicators and techniques suited to coating and substrate indicated.
   1. Apply Metallic Acrylic Polyurethane with spray equipment.

B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color and appearance.

D. When the color of a door frame changes from side to side, the change shall be made at the edge of the stop, where the transition is not visible when the door is in a closed position.

3.05 FIELD QUALITY CONTROL

A. Painted surfaces shall be considered to lack uniformity and soundness if any of the following defects are apparent to Architect.
   1. Brush/roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, or foreign materials in paint coatings.
   2. Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners, reentrant angles or similar conditions.
   3. Damage due to touching before paint is sufficiently dry or any other contributory cause.
   4. Damage due to application on moist surfaces or caused by inadequate protection from the weather.
   5. Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).

B. Painted surfaces shall be considered unacceptable if any of the following are evident under natural lighting source for exterior surfaces:
   1. Visible defects are evident on vertical or horizontal surfaces when viewed at normal viewing angles from a distance of not less than 39 inches.
   2. Visible defects are evident on ceilings, soffits and other overhead surfaces when viewed at normal viewing angles.
   3. When the final coat on any surface exhibits a lack of uniformity of color, sheen texture and hiding across full surface area.
   4. Dry mil thicknesses do not meet manufacturer’s recommended thickness or specified thickness.
   5. Lack of adhesion. Test surfaces indicating lack of adhesion in accordance with ASTM D3359 or as recommended by coating manufacturer.

C. Owner may provide field inspection and testing.
   1. Painted surfaces will be tested for dry mil thickness for each coat.
   2. Shop primers and painted surfaces will be tested for adhesion.
   3. Surfaces will be tested at frequency discussed in the preinstallation conference and as deemed appropriate by Owner.

D. Touch-up and restore painted surfaces damaged by testing.

1. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.06 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

B. Clean surfaces immediately of overspray, splatter, and excess material.

C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

D. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

E. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.07 PROTECTION

A. Protect finished work from damage.

3.08 EXTERIOR SCHEDULE

A. Steel: Semigloss, Two-Component, Pigmented Aliphatic Acrylic Polyurethane:
   1. Steel lintels.

3.09 INTERIOR SCHEDULE

A. Steel: Semigloss, Two-Component, Pigmented Aliphatic Acrylic Polyurethane:
   1. Exposed steel framing.

END OF SECTION

SECTION 10 11 01
VISUAL DISPLAY BOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Markerboards

B. Tackboards

1.02 RELATED REQUIREMENTS

A. Section 09 00 01 - Finish Legend: Color selections.

B. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports in metal stud walls.

1.03 REFERENCE STANDARDS

A. ANSI A135.4 - American National Standard for Basic Hardboard.

B. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's data on markerboard, tackboard, tackboard surface covering, trim, and accessories.

C. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.

D. Manufacturer's printed installation instructions.

E. Maintenance Data: Include data on regular cleaning, stain removal.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Visual Display Boards:
   1. AJW Architectural Products: www.ajw.com.
   2. Claridge Products and Equipment, Inc: www.claridgeproducts.com/#sle.
   3. Platinum Visual Systems: www.pvsusa.com.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 VISUAL DISPLAY BOARDS

A. Markerboards: Porcelain enamel on steel, laminated to core.
   1. Available Writing Surface Products:
      a. LCS3 manufactured by Claridge.
      b. e3 Environmental Ceramicsteel manufactured by Polyvision.
      c. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Color: White.
      a. Provide low gloss surface suitable for projection.
   3. Steel Face Sheet Thickness: 24 gage, 0.0239 inch.
   4. Core: Hardboard, manufacturer's standard thickness, laminated to face sheet.

5. Backing: Aluminum foil, laminated to core.
6. Size: As indicated on drawings.
   a. Do not permit seams in markerboards 16 feet or less in width.
7. Frame: Extruded aluminum, with concealed fasteners.
8. Frame Profile: Manufacturer's standard.
9. Frame Finish: Anodized, natural.
10. Accessories: Provide marker tray, map rail, map hooks, and flag holder.

B. Tackboards: Fine-grained, homogeneous natural cork and fabric facing.
1. Cork Thickness: 1/4 inch.
2. Fabric: As indicated below.
3. Backing: Hardboard, 1/4 inch thick, laminated to tack surface.
4. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
5. Size: As indicated on drawings.
6. Frame: Same type and finish as for markerboard.
7. Frame Profile: Manufacturer's standard
8. Accessories: Provide map rail.

2.03 MATERIALS

A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.

B. Hardboard for Cores: ANSI A135.4, Class 1 - Tempered, S2S (smooth two sides).

C. Foil Backing: Aluminum foil sheet, 0.005 inch thick.

D. Adhesive: Type recommended by panel manufacturer.
1. VOC Content: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.
   a. Panel Adhesives: 50 g/L.

2.04 ACCESSORIES

A. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall, full width of frame with end stops.
1. Provide a minimum of two map hooks for every 48 inches of map rail.

B. Temporary Protective Cover: Sheet polyethylene, 8 mil thick.

C. Flag Holders: Cast aluminum bored to receive 1 inch diameter flag staff, bracketed to fit top rail of board.

D. Marker Tray: Aluminum, manufacturer's standard profile one piece full length of markerboard, closed ends; concealed fasteners, same finish as frame.

E. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as instructed by the manufacturer.

B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Install boards in accordance with manufacturer's instructions.

B. Secure units level and plumb.

3.03 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.

END OF SECTION

SECTION 10 11 43
TACKABLE WALL SURFACES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient linoleum tackable wall surface TS-1.

B. Accessories as required for complete installation.

1.02 RELATED REQUIREMENTS

A. Section 09 00 01 - Finish Legend: Color selections.

B. Section 09 91 23 - Interior Painting: Primer applied to gypsum board substrate.

C. Section 10 11 01 - Visual Display Boards: Prefabricated, framed tackboards and markerboards.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, 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. Installation methods.
   4. Specimen warranty.

C. Shop Drawings: Elevations indicating proposed locations of panel edges and edge details.

D. Verification Samples:
   1. Each color of linoleum specified, minimum size 8 inches square, representing actual product in color and texture.
   2. Edge trim, minimum 6 inches long.

E. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 PREINSTALLATION CONFERENCE

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 01 30 00 - Administrative Requirements.
   1. Review installation procedures for tackable wall surfaces.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide all components of each type of tackable wall surfaces by a single manufacturer, including recommended adhesives.

B. Installer Qualifications: Firm specializing in specified surfaces, with not less than 5 years of documented experience in installing wall systems of the type specified, and approved by the manufacturer.

C. Surface Burning Characteristics: Provide system with flame spread index of 25, maximum, and smoke developed index of 40, maximum, when tested in accordance with ASTM E84.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect materials from excessive moisture in shipment, storage, and handling. Do not deliver materials to project until wet work such as concrete and gypsum board finishing has been completed.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.08 FIELD CONDITIONS

A. Do not begin installation until interior conditions have reached temperature and humidity that will be maintained during occupancy. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.09 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Special Warranty for Linoleum Tackable Wall Surfaces: Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Linoleum Tackable Wall Surfaces TS-1:
   1. Forbo Bulletin Board manufactured by Forbo Linoleum, Inc.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS

A. Linoleum Tackable Wall Surfaces TS-1:
   1. Linoleum:
      a. Material: Uni-color linoleum resilient homogeneous tackable surface consisting of linseed oil, granulated cork, rosin binders and dry pigments calendared onto a natural burlap backing. Color shall extend through thickness of material.
      b. Width: Roll goods, 48 inches.
      c. Gage: 1/4-inch.
      d. Backing: Burlap.
      e. Color: As indicated in Section 09 00 01- Finish Legend.
   2. Accessories:
      a. Adhesive: Solvent-free SBR type linoleum adhesive. Forbo L910 or equal as recommended by manufacturer.
      b. Metal Edge Coving Cap: Aluminum, square-edge with punched nail fin. Futura Industries #409980 CM 401, Mill Finish Aluminum; or equivalent product. Cove thickness to coordinate with linoleum material thickness.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of tackable wall surfaces. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Verify that substrate has been prime painted prior to installation of tackable wall surfaces.

C. Verify that all casework, markerboards, door and window jambs, finished ceiling, and other finished items abutting tackable wall surfaces have been installed.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Remove wall plates and other obstacles, and prepare substrates to receive core material in accordance with manufacturer's instructions.

C. Recess nails and screws. Repair irregular tape joints, sand and remove dust.

D. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install tackable wall surfaces at locations indicated, complying with manufacturer's instructions.

B. Install linoleum tackable wall surfaces in accordance with manufacturer's instructions.

1. Apply adhesive with a 1/16-inch square-notch trowel uniformly over wall surface.
2. Engage edges of bulletin board into metal edge coving. Roll sheet firmly into adhesive, making positive contact and removing air bubbles. Work from top to bottom, and side to side.
3. Immediately remove any adhesive residue from surface.
4. Scribe, cut, and fit material to butt tightly to adjacent surfaces.
5. Form butt-joints as required. Lap and double-cut seams.
6. Install metal edge coving at all locations where an unfinished edge of tackable wall surface occurs.

3.04 CLEANING

A. Clean exposed surfaces of tackable wall surfaces, complying with manufacturer's instructions for cleaning and repair of minor finish damage. Use a dry brush, vacuum or both. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.05 PROTECTION

A. Protect installed products until completion of project, using methods that will ensure that the finished work will be without damage or deterioration at Date of Substantial Completion.

B. Replace panels that cannot be cleaned and repaired, in a manner acceptable to the Architect, prior to the time of substantial completion.

END OF SECTION

SECTION 11 24 23
FALL RESTRAINT AND FALL ARREST SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Complete rooftop fall arrest and fall restraint anchor system, including, but not limited to:
   1. Steel pipe uprights and base plates.
   2. Retractable life lines.
   3. Vertical life lines.
   4. Full body harnesses.

1.02 RELATED REQUIREMENTS

A. Section 07 52 00 - Modified Bituminous Membrane Roofing: Interface with roofing at anchors.

B. Section 07 62 00 - Sheet Metal Flashing and Trim: Flashing at pipe supports.

1.03 REFERENCE STANDARDS

A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

F. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

H. ASTM D1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber.

I. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.

J. AWS D1.1/D1.1M - Structural Welding Code - Steel.

K. AWS D1.2/D1.2M - Structural Welding Code - Aluminum.

L. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel.

M. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel.

N. Occupational and Safety Health Administration (OSHA Standards):
   1. OSHA Rule on Fall Protection in General Industry, 29 CFR 1910 Subpart I.
   2. OSHA Rule on Safety Standards for Fall Protection in the Construction Industry, 29 CFR 1926.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design fall protection system capable of withstanding loads and stresses within limits and under conditions specified in OSHA and other applicable safety codes, including comprehensive engineering analysis by a qualified professional engineer licensed in the State of Oregon.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide descriptive product literature with relevant data highlighted. Include physical characteristics, performance data and limitations. Include manufacturer's installation instructions.

1. Submit manufacturer's instructions and test data for life lines and other accessory equipment. Submittal does not imply purchase by Owner.
2. Indicate source for Owner's future purchasing of additional accessory equipment.

C. Shop Drawings: Indicate complete layout and configuration of fall restraint system, including components and accessories.
1. Show rooftop locations of fall arrest anchors, configurations, dimensions, attachment details and components required for complete fall arrest system.
2. Show interface with adjacent materials.
3. Design connections and reinforcements as required to resist specified pullout and arrest forces.

D. Delegated-Design Submittal: Design fall restraint system to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Submit submittals as "Deferred Submittals." Transmit a copy of each submittal indicating agency approval to the Architect for record.
2. Provide details and calculations for factory-made framing connectors, stamped by a Professional Structural Engineer licensed in the State of Oregon, employed by manufacturer.
3. Engineer shall be responsible for design of anchors and attachments required to accept specified pullout forces without causing substantial damage to roof deck and structural framing.

E. Certificate: Certify that products of this section meet or exceed specified requirements. Include written certification signed by manufacturer's authorized representative.

F. Manufacturer's Instructions: Provide manufacturer's installation instructions. Indicate special procedures and conditions requiring special attention.

G. Project Record Documents: Record actual locations of each fall arrest anchor as installed.

H. Operation and Maintenance Data: Include manufacturer's maintenance procedures, safety inspection log book for yearly inspections and manufacturer's videotape illustrating on-site instruction to Owner's personnel in use of equipment.
1. Provide four copies of reduced plastic laminated drawings of roof plan for posting near roof access points, showing anchor locations and details.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
1. See Section 01 60 00 - Product Requirements, for additional provisions.
2. Turn accessory equipment over to Owner prior to Date of Substantial Completion. Obtain receipt signed by Owner.

1.06 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 of Oregon.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
1. Employs complete engineering and technical personnel needed to engineer, design and perform Work of this Section.
2. Firm must employ personnel dedicated to providing regularly scheduled authorized and competent personnel training courses to comply with OSHA requirements for Owner’s personnel.
3. Maintains a minimum $2,000,000 coverage for products and completed operations. Insurance must cover failure of the safety anchor itself.

C. OSHA Standards: Comply with Occupational Safety and Health Administration Standards for the Construction Industry 29 CFR 1926.500 Subpart M (Fall Protection), and with applicable State Administrative Code safety standards for fall restraint and fall arrest.

D. Installer Qualifications: Company specializing in performing work of the type specified and with minimum five years of documented experience.
   1. Manufacturer or certified by manufacturer as qualified to perform Work of this Section.

E. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
   3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

F. Source Limitation: Obtain all roof anchors through one source from a single manufacturer.

G. Testing: Perform quality control tests for each system in accordance with manufacturer's requirements.

1.07 PREINSTALLATION CONFERENCE

A. Preinstallation Conference: Conduct conference at the project site at least one week prior to start of work of this Section and start of roofing installation with roofing and deck subcontractors, Owner, Architect, manufacturer's representative and others as requested to attend.

1.08 COORDINATION

A. Coordinate attachment, flashing details and installation so as not to void any warranties of other trades, including, but not limited to, roofing system or flashing and sheet metal.

1.09 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers:
   1. Atlas Anchor Systems USA, Co: www.atlas-anchor.com.
   2. Guardian Fall Protection: www.guardianfall.com.
   3. Pro-Bel Enterprises Ltd: www.pro-bel.ca.com.
   4. Thaler Metal Industries: www.thalermetal .com.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DESIGN REQUIREMENTS

A. Design Criteria:
   1. Conform to OSHA for fall arrest and fall restraint systems, including structural connections and components. Provide fall protection anchors permanently attached to roof structure.
   2. Design connections and reinforcement as required to resist specified pullout and arrest forces.
      a. Pullout Force: Design fall arrest anchors and connections to resist 5,000 pound pullout force without damage to underlying roof structure.
      b. Arrest Force: Limit to 1,800 pound or less.
      c. Free Fall Distance: Limit to 6 foot.
   3. Fall Arrest and Fall Restraint Anchors: Permit free movement of persons over entire roof while attached by full body harness, retractable life line or vertical life line attached to D-ring or eye at each fall arrest anchor using quick release attachments.
      a. Fall Restraint: 4 users.
      b. Fall Arrest: 2 users.
      c. Design tie-back anchors to resist at least 5000 pounds applied in any direction at a height of 8-inches above top of roof.
   4. Upright Anchors: As instructed by manufacturer in layout and design acceptable to Architect and Structural Engineer.
      a. The layouts for anchors indicated on the drawings are for informational purposes only. It is the responsibility of the manufacturer/installer to meet all compliances and

requirements of this Section. Equally space uprights so that only one life line is needed to connect to D-rings or eyes at each row of uprights.

5. Include reinforcement as required to prevent damage to roof deck.
6. Attachment of anchors requires transfer of loads into building structural framing. Systems that only bolt into roof deck without transferring load are not acceptable. Include attachments to supporting structural framing as required to transfer pullout force.
7. Engineer and design system to accommodate roof deck, roofing type, structural requirements and watertight seal at roofing system.
   a. Roof anchors are to extend a minimum of 8-inches above the top of roof installation.

2.03 MATERIALS

A. Pipe: ASTM A53/A53M, Schedule 80. Finish galvanized.

B. Steel Plate: ASTM A36/A36M.

C. Steel D-Ring Eyelets: As required by system design.

D. Stainless Steel: ASTM A666, Type 304, 42 ksi yield strength.

E. Extruded Aluminum and Spun Aluminum: ASTM B221.

2.04 ACCESSORIES

A. Fasteners:
   1. Bolts, Nuts and Washers: Hot-dip galvanized, ASTM A153/A153M, Class C or D.
   2. Exposed Fasteners: As designed by manufacturer to accommodate deck type, structural framing and design loads.

B. Flashing: As specified in Section 07 62 00 - Sheet Metal Flashing and Trim.
   1. Non-Expanding Sealing Gaskets: Pre-cut and predrilled, 40 durometer, 1/8 inch, solid neoprene rubber meeting or exceeding ASTM D2000, for sealing under anchor bases.

C. Expanding Compression Gaskets: Neoprene rubber meeting or exceeding ASTM D1056, Type I (Closed Cell), Class B or C (Petroleum Resistant).

D. Joint Sealants: Non-skinning butyl sealant or neutral curing silicone sealant are recommended by manufacturer and roofing membrane manufacturer. Polyurethane sealant is not acceptable.

2.05 FABRICATION

A. Connections: Weld and grind smooth. Weld in accordance with AWS D1.1/D1.1M, AWS D1.2/D1.2M, AWS D1.3/D1.3M and AWS D1.6/D1.6M, as applicable.

B. Fabricate engineered fall restraint and fall arrest system suitable for roof and deck mounting with welded steel base plate and steel plate uprights or steel pipe uprights.

C. Provide drilled eye holes at steel plate uprights and D-Rings at steel pipe uprights suitable for attachment of life lines.

D. Size uprights for 4 to 8 inch exposure above roof, as required for proper flashing.

E. Fabricate to install below roof peaks.

F. Pre-drill holes for fasteners at baseplate.

2.06 FINISHES

A. Steel Pipe Uprights, Base Plates and D-Rings: Stainless steel, spun aluminum, or carbon steel hot-dip galvanized after fabrication. Galvanize carbon steel to following standards:
   1. Pipe: ASTM A53/A53M.
   2. Plate: ASTM A123/A123M.
   3. D-Rings: ASTM A123/A123M or ASTM A153/A153M.

B. Galvanizing Repair Compound: 95 percent zinc cold galvanizing compound.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify conditions as satisfactory to receive Work of this Section. Do no work until correction of unsatisfactory conditions.

B. Verify layout of roof fall arrest anchors and structural connections suitable for Work of this Section.

3.02 INSTALLATION

A. Install fall arrest system in accordance with manufacturer's instructions and recommendations and provisions of Contract Documents.

B. Lay out fall arrest system according to reviewed Shop Drawings.

C. Install upright fall arrest anchors as indicated in Structural Drawings, as required to conform to design requirements and as necessary for watertight, secure, permanent attachment, unless manufacturer recommends closer spacing.
   1. Provide plan indicating any deviations of installed anchor locations. Confirm changes in location with Structural Engineer of Record.

D. Isolate dissimilar metals to prevent contact.

E. Provide on-site inspection and supervision of installation by factory-trained representative.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Provide manufacturer's field representative to inspect installation.

C. Test 100 percent of anchors in accordance with manufacturer’s recommendations.

D. Test and adjust system devices. Replace damaged or malfunctioning items.

3.04 ADJUSTING

A. Repair or replace defective installations.

B. Field touch up damaged galvanizing surface finishes with galvanized finish using galvanizing repair compound.

3.05 CLEANING

A. Upon completion, remove surplus and excess materials, rubbish, tools and equipment.

3.06 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

B. See Section 01 79 00 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate operation of system to Owner's personnel.
   1. Use operation and maintenance data as reference during demonstration.
   2. Conduct walking tour of project.
   3. Briefly describe function, operation, and maintenance of each component.
   4. Turn over accessories to Owner.

D. Training: Train Owner's personnel on operation 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 training personnel.
   4. Location: At project site.

3.07 PROTECTION

A. Protect installed materials from subsequent construction operations.

B. Repair damage to adjacent materials caused by fall restraint system installation.

1. Damage to roofing membrane must be repaired by roofing installer in a manner that preserves the roofing system warranty.

END OF SECTION

SECTION 11 52 13
PROJECTION SCREENS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Front projection screen assemblies.

1.02 RELATED REQUIREMENTS

A. Division 26 - Electrical supply, conduit, and wiring for electric motor operated projection screens.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's catalog cuts and descriptive information on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings: For custom installations, indicate dimensions, verified field measurements, mounting details, and interface with adjacent construction.

D. Samples: For screen fabrics, submit two samples 6 x 6 inch in size.

E. Manufacturer's Qualification Statement.

F. Operation and Maintenance Data: Provide manufacturer's operation and maintenance instructions.

G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver projection screens to project site in manufacturer's original unopened packaging, and inspect for damage and proper size before accepting delivery.

B. Store in a protected, clean, dry area with temperature maintained above 50 degrees F, and stack in accordance with manufacturer's recommendations.

C. Acclimate screens to building temperatures for 24 hours prior to installation, in accordance with manufacturer's recommendations.

1.06 FIELD CONDITIONS

A. Maintain interior of building between 60 degrees F and 75 degrees F during and after installation of projection screens.

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide one year manufacturer warranty for projection screen assembly.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Da-Lite Screen Company: www.da-lite.com/#sle.

B. Draper, Inc: www.draperinc.com/#sle.

C. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FRONT PROJECTION SCREENS

A. Front Projection Screens: Factory assembled unless otherwise indicated.

B. Projection Viewing Surface: Matte white screen fabric, washable, flame retardant and mildew resistant.
   1. Greenguard for Children and Schools certified.

C. Manual Wall Mounted Projections Screens:
   1. Products:
      a. Da-Lite Model B.
      b. Draper Model Luma.
   2. Screen Format: NTSC 4:3 Video Format.
   3. Viewing Size: _____.
   4. Borders: None.
   5. Screen Drop: None required.
   6. Locations of Use: Classrooms

D. Exposed Screen Cases: Steel, with integral roller brackets.
   1. Finish: Powder coat or as standard with manufacturer.
   2. Color: White.
   3. End Caps: Steel; finished to match case.
   4. Mounting: Wall and ceiling, as indicated on drawings.
      a. Provide projected brackets sized to clear adjacent markerboards, where applicable.

E. Concealed-in-Ceiling Screen Cases: Steel, with integral roller brackets.
   1. Door Slat: Self trim; self-closing and -opening.
   2. Case Finish: Baked enamel.
   3. Case Color: White.
   4. End Caps: Steel; finished to match case.
   5. Electrically-Operated Screens: 1-1/2 inch aluminum door roller or as standard with manufacturer.

F. Manually-Operated Screens:
   1. Roller: 2 inch aluminum; spring loaded with locking device, or as standard with manufacturer.
   2. Screen Pull: Ring on bottom bar.
   3. Vertical Tensioning: Screen fabric weighted at bottom with steel bar and plastic end caps.

G. Electrically-Operated Screens:
   1. Roller: 2 inch aluminum, with locking device, or as standard with manufacturer.
   2. Vertical Tensioning: Screen fabric weighted at bottom with steel bar and plastic end caps.

H. Provide mounting hardware, brackets, supports, fasteners, and other mounting accessories required for a complete installation, in accordance with manufacturer's recommendations for specified substrates and mountings.

2.03 ELECTRICAL COMPONENTS

A. Electrical Components: Listed and classified by UL as suitable for the purpose specified and indicated.

B. Motors: Direct drive, 110/120 V, 60 Hz.
   1. Screen Motor: Mounted inside roller; three wire with ground; quick reverse type; equipped with thermal overload cut-off.
      a. Electrical Characteristics: 1.2 amps.
      b. Motor mounted on sound absorber.

C. Controls: Three (3) position control switch with plate.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate is finished and ready to accept screen installation.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that openings for recessed screens are correctly sized.

D. Verify type and location of electrical connections.

E. Do not install projection screens until climate control systems are in place and interior painting and other finishes are completed.

3.02 PREPARATION

A. Coordinate screen installation with installation of projection systems.

B. Coordinate installation with adjacent construction and fixtures, including ceilings, walls, lighting, fire suppression, and registers and grilles.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, using manufacturer's recommended hardware for relevant substrates.

B. Do not field cut screens.

C. Install screens in mountings as specified and as indicated on drawings.

D. Install plumb and level.

E. Install electrically operated screens ready for connection to power and control systems by others.

F. Adjust projection screens and related hardware in accordance with manufacturer's instructions for proper placement and operation.

G. Test electrical screens for proper working condition. Adjust as needed.

3.04 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

SECTION 11 52 71
PROJECTOR MOUNTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Projector mounts.

1.02 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Show anchorage details.

1.03 COORDINATION

A. Coordinate layout and installation of projector mount with adjacent construction.

PART 2 PRODUCTS

2.01 PROJECTOR MOUNTS

A. Product: Peerless; PRS-Kit 0811 Peerless Adjustable Height Projector Ceiling Mount Kit: peerlessmounts.com
   1. Adjustable height projector ceiling mount kit with 8 inch to 11 inch drop.
   2. Include universal clap.
   3. Color: Black.
   4. Independent roll, pitch and yaw adjustments.
   5. Include ceiling plate.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install projector mounts at locations indicated to comply with manufacturer's written instructions.

B. Securely anchor to supporting substrate in a manner that produces a smoothly operating mount with vertical edges plumb.

END OF SECTION

SECTION 12 24 00
WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Window shades and accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

B. Section 09 21 16 - Gypsum Board Assemblies: Substrate for window shade systems.

1.03 REFERENCE STANDARDS

A. ASTM D4674 - Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments.

B. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

C. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

D. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken.
   2. Do not install shades until final surface finishes and painting are complete.

1.05 PREINSTALLATION CONFERENCE

A. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of all affected installers.

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.

C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.

D. Window Treatment Schedule: For all roller shades.
   1. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.

E. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.

F. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.

G. Selection Samples: Include fabric samples in full range of available colors and patterns and color selections for metal finishes.
   1. Fabric selection samples are only required if fabric different than that specified is proposed.

H. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.
   1. Mark face of material to indicate interior face.

I. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

J. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.

K. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
   1. Indicate methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

L. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than twenty years of documented experience.

B. Installer Qualifications: Company trained and certified by the manufacturer, specializing in performing work of this type with minimum ten years of documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening using same room designations indicated on Drawings and in the Window Treatment Schedule.

B. Do not deliver shades to the project site until all concrete, masonry, and other wet work has been completed and is dry.

C. Handle and store shades in accordance with manufacturer's recommendations.

1.09 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Install shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.10 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
   1. Shade Hardware: 25 years.
   2. Fabric: 25 years.
   3. Aluminum and Steel Coatings: Five years.
   4. Installation: One year.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Roller Shades:
   1. Draper, Inc: www.draperinc.com/#sle.
   2. Nysan Shading Systems Ltd: www.nysan.com.
   3. MechoShade Systems, Inc: www.mechoshade.com.
   4. Roll-A-Shade: www.rollashade.com.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2.02 WINDOW SHADE APPLICATIONS

A. Shades at Exterior Windows and Storefront WS-2: Sheer shades.
   1. Type: Roller shades.

2. Fabric: _____.
3. Openness: _____.
4. Material: _____.
5. Color: _____.
6. Mounting: Outside (face of jambs).
7. Operation: Manual.

2.03 ROLLER SHADES

A. Roller Shades: Fabric roller shades complete with mounting brackets, roller tubes, hembars, hardware and accessories.
   1. Drop: Regular roll.
   2. Size: As indicated on drawings.

B. Fabric: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Refer to Window Shade Applications for material content and openness.
   2. Flammability: Pass NFPA 701 large and small tests.
   3. Fungal Resistance: No growth when tested according to ASTM G21.

C. Roller Tubes: As required for type of operation.
   1. Size: Manufacturer's standard, selected for suitability for installation conditions, span, and weight of shades.
      a. Roller tubes less than 1.55 inch in diameter for manual shades and less than 2.55 inches for motorized shades are not acceptable.
      b. Provide for positive mechanical engagement with drive/brake mechanism.
   2. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
      a. Provide removable/replaceable spline mounting without having to remove shade roller from shade brackets.
      b. Double sided pressure sensitive adhesive tape is not acceptable.

D. Hembars: Designed for weight requirements and adaptation to uneven surfaces, to maintain bottom of shade straight and flat.
   1. Style: Thermally sealed fabric pocket covering rectangular steel or aluminum hembar.
      a. Sewn hems and open hem pockets are not acceptable.

E. Manual Operation for Interior Shades: Clutch operated continuous loop; beaded ball chain.
   1. Provide #10 qualified stainless steel chain rated to 90 lb minimum breaking strength. Nickel plate chain is not acceptable.
      a. Provide tensioned chain pulley keeper at all locations.
   2. Provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change.
   3. Provide hardware for installation of a removable fascia, for both regular and/or reverse roll, which is installed without exposed fastening devices of any kind.
   4. Provide shade hardware system that allows for removable fascias to be mounted continuously across two or more shade bands without requiring exposed fasteners of any kind.
   5. Provide shade hardware system that allows for operation of multiple shade bands (multi-banded shades) by a single chain operator. Offset connectors to provide alignment from the first to the last shade band.
   6. Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connectors for drive mechanism connection to shade roller tube are not acceptable.

2.04 ACCESSORIES

A. Fascias: Size as required to conceal shade mounting.
   1. Style: As selected by Architect from shade manufacturer’s full selection.

2. Fascia shall be able to be installed across two or more shade bands in one piece.
3. Fascia shall fully conceal brackets, shade roller and fabric on the tube.
4. Chain drive shall fall behind the bottom return edge of the fascia without requiring notching of the fascia.
5. Provide bracket/fascia end caps where mounting conditions expose outside of roller shade brackets.
6. Material and Color: To match shade.

B. Brackets and Mounting Hardware: As recommended by manufacturer for mounting configuration and span indicated.

C. Fasteners: Non-corrosive, and as recommended by shade manufacturer.

2.05 FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Fabricate shades to fit openings within specified tolerances.
1. Dimensions - Outside Mounting: Extend blind to center of jambs and to stop flush with top of sill.

C. Fabricate shadecloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shadecloth to roll true and straight without shifting sideways more than 1/8 inch in either direction per 8 feet of shade height due to warp distortion or weave design.

D. Provide battens in standard shades as required to assure proper tracking and uniform rolling of the shadebands. Battens shall be roll-formed stainless steel or tempered steel, as recommended by manufacturer.

E. For railroaded shadebands, provide seams in railroaded multi-width shadebands as required to meet size requirements and in accordance with seam alignment acceptable to Architect. Furnish battens in place of plain seams when the width, height or weight of the shade exceeds manufacturer's standards.

F. Dimensional Tolerances: As recommended in writing by manufacturer.

G. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

A. Install level, plumb, square and true in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Installation Tolerances:
1. Maximum Offset From Level: 1/16 inch.

C. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.

D. Adjust level, projection and shade centering from mounting bracket. Verify there is no telescoping of shade fabric.
1. Adjust and balance roller shades to operate smoothly, easily, safely and free from binding or malfunction throughout entire operational range.

3.04 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.05 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

B. See Section 01 79 00 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

3.06 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 13 48 53
SEISMIC ANCHORAGE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The purpose of this section is to provide instructions relating to the design and construction of anchorage requirements for mechanical and electrical items, equipment and other components. It is required that these items be anchored to the facility in a manner whereby the overall reliability of the facility is not compromised.
   1. Provide bracing and anchorage as required to meet Oregon Structural Specialty Code (OSSC) requirements.

B. Unless otherwise determined by the Architect, it is not intended that any item of purchased equipment be modified to meet the requirements of this section.

1.02 RELATED SECTIONS

A. Section 06 41 00 - Architectural Wood Casework: Seismic bracing of architectural wood casework greater than six feet tall.

B. Section 09 51 00 - Acoustical Ceilings: Coordination of seismic bracing of ceilings and separate components, such as equipment that maybe mounted above or within finish ceilings.

C. Divisions 21, 22, 23, 26, 27 and 28: Provide and coordinate bracing of switchgear, patch panel racks, fire suppression and all other building components as dictated by code.

1.03 REFERENCES

A. As indicated in individual technical sections.

1.04 SYSTEM DESCRIPTION

A. General Connection Requirements:
   1. All supports and connections in construction shall be provided by the Contractor in accordance with the code for the criteria per contractor-supplied Structural Drawings, coordinated with the particular items included in the contract. The Contractor shall retain a registered professional engineer licensed in the State of Oregon to perform and seal this design work.

1.05 DESIGN REQUIREMENTS

A. Delegated Design: Design seismic anchorage, including comprehensive engineering analysis by a registered professional engineer licensed in the State of Oregon, using performance requirements and design criteria indicated.

B. Code: 2019 Oregon Structural Specialty Code shall be used for the design of seismic restraints of items indicated, with the additional requirements dictated by the referenced standards and the specific requirements and exceptions specified in this section.

C. Acquisition of design data and installation of gravity and seismic anchorages (restraints) shall be the responsibility of the Contractor unless otherwise noted in this section. Design data and shop drawings shall be provided for review and approval in accordance with the General Guidelines for Connecting to Structure below.

D. Distribution of Gravity and Seismic Loads to Structure:
   1. It is the responsibility of the Contractor to see that the combined equipment, system and piping loads do not exceed the capacity of any individual supporting structural member or group of structural members prior to the construction of the supporting members. If modifications are required, these modifications shall be brought to the attention of the Structural Engineer of Record.
   2. Supplemental structural distribution members shall be required when equipment gravity and seismic loads exceed design loads shown on the structural drawings and specifications.

3. All systems, equipment and casework, shall be connected to the buildings structural system in a rigid manner except units with special vibration isolation mounting requirements.
4. The Contractor shall make available to the Architect information required to verify the anchorage (restraint) of the following critical equipment as applicable to the project, including, but not limited to:
   a. Exhaust fans/supply fans.
   b. Cabinet heaters/fans.
   c. Air handling units.
   d. Make-up air units.
   e. Chillers.
   f. Chilled water pumps.
   g. Hot water heating and circulation pumps.
   h. Storage tanks.
   i. Compression tanks.
   j. Air compressors.
   k. Air separators.
   l. Converters.
   m. Domestic water booster pump assembly.
   n. Air conditioning units.
   o. Service light, video and equipment booms located at various locations.
   p. Equipment exceeding 400 lbs. or where recommended by manufacturer or required by code including Owner furnished equipment.
   q. Terminal units or VAV boxes.
   r. Generators.
   s. Substations.
   t. Switchgear.
   u. Switch boards.
   v. Transformers.
   w. Transfer switches.
   x. Panel boards.
   y. Light fixtures.
   z. Theatrical lighting system.
   aa. Exhaust hoods.
   ab. Owner furnished equipment.
   ac. Telecommunications and low voltage systems equipment racks and cabinets.
   ad. Cable tray, all types proposed, including, but not limited to, ladder, solid bottom and wire basket trays.
5. Information to be included, but not limited to the following:
   a. Center of gravity
   b. Weight
   c. Footprint
   d. Space envelope
   e. Tie-down provisions

1.06 SUBMITTALS

A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide Structural characteristics of all proposed components.

C. Shop Drawings: Indicate actual components and field configuration or limitations for each seismic restraint. Provide structural calculations.

D. Delegated Design and Certification of Connection Design:
   1. All design data and shop drawings shall be sealed by a professional engineer licensed in the State of Oregon and submitted for review to the Architect and structural engineer of

record before submittal to the Authority Having Jurisdiction (AHJ). Obtain approval for the AHJ before the equipment anchorage is fabricated or installed. Allow 4 weeks from time of Architect's receipt of submittal of design data and shop drawings for review. The following information must be included in the design data and shop drawings.

a. Exact dimension and intended locations of each unit.
b. Verification and location of weight relative to existing and new building structures (e.g., plan and height location of the center of gravity).
c. Scale drawings showing base details with original intended connection system.
d. Anchors to be installed per manufacturer's recommendations or as indicated. All anchors subject to field testing where loading appears to approach or exceed capacity of the anchor.

2. Submit submittals as "Deferred Submittals" in accordance with Section 01 30 00 - Administrative Requirements. Transmit a copy of each submittal indicating agency approval to the Architect for record.

1.07 QUALITY ASSURANCE

A. Perform design under direct supervision of a registered professional engineer experienced in design of this Work and licensed in Oregon.

PART 2 PRODUCTS

2.01 CONNECTION REQUIREMENT BY LOCATION AND STRUCTURAL MEMBER

A. Concrete Floor Slabs:
1. Conduits, pipe and ducts may be fastened to the grade slab with supports spaced in accordance with the requirements of Divisions 21, 22, 23, 26, 27 and 28.
2. For heavy building equipment (400 pounds or more), submit information on the following for review:
a. Weight
b. Dimensions
c. Center of gravity
d. Vibration criteria
e. Base connection details
3. The type of fastener to be used on the grade slab connections shall be either cast-in-place anchor bolts or wedge-anchors as specified below.

B. Suspended Ceilings: Support and brace in accordance with code and specified requirements.

C. Light Fixtures: In suspended ceilings, provide auxiliary supports to the structure in accordance with code requirements.

D. Maximum spacing of supports of equipment and systems suspended from underside of structure.
1. Provide gravity hangers or frames for conduit and pipes (copper or steel) running perpendicular to the joists or beams. Space the hangers as follows:

Pipe Size	Maximum Spacing
2-1/2-inch	11 feet
4-inch	14 feet
5-inch	16 feet
6-inch	16 feet
8-inch	14 feet
10-inch and over	Layout subject to approval of Architect

Note that sizes smaller than 2-1/2-inch shall be determined by analysis.
2. Provide gravity hangers at 10 feet maximum for ducts running perpendicular to joists and beams.
3. Pipes, conduits and ducts that are oriented parallel to joists or beams shall have vertical supports spaced at a maximum of 10 feet. Supports shall be attached to spreader beams connected to two or more joists as required by the Architect.

4. Lateral or transverse seismic sway bracing shall be provided at 20 feet maximum. It may be anchored at each girder that is oriented perpendicular to the pipe, conduit or duct. Location of the intermediate bracing between main girders lines shall be staggered to the individual runs and trades to avoid the concentration of loads on any individual joist or beam.
5. Longitudinal seismic bracing may be located at girders, with a maximum spacing of 40 feet on center and at ends, turns and bends with the same restriction as noted in paragraphs above.
6. Vertical Runs Between Floors: Provide tube or metal stud supports in accordance with requirements of this section. Connect to concrete floor or steel framing as noted in the General Guidelines for Connecting to Structure (below).

2.02 GENERAL GUIDELINES FOR CONNECTION TO STRUCTURE

A. Wedge-anchors (approved by ICC) may be used as attachments to the concrete slabs. For seismic design of the anchorage, a safety factor of 3 shall be used with the ultimate-rated capacity of the anchorage. For gravity load design at working stress, a safety factor of 5 shall be applied to the ultimate-rated capacity of the anchorage.

B. At suspended slabs, wedge-anchors shall be located at the thickened areas of slabs with metal deck.

C. Welded and bolted connections are not permitted to the main structural members (e.g., beams girders, columns, braces, etc.) except as noted in the following or by special approval:
   1. Clip angles or plate angles may be welded to structural columns, girders and beams (flanges and webs) with 3/16-inch by 3-inch maximum fillet welds.
   2. All bolted connections used to webs of steel shapes shall be verified by the Architect.

D. Clamps with positive grip or threaded fasteners may be used to attach to steel beam or girder webs. No "C" clamps are permitted.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 01 40 00.
   1. Installation of all wedge-anchors shall be performed under the continuous inspection of a certified inspector.
   2. Field tests of the anchorage shall be performed by a licensed testing laboratory under the supervision of a certified inspector.

B. Field Tests:
   1. A calibrated torque wrench shall be used to field test the installation of selected wedge anchorage. The wrench shall be calibrated by a licensed testing laboratory through tensile tests on the wedge-anchors. In the field verification test, the wedge-anchors shall be torque-tested to 1/2 the ultimate pull-out capacity.
   2. Fifty percent of the wedge-anchors shall be field tested if their design tensile load is more than 250 pounds. If the design tensile load is 250 pounds or less, 10 percent of the anchorages shall be field tested.
   3. One percent of the wedge-anchors shall be field tested for withdrawal at 1-1/2 times the design loading.

END OF SECTION

SECTION 21 00 00
FIRE SUPPRESSION BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 DESIGN-BUILD SUMMARY OF WORK

A. Work included in 21 00 00 applies to Division 21, Fire Suppression work to provide materials, labor, tools, permits and incidentals to make fire suppression systems ready for Owner's use for proposed project.

1.02 DESIGN-BUILD INSTRUCTIONS

A. This document is issued to give Bidders a basis for preparing a proposal to design and install a complete Fire Suppression system for this project.

B. Alternates to this Document may be offered as a separate proposal.

1.03 DESIGN-BUILD DESIGN APPROACH

A. Use this Specification as a guide for design/engineering requirements, workmanship and materials or construction. Utilize design-build concept throughout construction phase of project.

B. Investigate and be apprised of applicable codes, rules, and regulations as enforced by AHJ.

C. Visit the Site of the proposed construction. Verify and inspect the existing site to determine conditions that affect this work.

1.04 DESIGN-BUILD DESIGN CRITERIA/CALCULATIONS

A. Related Work Specified Elsewhere:

1. Contents of Section apply to Division 21, Fire Suppression Specifications.
2. Requirements of Section are a minimum for Division 21, Fire Suppression Sections, unless otherwise stated in each Section, in which case that Section's requirements take precedence.

B. Fire Suppression Design Criteria: Refer to individual Division 21, Fire Suppression Sections for fire suppression system design criteria.

C. Fire Suppression Equipment: Refer to individual Division 21, Fire Suppression Sections for fire suppression equipment requirements.

1.05 SECTION INCLUDES

A. Work included in 21 00 00, Fire Suppression Basic Requirements applies to Division 21, Fire Suppression work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of fire protection systems for proposed project.

B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.

C. Definitions:

1. Provide: To furnish and install, complete and ready for intended use.
2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete Item of work furnished.
4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent," substitution requests must be submitted to Engineer for

consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted Item.

5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.06 RELATED SECTIONS

A. Content of Section applies to Division 21, Fire Suppression Contract Documents.

B. Related Work:

1. Additional conditions apply to this Division including, but not limited to:
   a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
   b. Drawings
   c. Addenda
   d. Owner/Architect Agreement
   e. Owner/Contractor Agreement
   f. Codes, Standards, Public Ordinances and Permits

1.07 REFERENCES AND STANDARDS

A. References and Standards per Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) , Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, individual Division 21, Fire Suppression Sections and those listed in this Section.

B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:

1. State of Oregon:
   a. OAR - Oregon Administrative Rules
   b. OESC - Oregon Electrical Specialty Code
   c. OFC - Oregon Fire Code
   d. OMSC - Oregon Mechanical Specialty Code
   e. OPSC - Oregon Plumbing Specialty Code
   f. OSSC - Oregon Structural Specialty Code
   g. OEESC - Oregon Energy Efficiency Specialty Code

C. Reference standards and guidelines include but are not limited to the latest adopted editions from:

1. ABA - Architectural Barriers Act
2. ADA - Americans with Disabilities Act
3. ANSI - American National Standards Institute
4. ASCE - American Society of Civil Engineers
5. ASCE-7 Minimum Design Loads for Buildings and Other Structures
6. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
7. ASHRAE Guideline 0, the Commissioning Process
8. ASME - American Society of Mechanical Engineers
9. ASPE - American Society of Plumbing Engineers
10. ASTM - ASTM International
11. AWWA - American Water Works Association

12. EPA - Environmental Protection Agency
13. ETL - Electrical Testing Laboratories
14. FCC - Federal Communications Commission
15. FM - FM Global
16. FM Global - FM Global Approval Guide
17. ICC - International Code Council
18. ICC-ESR - International Code Council Evaluation Service Reports
19. HI - Hydraulic Institute Standards
20. ISO - International Organization for Standardization
21. NEC - National Electric Code
22. NEMA - National Electrical Manufacturers Association
23. NFPA - National Fire Protection Association:
    a. NFPA 13 - Standard for the Installation of Sprinkler Systems
    b. NFPA 24 - Standard for Installation of Private Fire Service Mains and Their Appurtenances
    c. NFPA 25 - Standard for Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
    d. NFPA 70 - National Electrical Code
    e. NFPA 72 - National Fire Alarm and Signaling Code
24. NRCA - National Roofing Contractors Association
25. OSHA - Occupational Safety and Health Administration
26. UL - Underwriters Laboratories Inc.

D. See Division 21, Fire Suppression individual Sections for additional references.

1.08 SUBMITTALS

A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 21, Fire Suppression sections.

B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.

C. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.

D. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. Copy Architect on all transmissions/submissions.

E. Submit shop drawings, calculations and product data sheets as one complete stand-alone package to AHJ, Owner's insurance underwriter and Engineer.

F. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 21, Fire Suppression Sections.

G. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the

submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.

1. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed Item. Highlight connections by/to other trades.
2. Include technical data, installation instructions and dimensioned drawings for products, equipment and devices installed, furnished or provided. Reference Division 21, Fire Suppression specification Sections for specific Item required in product data submittal outside of these requirements.
3. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.
4. For vibration isolation of equipment, list make and model selected with operating load and deflection. Indicate frame type where required. Submit manufacturer's product data.
5. See Division 21, Fire Suppression Sections for additional submittal requirements outside of these requirements.

H. Maximum of two reviews provided of complete submittal package. Arrange for additional reviews and/or early review of long-lead Item; Bear costs of additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.

I. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer’s comments. Identify Engineer’s comments and provide an individual response to each of the Engineer’s comments. Cloud changes in the submittals and further identify changes which are in response to Engineer’s comments.

J. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-10 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.

K. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 21, Fire Suppression coordination documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical and Division 28, Electronic Safety submittals.

L. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.

M. Substitutions and Variation from Basis of Design:

1. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
2. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of

"Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.

N. Shop Drawings:

1. Provide coordinated Shop Drawings which include physical characteristics of all systems, equipment and piping layout, pipe layout, hanger layout, sway brace layout, seismic restraints, sway brace calculations, drains, location of drain discharge, risers, valves, details, water test information, physical device layout plans, and control wiring diagrams. Reference individual Division 21, Fire Suppression Sections for additional requirements for shop drawings outside of these requirements.
2. Shop Drawings and hydraulics calculations, sway brace calculations, trapeze hanger calculations, and the like, to be prepared under the direct supervision and control of a Professional Engineer competent to do such work and licensed in the state of Oregon. Drawings and calculations to bear the seal and wet signature of the professional Engineer.
3. Provide Shop Drawings which indicate information required by NFPA 13. Include room names and fire sprinkler occupancy hazard classifications.
4. Provide Shop Drawings illustrating information for Hydraulic Information Sign for each hydraulic remote area calculated.
5. Utilizing the Reflected Ceiling backgrounds, provide Shop Drawings illustrating locations of fire sprinklers and piping.
6. Utilizing the Structural backgrounds, provide Shop Drawings illustrating locations and types of hangers and sway braces.
7. Provide Shop Drawings illustrating each type of hanger, including fasteners to structure.
8. Provide Shop Drawings illustrating each type of branchline restraint and sway brace, including length of sway brace member, sway brace fittings, minimum and maximum angles from vertical of sway brace member, method of attachment to structure, size, length and embedment of attachment to structure and size and type of structural member to which sway brace will be attached. Number each type of restraint and sway brace. Indicate on Drawings locations of each type of numbered restraint and sway brace.
9. Provide details for any hanger, attachment, or sway brace to be attached to any I-joist, structural insulated panels (SIPs), cross laminated timber, and similar engineered structural products according to the specifications of the engineered product manufacturer.
10. Provide Shop Drawings illustrating information for Sprinkler System General Information Sign.
11. Shop Drawings to include a cross-sectional view that shows the sprinkler heads and piping in relation to the building's architectural and structural information. View to be chosen based on a location that will display the most information.
12. When required, provide Coordination Drawings.
13. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.
14. Provide details of hanger, sway bracing and branch line restraint attachments to structure and to piping. Include details on the size and load capacities of fasteners. Provide verification of the structural capacity to withstand seismic load.
15. Provide sway bracing calculations on drawings showing horizontal seismic design load and requirements, with indication of zone of influence for each bracing location.

16. Provide a schedule of sway bracing type, size, and design criteria, including length, angle from vertical, and load capacities.
17. Clearly indicate the elevation of the highest sprinkler in relation to the elevation of the flow test pressure gauge monitor hydrant.
18. Provide details of flexible sprinkler hose fitting per manufacturer's schedule of equivalent feet used in hydraulic calculations, showing device length, maximum number of 90-degree bends and expected radius of bends.
19. Provide a schedule of signage to be installed at each flexible sprinkler hose fitting.
20. On the drawings, provide a list of number, model, temperature, sprinkler Identification number, manufacturer, orifice, deflector type, thermal sensitivity and pressure rating, quantity of each type to be contained in the spare sprinkler cabinet and the issue date or revision date of the list."
21. Spare sprinkler head cabinet size indicating the number of spare sprinkler head to be contained therein.

O. Samples: Provide samples when requested by individual Sections.

P. Resubmission Requirements:
1. Make any corrections or change in submittals when required. Provide submittals as specified. The Engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Clearly indicate changes on Drawings and cloud changes in the submittals.
2. Resubmit for review until review indicates no exceptions taken or make "corrections as noted".

Q. Operation and Maintenance Manuals/Owner's Instructions:
1. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or Item requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
    a. Include copies of certificates of code authority acceptance, code-required acceptance tests; test reports and certificates.
    b. Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Sections.
    c. Catalog description of each Item of equipment actually installed on job.
    d. Instructions for operation and maintenance of fire suppression systems composed of operating instructions, maintenance instructions and manufacturer's literature as follows:
        1) Testing and Maintenance Schedule Chart: Provide an 8-1/2- by 11-inch typewritten list of each item of installed equipment requiring testing inspection , lubrication or service, describing and scheduling performance of maintenance.
        2) Manufacturer's Literature: Provide copies of manufacturer's instructions for operation and maintenance of fire suppression equipment, including replacement parts list with name and address of nearest distributor. Mark each copy with equipment identification label as listed in equipment schedule, i.e. F-5 etc.
    e. Include product certificates of warranties and guarantees.
    f. Include Record Drawings,

g. Include copy of water supply flow test used as basis for hydraulic calculations.

h. Include hydraulic calculations and sway brace calculations.

i. Include Contractor’s Material and Test Certificates for Aboveground Piping/Underground Piping.

j. Include a copy of NFPA 25.

k. Include a copy of valve charts and whether normally open or normally closed.

l. Include a copy of drain, auxiliary, and low point drains charts.

m. Include a copy of the list to be included in the spare sprinkler head box.

n. Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.

o. Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, and quantities relevant to each piece of equipment: i.e. belts, motors, lubricants, and filters.

p. Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub-assemblies.

q. Include copy of startup and test reports specific to each piece of equipment.

r. Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.

2. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 21 00 00, Fire Suppression Basic Requirements, Article titled "Demonstration".

3. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.

R. Record Drawings:

1. Maintain at site at least one set of Drawings for recording “As-constructed” conditions. Indicate on Drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical Item. Include items changed by field orders, supplemental instructions, and constructed conditions.

2. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.

3. At completion of project, input changes to original project on CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD disk and drawings upon substantial completion.

4. Invert elevations and dimensioned locations for water services and drainage piping below grade extending to 5-feet outside building line.

5. Record Drawings to include site information or reference site information for complete understanding of the fire protection system between the building and the point of connection to the water supply and location of flow test pressure hydrants.
6. See Division 21, Fire Suppression individual Sections for additional items to include in Record Drawings.

S. Calculations: Submit hydraulic and sway brace and the like calculations.

1. Hydraulic Calculations:
   a. Include friction losses between the hydraulically most remote design area and the hydrant flow test pressure hydrant.
   b. Hydraulic calculations to be performed on a nationally recognized fire sprinkler hydraulic calculation computer program, with cover sheets in the format required by the latest edition of NFPA 13. Hydraulic calculations performed “by hand” or not on a nationally recognized fire sprinkler hydraulic calculations computer program will be returned without review by engineer.
   c. Provide one or more hydraulic calculations for each hydraulically most remote area.
   d. Where it is not obvious which area is most hydraulically remote, perform and submit for review additional hydraulic calculations proving the hydraulically most remote area.
   e. For grid systems, either provide “peaked” hydraulic calculations, or provide two additional sets of hydraulic calculations for each hydraulically most remote area.
   f. Include pressure losses between the highest sprinkler and the elevation of the pressure gauge monitor hydrant of the flow test.
   g. Include friction loss for flexible branch line connectors per manufacturer's schedule of equivalent feet for device length, maximum number of bends and expected radius of bends.
   h. When flexible sprinkler hose fittings are added to an existing system, provide hydraulic calculations verifying the design flow rate will be achieved."
   i. For Future Tenant Improvement Spaces: Include in hydraulic calculations friction loss allowances for future installation of flexible sprinkler head connectors so that flexible connectors may be installed in the future without revisions to the overhead system.
2. Sway Brace Calculations:
   a. Sway brace calculations utilizing a proprietary computer calculation program only used for the sway brace components supported by that manufacturer. For example, only “manufacturer X” sway brace components, and not those of another manufacturer, may be calculated on a "manufacturer X” sway brace computer calculation program.
   b. Provide seismic calculations for any sway brace to be attached to any I-joist, structural insulated panels (SIPs), cross laminated timber, and similar engineered structural products according to the specifications of the I-joist manufacturer.

1.09 QUALITY ASSURANCE

A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted

for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.

B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.

C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every Item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.

D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.

E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.

F. Provide products that are UL listed.

G. Piping Insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.10 WARRANTY

A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.

B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.11 COORDINATION DOCUMENTS

A. Prior to construction, prepare and submit coordinated layout drawings (composite drawings), to coordinate installation and location of ductwork, grilles, diffusers, piping, fire sprinklers, fire alarm, plumbing, cable trays, lights, and electrical services. Composite Drawings show services on single sheet. Key Drawings to structural column identification system. Prior to completion of Drawings, coordinate proposed installation with architectural and structural requirements, and other trades (including plumbing, HVAC, electrical, fire alarm ceiling suspension and tile systems, etc.), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling and finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence. Unless otherwise required by Division 00, Procurement and Contracting Requirements and/or Division 01, General Requirements, Division 23, HVAC to combine information furnished by other trades onto master coordination documents.

B. Prepare Drawings as follows:

1. Provide drawings in CAD Format. CAD format release equal to design documents. Drawings to be same sheet size and scale as Contract Drawings and indicate location, size and elevation above finished floor of equipment and distribution systems.
2. Review and revise, as necessary, section cuts in Contract Drawings after verification of field conditions.
3. Indicate fire protection system piping including fittings, hangers, access panels, valves, and bottom of pipe elevations above finished floor.

4. Indicate inverts and provision for piping that must be graded to have right-of-way over more flexible Item. Drawings also to indicate proposed ceiling grid and lighting layout as shown on electrical drawings, architectural reflected ceiling drawings and HVAC equipment, ductwork and piping. Drawings to indicate proposed and identified structural members to which hangers and sway braces will be attached as shown on structural drawings.
5. Incorporate Addenda Item and change orders.
6. Provide additional coordination as requested by other trades.

C. Advise Architect in event conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.

D. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.

E. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer, including but not limited to sprinkler heads, pipe, fittings, hangers and bracing materials.

2.02 STANDARDS OF MATERIALS AND WORKMANSHIP

A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL, ETL, FM, and ICC-ES approved for their intended fire protection function or have adequate approval or be acceptable by State, County, and City authorities.

B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.

C. Hazardous Materials:

1. Comply with local, State of Oregon, and Federal regulations relating to hazardous materials.
2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.01 ACCESSIBILITY AND INSTALLATION

A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.

B. Install equipment requiring access (i.e. drains, control operators, valves, motors, engines, pumps, controllers, air compressors, gauges, fill cups, tanks, cleanouts and the like) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.

C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation

instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.

D. Earthwork:

1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with the following:

a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with the provisions specified. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.

b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.

c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.

E. Firestopping:

1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection.

2. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM International E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

F. Pipe Installation:

1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating coordinating installation of piping systems.

2. Include provisions for servicing and removal of equipment without dismantling piping.

G. Plenums: Provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

3.02 SEISMIC CONTROL

A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 21, Fire Suppression Sections.

B. Provide fire suppression equipment and piping, both hanging and base mounted, with mounting connection points of sufficient strength to resist lateral seismic forces equal to lateral seismic forces as determined by building code and NFPA 13 calculations, whichever is more demanding.

C. See Structural Drawings for seismic design criteria for sway bracing and seismic restraint.

D. Earthquake resistant designs for Fire Protection (Division 21) equipment and distribution, i.e. fire sprinkler systems, fire standpipe systems, fire pumps, fire pump controllers, fire tanks, clean agent fire suppression systems, etc. to conform to regulations of jurisdiction having authority.

E. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.

F. Provide stamped Shop Drawings from licensed Engineer of seismic bracing and seismic movement assemblies for piping, equipment, tanks, pumps controllers and the like. Submit shop drawings along with equipment submittals.

G. Provide stamped Shop Drawings from licensed Engineer of seismic flexible joints for piping and crossing building expansion or seismic joints. Submit Shop Drawings along with seismic bracing details.

H. Provide details of flexible drops for sprinklers in conformance with Building Code and ASCE 7 requirements of ceilings. Coordinate with Architectural and Structural Drawings and Specifications.

I. Piping: Per NFPA 13, ASCE-7 and local requirements.

J. Equipment:

1. Per "Seismic Restraints Manual Guidelines for Mechanical Systems" latest edition published by SMACNA, ASCE 7 and local requirements.
2. Provide means to prohibit excessive motion of fire protection equipment during an earthquake.

3.03 REVIEW AND OBSERVATION

A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.

B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:

1. Prior to covering walls.
2. Prior to ceiling cover/installation.
3. When main systems, or portions of, are being tested and ready for inspection by AHJ.
4. When mains or branchlines are to be permanently concealed by construction or insulation systems.
5. When fire suppression systems, or portions of, are being tested and ready for inspection by AHJ.

C. Bear responsibility and cost to make piping accessible, to expose concealed lines, or to demonstrate acceptability of the system. If Contractor fails to notify Architect at times prescribed above, costs incurred by removal of such work are the responsibility of the Contractor.

D. Final Punch: Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.04 CUTTING AND PATCHING

A. Confirm Cutting and Patching requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and the following:

1. Cutting and patching performed under Division 21, Fire Suppression includes, but is not limited to:
   a. Cutting and patching of plaster or partitions.
   b. Cutting and patching of finished ceilings.

2. Perform cutting and patching by skilled craftsmen in trade of work to be performed. Fill holes which are cut oversized for completed work. Match refinished areas with existing adjacent finish in a manner acceptable to Architect.
3. When masonry to concrete construction must be penetrated, provide a steel pipe sleeve in opening and grout in place in a neat manner. Leave grout surface to match existing finish. Provide escutcheons. If sleeves are not provided, core drill penetrations.
4. Locate concealed utilities to eliminate possible service interruption or damage.
5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.
6. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
7. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
8. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
9. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, landscaping, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
10. Repair mutilation of building around pipes, equipment, hangers, and braces.

3.05 EQUIPMENT SELECTION AND SERVICEABILITY

A. Replace or reposition equipment which is too large or located incorrectly to permit servicing at no additional cost to Owner.

3.06 DELIVERY, STORAGE AND HANDLING

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and the following:

1. Handle materials delivered to project site with care to avoid damage and deterioration. Store materials in original containers which identify manufacturer, name, brand and model numbers on site inside building or protected from weather, sun, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt and/or dust as a result of improper storage to be replaced before installation.
2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
3. Protect bright finished shafts, bearing housings and similar Item until in service.

3.07 DEMONSTRATION

A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.

B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.

C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

D. Prior to acceptance of work and during time designated by Architect, provide necessary qualified personnel to operate system for a period of two hours.

E. Instruct the Owner in the operation of the sprinkler system, including main valve position (open or closed) recognition, system drainage, system testing, dry pipe valve reset and the relation to the fire alarm system.

F. Upon completion of work and adjustment of equipment, test systems to demonstrate to Owner's Authorized Representative and Architect that equipment is furnished and installed or connected under provisions of these Specifications.

3.08 CLEANING

A. Confirm Cleaning requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.

B. Upon completion of installation, except for sprinklers, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

C. Sprinklers may not be cleaned except for vacuuming in a manner in which no part of the sprinkler is touched by the vacuuming equipment. Replace sprinklers which bear traces of foreign substances with sprinklers of same model, temperature, K-factor, orifice, finish, style, orientation, and the like.

3.09 INSTALLATION

A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.

B. Install equipment in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.

C. Start-up equipment, in accordance with manufacturer's start-up instructions, in the presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment. Provide pump impellers to obtain Basis of Design design capacities.

D. Provide miscellaneous supports/metals required for installation of equipment and piping.

3.10 PAINTING

A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and the following:

1. Ferrous Metal: After completion of fire protection work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
2. After acceptance by AHJ, in a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
3. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
4. Piping: Clean, primer coat and paint exposed piping on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.
5. Covers: Covers such as vault covers and the like will be furnished with finishes which resist corrosion and rust.

3.11 ACCEPTANCE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Sections in Division 21, Fire Suppression and the following:

1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
   a. Testing reports including Contractor's Material and Test Certificate for Underground Piping, Contractor's Material and Test Certificate for Aboveground Piping, Contractor's Material and Test Certificate for Private Fire Service Mains, Fire pump acceptance test data report, and the like.
   b. Cleaning
   c. Operation and Maintenance Manuals
   d. Training of Operating Personnel
   e. Record Drawings
   f. Warranty and Guaranty Certificates
   g. Start-up/Test Document and Commissioning Reports
   h. Letter of Conformance

3.12 FIELD QUALITY CONTROL

A. Confirm Field Quality Control requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.

B. Upon completion of installation of equipment, sprinklers, hose valves and piping and after units are water pressurized, test system to demonstrate capability and compliance with requirements. When possible, correct malfunctioning Item at site, then retest to demonstrate compliance; otherwise remove and replace with new Item and proceed with retesting.

C. Inspect each installed Item for damage to finish. If feasible, restore and match finish to original, except fire sprinklers, at site; otherwise, remove Item and replace with new Item. Feasibility and match to be judged by Architect. Remove cracked or dented Item and replace with new Item.

D. Fire sprinklers may not be reused, or cleaned, except for dusting. Replace damaged, field painted, oversprayed, overcoated or field coated sprinklers with new sprinklers of same manufacturer, model, finish, K-factor and performance characteristics. Where identical replacement sprinklers are not available, provide sprinklers of similar finish, style, K-factor and performance characteristics.

3.13 LETTER OF CONFORMANCE

A. Provide Letter of Conformance and copies of manufacturers' warranties and extended warranties with a statement that fire suppression items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

3.14 ELECTRICAL INTERLOCKS

A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize fire protection equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

3.15 CONNECTIONS TO EXISTING

A. Prior to connection of piping to existing piping or utilities, field verify existing conditions and exact sizes and locations of existing piping. Provide additional offsets, transitions, joints, cut-ins, and replace portions of existing as required to facilitate connections of new.

END OF SECTION

SECTION 21 05 00
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. Buried Ductile Iron Pipe and Fittings
2. Buried PVC (Polyvinyl Chloride) Pipe and Fittings
3. Joint Restraints
4. Aboveground Black Steel Pipe and Fittings
5. Wall and Floor Penetrations and Sleeves
6. Switches, Valve Supervisory
7. Switches, Water Detector
8. Hangers and Supports
9. Struts and Strut Clamps
10. Sway Braces and Restraints
11. Anchors and Attachments
12. Pipe Stands
13. Gauges
14. Bells
15. Fire Department Connection
16. Valves
17. Backflow Prevention Devices
18. Pipe, Valve, and Fire Protection Equipment Identification
19. Signs
20. Drains

1.02 RELATED SECTIONS

A. Contents of Division 21, Fire Suppression and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:

1. Division 22, Plumbing
2. Division 23, Heating, Ventilating and Air Conditioning
3. Division 26, Electrical
4. Division 28, Electronic Safety
5. Division 31, Earthwork
6. Section 21 00 00, Fire Suppression Basic Requirements
7. Section 21 12 00, Fire Suppression Standpipes
8. Section 21 13 00, Fire Suppression Sprinkler Systems

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

B. Meet requirements of ASCE 7, Minimum Design Loads for Buildings and Other Structures, by American Society of Civil Engineers, latest adopted edition.

1.04 SUBMITTALS

A. Submittals as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Material and Equipment: Listed for its intended fire protection use in current UL Fire Protection Equipment Directory, or UL Online Certifications Directory for Fire Protection, International Code Council Evaluation Service Reports, or FM Global Approval Guide. All material and equipment to be new and from a current manufacturer.
2. Provide per AHJ requirements.
3. References to product Specifications for materials are listed according to accepted ANSI, ASTM, ASME, AWWA and other base standards. Materials to meet latest approved versions of these standards.
4. Fire Suppression Screw-Thread Connections: Comply with local fire department/fire marshal regulations for sizes, threading and arrangement of connections for fire department equipment to fire department connections.
5. Manufacturers: Unless an item is marked "No substitutions", submit substitution request for materials of other than named manufacturers.
6. Noise and Vibration:
   a. Install vibration isolators and measures required to prevent noise and vibration from being transmitted to occupied areas. Select equipment to operate within noise coefficient (NC) design level for particular type of installation in relation to its location.
   b. After installation, make proper adjustments to reduce noise and vibration to acceptable levels as defined by Architect.
   c. In acoustically sensitive areas, design system in a manner that minimizes the number of wall penetrations.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.07 FLOW TEST

A. If flow test information provided below has been conducted less than 12 months prior to working plan submittal, utilize for design of NFPA 13 fire sprinkler and NFPA 14 standpipe systems.

B. If flow test information provided below has been conducted greater than 12 months prior to working plan submittal, the information provided is advisory only and not to be used for design. Provide materials and labor for a new water supply test on the closest nearby fire hydrants per NFPA 13 and NFPA 291. Utilize new flow test results for design of NFPA 13 fire sprinkler and NFPA 14 standpipe systems.

C. Flow Test:

1. Flow: _____ GPM at a residual pressure of _____ PSI.
2. Static Pressure: _____ PSI.
3. Location: _____.
4. Elevation: _____.
5. Date: _____.
6. Information Provided By: _____.

1.08 SYSTEM IMPAIRMENT

A. When returning a water-based fire protection system to service after impairment or control valve closure, verify the system is in working order by performing a main drain test per NFPA 25.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Buried Ductile Iron Pipe and Fittings:
   1. American Cast Iron Pipe Company
   2. Atlantic States Cast Iron Pipe Company
   3. Clow Water Systems Company
   4. EBAA Iron, Incorporated
   5. EBAA Iron, Incorporated Flex-Tend Flexible Expansion Joint, Flex-Tend Force Balance Flexible Expansion Joint
   6. Griffin Pipe Products Company
   7. McWane Cast Iron Pipe Company
   8. Pacific States Cast Iron Pipe Company
   9. United States Pipe & Foundry Company
   10. Star Pipe Products
   11. Tyler Union
   12. Or approved equivalent.

B. Buried PVC (Polyvinyl Chloride Pipe and Fittings:
   1. Certainteed Corporation
   2. JM Eagle
   3. National Pipe and Plastics Incorporated
   4. Or approved equivalent.

C. Joint Restraints:
   1. Star Pipe Products
   2. Tyler Pipe Company
   3. EBAA Iron, Incorporated
   4. Uni-Flange Corporation
   5. Union Foundry Company
   6. United States Pipe and Foundry Company
   7. Or approved equivalent.

D. Aboveground Black Steel Pipe and Fittings:
   1. Pipe:
      a. Bull Moose Tube
      b. Wheatland Tube Company
      c. Youngstown Tube Company
      d. Tex-Tube Company
      e. State Pipe and Supply, Incorporated
      f. Or approved equivalent
   2. Fittings, Mechanical and Grooved Couplings:
      a. Victaulic
      b. Gruvlok
      c. Shurjoint Piping Products Incorporated

d. Smith-Cooper International
e. Tyco Fire & Building Products
f. Viking Corporation
g. Allied Rubber and Gasket Company Incorporated, dba ARGCO
h. Anvil International
i. Dixon Valve & Coupling
j. Or approved equivalent.

3. Fittings, Threaded:
   a. Ward Manufacturing
   b. Anvil International
   c. Smith-Cooper International
   d. Aegis Technologies
   e. Or approved equivalent.
4. Fittings, Rubber Gasketed:
   a. Victaulic
   b. Anvil International
   c. AnvilStar
   d. EBAA Iron, Incorporated
   e. Shurjoint Piping Products, Incorporated
   f. Smith-Cooper International
   g. Tyco Fire & Building Products
   h. Viking Corporation
   i. Ward Manufacturing
   j. Allied Rubber and Gasket Company Incorporated, dba ARGCO
   k. Dixon Valve & Coupling
   l. Or approved equivalent.
5. Fittings, Welded:
   a. Anvil International
   b. Shurjoint Piping Products Incorporated
   c. Smith-Cooper International
   d. State Pipe & Supply, Incorporated
   e. Or approved equivalent.
6. Fittings, Flanged:
   a. Victaulic; Groove/Flange Adapter.
   b. United Brand Fittings
   c. U.S. Pipe
   d. Anvil S.P.F.
   e. Iowa Fittings Company
   f. Tyco Fire Products; Grinnell Groove/Flange Adapter
   g. Or approved equivalent.

E. Wall and Floor Penetrations and Sleeves:
   1. Allied Rubber and Gasket Company, Incorporated, dba ARGCO
   2. Fire Protection Products Incorporated (FPPI)
   3. Or approved equivalent.

F. Switches, Valve Supervisory:

1. Outside Screw and Yoke Valve Supervisory Switch:
   a. Potter Electric Signal Company; Model OSYSU-1, -2.
   b. System Sensor; Model OSY2 or OSYECP.
   c. Or approved equivalent.
2. Post Indicator Valve (PIV) Control Valve Supervisory Switch:
   a. Potter Electric Signal Company; Model PCVS-1, -2.
   b. System Sensor; Model PIVB2 or PIVBEXP.
   c. Or approved equivalent.
3. Non-Rising Stem Valve Supervisory Switch:
   a. Potter Electric Signal Company; Model PTS-C.
   b. System Sensor; Model PSP1.
   c. Or approved equivalent.
4. Ball Valve Supervisory Switch:
   a. Potter Electric Signal Company; Model RBVS.
   b. System Sensor; Model PSP1.
   c. Or approved equivalent.
5. Angle Valve Supervisory Switch:
   a. System Sensor; Model PSP1.
   b. Or approved equivalent.

G. Switches, Water Detector:
1. Water Flow Switches:
   a. Wet Sprinkler Systems:
      1) Potter Electric Signal Company; Model VSR.
      2) System Sensor; Model WFD.
      3) Or approved equivalent.
2. Pressure Operated Alarm Switches:
   a. Dry Pipe Sprinkler Systems:
      1) Detection of Water Flow:
         (a) Potter Electric Signal Company; Model PS10.
         (b) System Sensor; Model EPS or EPS EXT.
         (c) Or approved equivalent.
      2) Detection of Low Pressure:
         (a) Potter Electric Signal Company; Model PS40.
         (b) System Sensor; Model EPS or EPS EXP.
         (c) Or approved equivalent.

H. Hangers and Supports:
1. Cooper B-Line Tolco
2. Anvil International
3. ITW Buildex Sammys
4. Erico International
5. PHD Manufacturing Incorporated
6. Or approved equivalent.

I. Struts and Strut Clamps:
1. Cooper B-Line Tolco
2. Or approved equivalent.

J. Sway Braces and Restraints:
   1. Cooper B-Line Tolco
   2. Anvil International
   3. Erico International
   4. PHD Manufacturing Incorporated
   5. Or approved equivalent.

K. Anchors and Attachments:
   1. Concrete:
      a. Cast-In Place Anchors for Hangers:
         1) Cooper B-Line Tolco
         2) Erico International
         3) Or approved equivalent.
      b. Cast-In Place Anchors for Braces:
         1) Cooper B-Line Tolco
         2) Anvil International; Figure 282 with nut.
         3) Erico International
         4) Or approved equivalent.
      c. Attachments as specified or described by structural. If not specified or described by structural, then as follows:
         1) Hilti; Model Kwikbolt TZ
         2) Powers; Models Snake+, Power Stud+ SD2, or Powers Wedge-Bolt.
         3) Simpson Strong-Tie
         4) DeWalt; Mini-Undercut+, internally threaded undercut anchor.
         5) Or approved equivalent.
   2. Wood:
      a. Cooper B-Line Tolco:
      b. Anvil International
      c. Elco Construction Products, Hangermate
      d. Erico International
      e. ITW Buildex Sammys
      f. Or approved equivalent.
   3. Steel:
      a. Cooper B-Line Tolco
      b. Anvil International
      c. Elco Construction Products, Hangermate
      d. Erico International
      e. ITW Buildex Sammys
      f. Or approved equivalent.

L. Pipe Stands:
   1. Cooper B-Line Tolco; Fig B3092 with Fig. B3088ST.
   2. Anvil International; Figure 259 with Figure 62 or 63.
   3. Or approved equivalent.

M. Gauges:
   1. Ashcroft; Model 105P-XUL.

2. US Gauge; Model 1590K.
3. Brecco
4. Reliable Automatic Sprinkler Company
5. Fire Protection Products, Incorporated (FPPI)
6. Allied Rubber and Gasket Company Incorporated, dba ARGCO
7. Wika Instrument Corporation
8. Or approved equivalent.

N. Bells:
1. Interior/Exterior Alarm Bells:
a. Potter; Model PB, 8-inch.
b. System Sensor
c. Or approved equivalent.

O. Fire Department Connection:
1. Guardian Fire Equipment
2. Fire End Croker Corporation
3. Potter-Roemer
4. Elkhart Brass
5. Tyco Fire & Building Products
6. Fire Protection Products, Incorporated (FPPI)
7. Or approved equivalent.

P. Valves:
1. OS&Y Gate:
a. 175 PSI:
1) Nibco; Model F-607-0.
2) Mueller; Model R-2360-6.
3) Or approved equivalent.
b. 250 PSI:
1) Victaulic; Model 771.
2) Or approved equivalent.
c. 350 PSI:
1) Nibco; Model F697-0.
2) Or approved equivalent.
d. 2-inches and Smaller:
1) Nibco; Model T-104.
2) Or approved equivalent.
2. NRS Gate:
a. 175 PSI:
1) Nibco M/F-609 with Nibco NIP1A for yard use.
2) Nibco M/F-609 with Nibco NIP2A for wall use.
3) Or approved equivalent.
b. 200 PSI:
1) Mueller A-2361 with Mueller A-2080x indicator post for yard use.
2) Mueller A-2361 with Mueller A-20813 wall type indicator post for wall use.
3) Or approved equivalent.

c. 250 PSI:
   1) Victaulic; Model 772, with Model 774 indicator post for yard use.
   2) Victaulic; Model 772, with Model 773 wall type indicator post for wall use.
   3) Or approved equivalent.

3. Swing Check:
   a. Victaulic; Model 717.
   b. Nibco; Model F-908-W.
   c. Mueller; Model A-2122-6.
   d. Viking Easy Riser Swing Check.
   e. Tyco; Model CV-1F.
   f. AnvilStar; Series 78FP.
   g. Reliable; Model G.
   h. Or approved equivalent.
4. Wafer Check:
   a. Nibco; Model W-900-W.
   b. Mueller; Model A2102.
   c. Viking
   d. Tyco
   e. Or approved equivalent.
5. Butterfly Valves:
   a. Victaulic; Series 705, Series 707, Series 765, Series 766.
   b. Nibco; Model WD3510-8.
   c. Tyco; Model BFV-N.
   d. Use lug body next to pumps; Nibco; Model LD-3510-6.
   e. Reliable; Model REL-BFG-300-I.
   f. Or approved equivalent.
6. Pressure Relief:
   a. Watts; Model FP-53L.
   b. United Brass Works; Model 132.
   c. AGF
   d. Or approved equivalent.
7. Automatic Ball Drip Drain Valve:
   a. Tyco; Model AD-1,-2.
   b. Reliable Automatic Sprinkler Company
   c. Or approved equivalent.
8. Three-Way Gauge Valve:
   a. Fire Protection Products Incorporated (FPPI): 1/4-inch IPS, UL/ULC Listed, 300 psi.
   b. AGF Manufacturing Inc.; Model 7600, 1/4-inch 3-Way Globe Valve.
   c. Nibco; 400 PSI WWP Bronze Side Outlet Globe Valve KT-291-W3.
   d. Or approved equivalent.
9. Automatic Air Release Valve:
   a. Potter Electric Signal Company
   b. Or approved equivalent.

10. Ball Valve:
    a. Victaulic; Series 728.
    b. Apollo Valves; 64 Series, 1/4-inch through 2-inches.
    c. Fire Protection Products Incorporated (FPPI)
    d. Nibco; Models KX-505-W-8, KT-580-70-UL, or KT-585-70-UL.
    e. Or approved equivalent.

Q. Backflow Prevention Devices:
1. Double Check Valve Assembly:
    a. Ames; Colt C200/C300.
    b. Ames; Maxim 200/300.
    c. Ames; Silver Bullet 2000SS/3000SS.
    d. Febco; Models 850/870 or 856/876.
    e. Zurn Wilkins; Model 350.
    f. Apollo Valves; Model DCDA4SG.
    g. Or approved equivalent.

R. Pipe, Valve, and Fire Protection Equipment Identification:
1. Fire Protection Products, Incorporated (FPPI)
2. Allied Rubber and Gasket Company, Incorporated, dba ARGCO
3. Or approved equivalent.

S. Signs:
1. Tyco Fire Products
2. Reliable Automatic Sprinkler
3. Viking Corporation
4. Allied Rubber and Gasket Company, Incorporated, dba ARGCO
5. Or approved equivalent.

T. Drains:
1. Reference Aboveground Black Steel Pipe and Fittings.
2. AGF
3. Victaulic
4. Or approved equivalent.

2.02 BURIED DUCTILE IRON PIPE AND FITTINGS

A. Pipe:
1. Thickness: Class 52 ductile iron, AWWA C151.
2. Pressure: 150 psi.
3. Cement mortar lined per AWWA C104, field encased with 8 mil polyethylene bag per AWWA C105. Coat all bolts, restraining rods, and the like with bitumastic prior to encasement in the polyethylene bag.

B. Fittings: AWWA C110, 350 psi. Cement mortar lined per AWWA C104, field encased with 8 mil polyethylene bag per AWWA C105. Coat all bolts, restraining rods, and the like with bitumastic prior to encasement in the polyethylene bag.

C. Fittings restrained with thrust blocks or restraining rods per NFPA 24.

D. Underground Valves: Factory coated with powdered epoxy or equivalent corrosion resistant coating. Bolts coated with bitumastic in the field. Encase the entire valve in 8-mil polyethylene bag in accordance with AWWA C-105.

E. Flexible Underground Expansion Joints:
1. AWWA C153, AWWA C116, AWWA C105.

2. Expansion joint designed and cast as an integral part of a ball and socket type flexible joint.
3. Internal and external epoxy lined.
4. Sealing Gasket: EPDM.
5. Polyethylene sleeve.

2.03 BURIED PVC (POLYVINYL CHLORIDE) PIPE AND FITTINGS

A. Pipe: SDR-18, AWWA C900.

B. Fittings:

1. AWWA C907, CSA B137.2.
2. PVC fittings restrained with thrust blocks per NFPA 24.
3. Ductile Iron Fittings and Restraining Rods: AWWA C110, 350 psi or 24.13 bar. Cement mortar lined per AWWA C104, field encased with 8 mil polyethylene bag per AWWA C105. Coat all bolts, restraining rods, and the like with bitumastic prior to encasement in the polyethylene bag.
4. Underground Valves: Factory coated with powdered epoxy or equivalent corrosion resistant coating. Bolts coated with bitumastic in the field. Encase the entire valve in 8-mil polyethylene bag in accordance with AWWA C-105.

C. Install tracer wire on all non-metallic underground water lines. Type R.H.W., #10 A.W.G. stranded.

2.04 JOINT RESTRAINTS

A. Mechanical joint wedge action for ductile iron pipe.

B. Gland: Ductile Iron.

C. Wedges: Ductile iron.

D. Full restraint pressure rating of pipe with minimum safety factor of 2:1.

2.05 ABOVEGROUND BLACK STEEL PIPE AND FITTINGS

A. Wet Pipe Systems:

1. Pipe Size 2-inch Diameter and Smaller: ASTM A53, ASTM A135, or ASTM A795; minimum of Schedule 40.
2. Pipe Size 2-1/2-inch Diameter and Larger: ASTM A53, ASTM A135, or ASTM A795; minimum of Schedule 10.
3. Exposed pipe 8-feet or less above finished floor: A minimum of Schedule 40.

B. Dry Pipe Systems:

1. Pipe Size 2-inch Diameter and Smaller: ASTM A53, ASTM A135, or ASTM A795; Schedule 40 only, shop welded, or threaded or cut grooved.
2. Pipe Size 2-1/2-inch Diameter and Larger: ASTM A53, ASTM A135, or ASTM A795; minimum of Schedule 10.
3. Exposed pipe 8-feet or less above finished floor: Minimum of Schedule 40.

C. Joints:

1. Threaded, flanged or bevel welded.
2. Piping installed in plenums or shafts to have welded joints.

D. Fittings:

1. Threaded:
   a. Malleable Iron: Class 150 and Class 300, ANSI B16.3.
   b. Cast Iron: Class 125 and 250, ANSI B16.3.
2. Flanged:
   a. Cast iron; Class 125 and 250, ASME B16.1.
   b. Raised ground face, bolt holes spot faced.

3. Welded:
    a. Carbon Steel: Long radius, standard weight or extra strong.
    b. Factory Wrought Steel Buttweld Fittings: ASME B16.9.
    c. Buttwelding Ends for Pipe, Valves, Flanges and Fittings: ASME B16.25.
    d. Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures: ASTM A234.
    e. Steel Pipe Flanges and Flanged Fittings: ASME B16.5.
    f. Forged Steel Fittings, Socket Welded and Threaded: ASME B16.11.
4. Mechanical Fittings and Grooved Couplings:
    a. Couplings: UL 213, AWWA C606, ASTM A536 ductile iron or ASTM A47 malleable iron, with enamel finish and grooves or shoulders designed to accept grooved couplings. Synthetic-rubber gasket with central-cavity, pressure-responsive design and ASTM A183 carbon-steel bolts and nuts.
    b. FM Global approved.

E. Anti-Microbial Coating: Factory-applied coating to inhibit corrosion from microbiological organisms.

2.06 WALL AND FLOOR PENETRATIONS AND SLEEVES

A. Below Grade and High Water Table Areas: Waterproof elastomeric compound.

2.07 SWITCHES, VALVE SUPERVISORY

A. Provide to mount on applicable, compatible valve (OS&Y gate, or PIV), with SPDT switches to match requirements of fire alarm system. Provide with cover tamper switch where required by AHJ.

2.08 SWITCHES, WATER DETECTOR

A. Provide with cover tamper switch where required by AHJ.

B. Water Flow Switches:
1. Vane-type; SPDT switches; electronic retard, adjustable time delay (0 to 75 seconds).
2. Wet Sprinkler Systems, NFPA 13: 450 PSI, 18-feet per second, 4-10 gpm.

C. Pressure Operated Alarm Switches: Pressure actuated with SPDT electrical switches and adjustable time delay (0 to 75 seconds).

2.09 HANGERS AND SUPPORTS

A. General: Select size of hangers and supports to exactly fit pipe size for bare piping.

B. Hangers: Ferrous.

C. Hanger Rods: Zinc electroplated carbon steel.

D. Finishes: Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

E. Materials:
1. Use carbon steel pipe hangers and supports, metal trapeze pipe hangers and attachments for general service applications.
2. Use stainless steel hangers, rods and attachments for corrosive environment applications. Examples of corrosive environment applications include, but are not limited to: swimming pools and spas, pool and spa equipment rooms and adjacent areas, chemical rooms, kidney dialysis areas, marine and beach environments, commercial laundries and the like.

F. Anti-Scratch Padding: Use padded hangers for piping subject to scratching.

2.10 STRUTS AND STRUT CLAMPS

A. Electro-galvanized steel.

B. Designed for supporting pipe runs from strut supports.

C. Strut clamps UL listed for fire protection.

D. Stainless steel for corrosive environment applications. Examples of corrosive environment applications include, but are not limited to: swimming pools and spas, pool and spa equipment rooms and adjacent areas, chemical rooms, kidney dialysis areas, marine and beach environments, commercial laundries and the like.

2.11 SWAY BRACES AND RESTRAINTS

A. Sway Bracing: From a single manufacturer and compatible with sway brace calculation program.

B. Stainless steel for corrosive environment applications. Examples of corrosive environment applications include, but are not limited to: swimming pools and spas, pool and spa equipment rooms and adjacent areas, chemical rooms, kidney dialysis areas, marine and beach environments, commercial laundries, and the like.

2.12 ANCHORS AND ATTACHMENTS

A. General: Anchor supports to masonry, concrete and block walls per anchoring system manufacturer's recommendations, or as modified by project Structural Engineer.

B. Materials:

1. Ferrous.
2. Stainless steel for corrosive environment applications. Examples of corrosive environment applications include, but are not limited to: swimming pools and spas, pool and spa equipment rooms and adjacent areas, chemical rooms, kidney dialysis areas, marine and beach environments, commercial laundries, and the like.

C. Cast in Place Anchors for Hangers: Verify listing is for hangers, braces, or both.

D. Attachments in Concrete:

1. Suitable for hanging and bracing fire protection systems in concrete which is subject to cracking in a seismic event.
2. Seismic Design Areas C, D, E and F:
   a. Compatible with International Code Council Evaluation Service Acceptance Criteria AC-193 and AC308 for expansion, screw and adhesive anchors. Meet requirements of ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary.
   b. All models of Hilti HDI and ITW Red Head Multi-Set II anchors are not approved for attaching fire protection systems in Seismic Design Areas C, D, E and F. No Exceptions.

E. ITW Buildex Sammys with FM Approval only are not allowed in certain seismic zones. Verify with FM that FM Approval is effective in project's seismic zone.

2.13 PIPE STANDS

A. Adjustable Pipe Saddle Support with Yoke:

1. Designed to support horizontal pipe from floor stanchion.
2. U-bolt and hex nuts to hold pipe securely to saddle or pipe clamp type.
3. ANSI/MSS SP-69; SP-58. Type 37.
4. Steel pipe with steel saddle.

B. Base Stand:

1. Steel pipe welded to steel base plate.
2. Meet requirements of 12X anchor diameter hole spacing for seismic applications.

2.14 GAUGES

A. Pressure Gauges: 3.5-inch, dial type, bronze bourdon tube or spring type, stainless steel case. 0 to 300 PSI.

2.15 BELLS

A. Exterior Alarm Bells: Minimum weatherproof backbox, typical 90 dBA at 10-feet.

2.16 FIRE DEPARTMENT CONNECTION

A. General:
   1. Thread to match fire department hardware; automatic drip connected to drain; threaded dust cap and chain of same material and finish as body.
   2. Provide with individual clappers.
B. Type: Free-Standing Type
C. Finish: Ductile Iron
D. Inlet Size: 2-1/2-inch.
E. Number of Inlets: Two.
F. Outlet Size: 4-inch.
G. Size of Pipe between Fire Department Connection and Sprinkler System: 4-inch.
H. Drain: 3/4-inch automatic ball drip, to outside.
I. Sign: Auto Sprinkler Fire Department Connection

2.17 VALVES

A. OS&Y Gate:
   1. 2-1/2-inches and Larger: Iron body.
   2. 2-inches and Smaller: Bronze body.
B. NRS Gate:
   1. Iron body. Non-rising stem with indicator post.
   2. Underground Butterfly Valves: Telescopic barrel type.
C. Swing Check: Iron body, rubber and bronze faced checks.
D. Wafer Check: Iron body, rubber seat, spring actuated.
E. Butterfly Valves: Ductile iron body with factory-installed tamper switches. Use lug body next to pumps.
F. Pressure Relief: Bronze body, stainless steel spring.
G. Automatic Ball Drip Drain Valve: Bronze, spring-type.
H. Three-Way Gauge Valve: Brass; rated to 300 psi.
I. Automatic Air-Release Valve for Wet Systems:
   1. Rated to 175 psi.
   2. Automatic float-type with shutoff mounted in a water retention pan.
   3. Single set 24VAC@2A for electronic supervision.
   4. Ball valve switch with cover tamper.
J. Ball Valves: Brass body, brass stem; forged brass ball disc.

2.18 BACKFLOW PREVENTION DEVICES

A. Double Check Valve Assembly:
   1. Two check valves in series with OS&Y gate or butterfly valves at each end.
   2. Provide detector if required by local utility.
   3. UL listed or FM Global Approved for fire suppression service as an assembly.
   4. Approved by local and state authorities, including project's State Department of Health for the position in which it is installed.
B. Provide Water Bureau approved Bypass-Meter and compatible Touch-Pad. Touch-Pad unit must be accessible from right-of-way.

2.19 PIPE, VALVE, AND FIRE PROTECTION EQUIPMENT IDENTIFICATION

A. Engraved plastic laminate or corrosion resistant metal sign or plastic equipment marker.

B. Corrosion-resistant chain or permanent adhesive.

2.20 SIGNS

A. Engraved plastic laminate or corrosion resistant metal sign or plastic equipment marker.

B. Corrosion-resistant chain or permanent adhesive.

2.21 DRAINS

A. Reference Aboveground Black Steel Pipe and Fittings.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Install in conformance with UL Listing, FM Approval or ICC-ES requirements and restrictions.

3.02 BURIED DUCTILE IRON PIPE AND FITTINGS

A. Pipe Sleeves:

1. Lay out work in advance of pouring concrete and furnish and set sleeves necessary to complete work.
2. Floor Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Extend sleeve 1-inch above finished floor. Caulk pipes passing through floor with nonshrinking firestopping, smokestopping and water stopping grout or approved equivalent caulking compound. Caulk/seal piping passing through fire rated building assembly with UL rated assemblies.
3. Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk pipes passing through walls with nonshrinking caulking compound. Caulk/seal piping passing through fire-rated building assemblies with UL Listed or FM approved fire-rated firestopping compound. Provide fire-rated assemblies per local AHJ requirements.
4. Coordinate with trades for locations of pipe sleeves in reinforced concrete and steel beams. Penetrations must be indicated on structural shop drawings. See Drawings and Specifications for specific sleeve location limitations.

B. Buried Pipe:

1. Hydraulically calculated pipe to be of sufficient size as to deliver the required flow while not exceeding a flow velocity of 15-feet per second or as required in accordance with the water department requirements, whichever is less.
2. Excavation and Backfill:
   a. General: Perform necessary excavation and backfill required for installation of mechanical work. Repair piping or other work damaged by Contractor's operations.
   b. Water: Keep excavations free of standing water. Re-excavate and fill back excavations damaged or softened by water or frost to original level with sand, crushed rock or other approved material at no expense to Owner.
   c. Tests: During progress of work for compacted fill, Owner reserves right to request compaction tests made under direction of a testing laboratory.
   d. Trench Excavation: Excavate trenches to necessary depth and width, removing rocks, unstable soil (i.e. muck, peat and the like), roots and stumps. Excavation material is classified as "base fill" and "native." Base fill excavation material consisting of placed crushed rock may be used as backfill above "Pipe Zone." Remove and dispose off site native

excavation material at no expense to Owner. Adequate width of trench for proper installation of piping or conduit.

e. Support Foundations:

1) Foundations: Excavate trenches located in unstable ground areas below elevation required for installation of piping to a depth which is determined by Architect as appropriate for conditions encountered. Place and compact approved foundation material in excavation up to "Bedding Zone." Dewatering, placement, compaction and disposal of excavated materials to conform to requirements contained in other Sections of Specifications or Drawings.

2) Over-Excavations: Where trench excavation exceeds required depths, provide, place and compact suitable bedding material to proper grade or elevation at no additional cost to Owner.

3) Foundation Material: Where native material has been removed, place and compact necessary foundation material to form a base for replacement of required thickness of bedding material.

4) Bedding Material: Full bed site piping on sand, pea gravel or 3/4-inch minus crushed rock. Place a minimum 4-inch deep layer of sand or crushed rock on leveled trench bottom for this purpose. Remove bedding to necessary depth for piping bells and couplings to maintain contact of pipe on bedding for its entire length. Provide additional bedding in excessively wet, unstable, or solid rock trench bottom conditions as required to provide a firm foundation.

f. Backfilling:

1) Following installation and successful completion of required tests, backfill piping in lifts.

(a) In "Pipe Zone," place backfill material and compact in lifts not to exceed 6-inches in depth to a height of 12-inches above top of pipe. Place backfill material to obtain contact with entire periphery of pipe, without disturbing or displacing pipe.

(b) Place and compact backfill above "Pipe Zone" in layers not to exceed 12-inches in depth.

2) Backfill Material:

(a) Backfill Material in "Pipe Zone": 3/4-inch minus crushed rock, sand or pea gravel.

(b) Crushed rock, fill sand or other backfill material approved elsewhere in Specifications may be used above "Pipe Zone."

g. Compaction of Trench Backfill:

1) Where compaction of trench backfill material is required, use one of following methods or combination thereof:

(a) Mechanical tamper,

(b) Vibratory compacter, or

(c) Other approved methods appropriate to conditions encountered.

2) Architect to have right to change methods and limits to better accommodate field conditions. Compaction sufficient to attain 95 percent of maximum density at optimum moisture content unless

noted otherwise on Drawings or elsewhere in Specifications. Water "puddling" or "washing" is prohibited.

C. Keep pipe openings closed by means of plugs or caps to prevent entrance of foreign matter. Protect piping and fittings against dirty water, chemicals, and mechanical damage both before and after installation. Restore to original condition or replace damaged pipe and fittings prior to final acceptance of work.

3.03 BURIED PVC (POLYVINYL CHLORIDE) PIPE AND FITTINGS

A. Securely fasten tracer wire to top of water line and place along the outside of transition to ductile iron pipe with one foot of slack placed adjacent to ductile iron pipe.

B. Buried Pipe:

1. Hydraulically calculated pipe to be of sufficient size as to deliver the required flow while not exceeding a flow velocity of 15-feet per second or as required in accordance with the water department requirements, whichever is less.

2. Excavation and Backfill:

a. General: Perform necessary excavation and backfill required for installation of mechanical work. Repair piping or other work damaged by Contractor's operations.

b. Water: Keep excavations free of standing water. Re-excavate and fill back excavations damaged or softened by water or frost to original level with sand, crushed rock or other approved material at no expense to Owner.

c. Tests: During progress of work for compacted fill, Owner reserves right to request compaction tests made under direction of a testing laboratory.

d. Trench Excavation: Excavate trenches to necessary depth and width, removing rocks, unstable soil (i.e. muck, peat and the like), roots and stumps. Excavation material is classified as "base fill" and "native." Base fill excavation material consisting of placed crushed rock may be used as backfill above "Pipe Zone." Remove and dispose off site native excavation material at no expense to Owner. Adequate width of trench for proper installation of piping or conduit.

e. Support Foundations:

1) Foundations: Excavate trenches located in unstable ground areas below elevation required for installation of piping to a depth which is determined by Architect as appropriate for conditions encountered. Place and compact approved foundation material in excavation up to "Bedding Zone." Dewatering, placement, compaction and disposal of excavated materials to conform to requirements contained in other Sections of Specifications or Drawings.

2) Over-Excavations: Where trench excavation exceeds required depths, provide, place and compact suitable bedding material to proper grade or elevation at no additional cost to Owner.

3) Foundation Material: Where native material has been removed, place and compact necessary foundation material to form a base for replacement of required thickness of bedding material.

4) Bedding Material: Full bed site piping on sand, pea gravel or 3/4-inch minus crushed rock. Place a minimum 4-inch deep layer of sand or crushed rock on leveled trench bottom for this purpose. Remove bedding to necessary depth for piping bells and couplings to maintain contact of pipe on bedding for its entire length. Provide additional bedding in excessively wet, unstable,

or solid rock trench bottom conditions as required to provide a firm foundation.

f. Backfilling:

1) Following installation and successful completion of required tests, backfill piping in lifts.

(a) In "Pipe Zone," place backfill material and compact in lifts not to exceed 6-inches in depth to a height of 12-inches above top of pipe. Place backfill material to obtain contact with entire periphery of pipe, without disturbing or displacing pipe.

(b) Place and compact backfill above "Pipe Zone" in layers not to exceed 12-inches in depth.

2) Backfill Material:

(a) Backfill Material in "Pipe Zone": 3/4-inch minus crushed rock, sand or pea gravel.

(b) Crushed rock, fill sand or other backfill material approved elsewhere in Specifications may be used above "Pipe Zone."

g. Compaction of Trench Backfill:

1) Where compaction of trench backfill material is required, use one of following methods or combination thereof:

(a) Mechanical tamper,

(b) Vibratory compacter, or

(c) Other approved methods appropriate to conditions encountered.

2) Architect to have right to change methods and limits to better accommodate field conditions. Compaction sufficient to attain 95 percent of maximum density at optimum moisture content unless noted otherwise on Drawings or elsewhere in Specifications. Water "puddling" or "washing" is prohibited.

C. Keep pipe openings closed by means of plugs or caps to prevent entrance of foreign matter. Protect piping and fittings against dirty water, chemicals, and mechanical damage both before and after installation. Restore to original condition or replace damaged pipe and fittings prior to final acceptance of work.

3.04 JOINT RESTRAINTS

A. Install per manufacturer's instructions and recommendations.

B. Reference 3.01, General Installation Requirements.

3.05 ABOVEGROUND BLACK STEEL PIPE AND FITTINGS

A. Piping Routing:

1. Route piping, except as otherwise indicated, vertically and horizontally (sloped to drain). Avoid diagonal runs wherever possible. Orient horizontal routes parallel with walls and beam lines.

2. Install piping as shown or described by diagrams, details and notations on Drawings or, if not indicated, install piping to provide the shortest route which does not obstruct usable space or block access for servicing the building and its equipment.

3. Install piping in concealed spaces above finished ceilings. Prior to design and installation. obtain pre-approval by Architect for exposed piping.

4. In open-to-structure areas which are open to public view, route exposed piping to minimize visual impact. Obtain Architect's and Engineer's approval of exposed piping installation.
5. Coordinate installation with other trades. Route piping as required to avoid building structure, equipment, plumbing piping, HVAC piping, ductwork, lighting fixtures, electrical conduits and bus ducts and similar work. Final location of lighting will have priority over final sprinkler locations. Provide drains to trapped sections of system which result from such routing. Other trades take precedence for installation space.
6. Support piping adjacent to walls, overhead construction, columns and other structural and permanent enclosure elements of the building. Limit clearance to 2-inches wherever furring is indicated for concealment of piping. Allow for insulation thickness. Locate insulated piping to provide minimum 1-inch clearance outside insulation.
7. Wherever possible in finished and occupied spaces, conceal piping from view by locating within column or beam enclosures, hollow wall construction, or above suspended ceilings. Do not encase horizontal routes in solid partitions, except where approved.
8. General Electrical Equipment Clearances: Do not route piping through electrical rooms, transformer vaults, elevator equipment rooms and other electrical or electronic equipment spaces and enclosures. Do not route piping above electric power or lighting panel, switchgear, low voltage panel, or similar electric device.
9. Rooms Protected by Alternative Systems: Route water filled and dry system piping around rooms protected by pre-action systems, clean agent systems, gaseous suppression systems and other alternative fire suppression systems.
10. Install pipe runs to minimize obstruction to other work.
11. Pitch all dry and pre-action system piping 1/4-inch per 10-feet for mains and 1/2-inch per 10-feet for branch lines, including pipe passing through both warm and cold areas.

B. Couplings:
1. Install where indicated on Drawings and on each side of pieces of equipment to permit easy removal of equipment.
2. Deburr cut edges.

C. Pipe Penetrations: Wire pipe cutout coupon at point of pipe penetration.

D. Pipe and Pipe Fittings:
1. Expansion and Flexibility: Install work with due regard for expansion and contraction to prevent damage to the piping, equipment, building and its contents. Provide piping offsets, loops, approved type expansion joints, sway bracing, wire restraints, vertical restraints, flexible couplings or other means to control pipe movement and to minimize pipe forces.
2. Coordinate support of pipe 4-inches and larger with Structural Engineer.
3. Provide clearances around piping per NFPA 13.
4. Install dry and pre-action welded pipe with welds facing vertically up, or where this is not possible, as close as possible to vertical between 46 degrees and 234 degrees. Intent is to minimize corrosion caused by moisture in the bottom of pipes.

3.06 WALL AND FLOOR PENETRATIONS AND SLEEVES

A. Escutcheons: Install on exposed pipes passing through walls or floors.
1. Pipe Sleeves: Lay out work in advance of pouring concrete and furnish and set sleeves necessary to complete work.

2. Floor Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Extend sleeve 1-inch above finished floor. Caulk pipes passing through floor with nonshrinking fire and water resistant grout or approved equivalent caulking compound. Caulk/seal piping passing through fire rated building assembly with UL rated assemblies. Provide fire-rated assemblies per local AHJ requirements.
3. Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk pipes passing through walls with non-shrinking caulking compound. Caulk/seal piping passing through fire-rated building assemblies with UL Listed or FM Approved fire-rated firestopping compound. Provide fire-rated assemblies per local AHJ requirements.
4. Beam Sleeves: Coordinate with trades for locations of pipe sleeves in reinforced concrete and steel beams. Penetrations must be indicated on structural shop drawings. See Drawings and Specifications for specific sleeve location limitations. Pipe sleeve locations must be indicated on reinforced concrete and steel beam shop drawings. Field cutting of beams not allowed without written approval of structural engineer. No extra costs allowed for failure to coordinate beam penetrations prior to reinforced concrete and steel beam shop drawing submittal.
5. Penetrations in Fire-Rated Wall/Floor Assemblies:
    a. Reference Division 07, Thermal and Moisture Protection.
    b. Coordinate with Drawings location of fire rated walls, ceilings and floors. When these assemblies are penetrated, seal around piping and equipment with approved firestopping material.
    c. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814 and NFPA.
    d. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814.

3.07 SWITCHES, VALVE SUPERVISORY

A. Coordinate with Division 28, Electronic Safety.

3.08 SWITCHES, WATER DETECTOR

A. Wire pipe cutout coupon at point of connection of switch to pipe.

B. Flow switches: Connect to system side of valves and drain connections.

C. Coordinate with Division 28, Electronic Safety.

3.09 HANGERS AND SUPPORTS

A. Installation of pipe hangers, inserts and supports to conform to NFPA 13. Provide adjustable hangers, inserts, brackets, clamps, supplementary steel and other accessory materials required for proper support of pipe lines and equipment. Provide supplementary materials for proper support and attachment of hangers.

3.10 STRUTS AND STRUT CLAMPS

A. Install per manufacturer's listed orientation.

3.11 SWAY BRACES AND RESTRAINTS

A. Locate per orientation and spacing as required by sway brace calculations.

B. Attach sway bracing directly to pipe or equipment being braced.

C. Do not attach sway bracing to bottom of truss members.

3.12 ANCHORS AND ATTACHMENTS

A. In post-tension construction, determine location of post-tension cables and install anchors to avoid contact or interference with post-tension cables. Coordinate with Structural.

B. Do not use powder-driven attachments.

C. Building Attachments and Inserts: Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves and flanges, for sizes NPS 2-1/2 and larger. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

D. Hanger and Support Attachments:

1. Concrete:

a. Before Pouring: Prior to installation, coordinate locations of cast in place concrete inserts with other trades. Install in accordance with manufacturer's instructions.

b. After Pouring:

1) Where supports in slabs are required after concrete has been poured, provide drilled-in threaded inserts (mechanical-expansion anchors), installed in accordance with manufacturer's recommendations.

2) Install mechanical-expansion anchors after concrete is completely cured and in accordance with manufacturer's installation instructions.

3) Where anchors are to be installed in post-tension construction, determine and avoid locations of post-tension cables prior to drilling.

2. Metal Floor Deck: Support hangers per UL Listing or FM Approval for selected concrete insert before pouring of concrete topping, or from beam clamps fastened to structural steel.

3. Steel Joists: Support hangers from beam clamps fastened to bar joists or to auxiliary steel between bar joists as required.

4. C-Clamp Hangers: Do not attach to one side of double-angle bottom members.

5. Locate and install hangers, supports and attachments connecting to I-joists, structural insulated panels (SIPs), cross laminated timber and similar engineered structural products according to the structural product manufacturer specifications.

E. Make available to the Architect information required to verify the anchorage, sway bracing and restraint of fire protection systems.

3.13 PIPE STANDS

A. Secure to floor.

B. Install to maintain pipe level and plumb.

C. Securely attach to supported pipe by u-bolt.

3.14 GAUGES

A. Install gauges conveniently and accessibly located with reference to finished building for repairs, removal and service.

B. Install with dial positioned for maximum visibility.

3.15 BELLS

A. Locate exterior alarm bells at 8-feet above finished grade. Coordinate with Architect.

B. Coordinate with Divisions 26, Electrical and Division 28, Electronic Safety.

3.16 FIRE DEPARTMENT CONNECTION

A. Locate with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.

B. Provide method of draining FDC piping. Drain to sanitary sewer by indirect connection, or to exterior where damage, including damage to landscaping and staining of concrete, will not occur.

C. Locate away from building egress paths. Coordinate location with Fire Marshal.

3.17 VALVES

A. General:

1. Provide post indicator on buried control valves.
2. Inspect valves for leaks. Adjust or replace packing to stop leaks. Replace valve if leak persists.

B. Installation:

1. Install valves where required for proper operation, testing and drainage. Locate valves so as to be accessible and so that separate support can be provided when necessary. Install conveniently and accessibly located with reference to finished building for repairs, removal and service.
2. Swing Check Valves: Install in horizontal position with hinge pin horizontally perpendicular to centerline of pipe. Install for proper direction of flow.
3. Wafer Check Valves: Install between two flanges in horizontal or vertical position, position for proper direction of flow.

C. Pressure Relief Valves: Provide piping to permanent drain.

3.18 BACKFLOW PREVENTION DEVICES

A. Install conveniently and accessibly located with reference to finished building for repairs, removal and service.

B. Provide listed backflow assembly at sprinkler system water source connection. Coordinate with local utility; conform to their installation requirements.

C. Provide method of forward flow testing at full system demand without dismantling any part of the system. Indicate location, method of testing and location of test drain discharge on submittal and As-Built Drawings. Provide signage as required by NFPA 13. Locate drainage for forward testing where damage will not occur, including damage to landscaping.

D. Chain and padlock in "open" position. Provide two sets of keys.

E. Provide control valve supervisory switches connected to the fire alarm system.

F. Reduced Pressure Backflow Preventer:

1. Locate within 5-feet of finished floor near drain shown on Plumbing Drawings or an existing drain of sufficient size which can accept full discharge of relief valve without doing damage or arrange and pay for installation of a suitable size drain.
2. Provide drain piping to sanitary sewer. Coordinate with Division 22, Plumbing.

3.19 PIPE, VALVE, AND FIRE PROTECTION EQUIPMENT IDENTIFICATION

A. Install engraved plastic laminate or corrosion resistant metal sign or plastic equipment marker, secured with corrosion-resistant chain or permanent adhesive on or near each Item of fire suppression equipment and each operational device, as specified in this specification if not otherwise specified for each Item or device.

B. Provide signs for the following general categories of equipment and operational devices: Valves, drains, pumps, standpipes, tanks and similar equipment.

C. Each new piece of equipment to bear a permanently attached identification plate, listing manufacturer's name, capacities, sizes and characteristics.

D. Piping to bear the manufacturer's name, schedule of thickness, size and ASTM identification number

E. Provide valve tag on every valve, control device, main drain, auxiliary drain, and drum drip in each system. Exclude check valves and valves within factory fabricated equipment units. List each tagged valve in valve schedule for each piping system.

F. List each tagged item and its location in valve schedule; identify on fire suppression drawings.

G. Install framed, glass or rigid transparent plastic covered, mounted valve schedule and valve location drawing in main riser or fire pump room.

H. Provide identification sign on ceiling tile below valve location.

I. Provide permanent identification sign at pressure regulating valves stating required setting of pressure regulator.

J. Adjusting: Relocate fire suppression identification device which has become visually blocked.

K. Cleaning: Clean face of identification devices and glass frames of valve charts.

3.20 SIGNS

A. General Information Signs: Provide a general information sign used to determine system design basis and information relevant to the inspection, testing and maintenance requirements required by NFPA 25, Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems. Such general information is to be provided with a permanently marked weatherproof metal or rigid plastic sign, secured with corrosion-resistant wire, chain, or other acceptable means. Such signs are to be placed at each system control rise loop and auxiliary system control valve. The sign is to include the following information:

1. Name and Location of the Facility Protected
2. Presence of High-Piled and/or Rack Storage
3. Maximum Height of Storage Planned
4. Flow Test Data
5. Location of Auxiliary Drains and Low Point Drains
6. Original Results of Main Drain Flow Test
7. Name of Installing Contractor or Designer
8. Indication of presence and location of other auxiliary systems.

B. Dry Signs: At system riser supplying dry systems, provide the following information: volume in gallons contained in each system.

3.21 DRAINS

A. Locate drain connections within 7-feet of floor. Provide piping capable of being fully drained.

B. Provide a drain vent at top of vertical drains. Coordinate with Division 22, Plumbing.

C. Coordinate location of auxiliary drains with Architect. Architect to approve location before drain is installed.

D. Protect drains from tampering and accidental operation.

E. Protect drain discharge at the exterior with a turned-down 45 degree elbow.

END OF SECTION

SECTION 21 12 00
FIRE SUPPRESSION STANDPIPES

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Fire Suppression Hose Valves
   2. Roof Hydrant Connections
   3. Hydraulic Information Signs

B. This is a contractor designed system. Contact AHJ prior to bid and provide required fire system components as prescribed by governing codes as interpreted by AHJ.

C. Scope: Hydraulically Calculated
   1. Class I Manual Wet Pipe Standpipe System
   2. Combination Sprinkler Riser and Class I Manual Wet Standpipe System

1.02 RELATED SECTIONS

A. Contents of Division 21, Fire Suppression and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:
   1. Division 22, Plumbing
   2. Division 23, Heating, Ventilating and Air-Conditioning
   3. Division 26, Electrical
   4. Division 28, Electronic Safety
   5. Section 21 00 00, Fire Suppression Basic Requirements
   6. Section 21 05 00, Common Work Results for Fire Suppression
   7. Section 21 13 00, Fire Suppression Sprinkler Systems

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

B. Provide hydraulic calculations for the standpipe system.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

B. System Test:
   1. Hydrostatically test entire system in accordance with NFPA 14.
   2. Test to be Witnessed by:
      a. Fire Marshal
      b. AHJ
      c. Owner's Insurance Underwriter
      d. Engineer

1.06 WARRANTY

A. Warranty of materials and workmanship as outlined in Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Fire Suppression Hose Valves:
   1. Potter Roemer
   2. Guardian Fire Equipment
   3. Fire End & Croker Corporation
   4. Or approved equivalent.

B. Roof Hydrant Connections:
   1. Potter Roemer
   2. Guardian Fire Equipment
   3. Fire End & Croker Corporation
   4. Or approved equivalent.

C. Hydraulic Information Signs:
   1. Tyco Fire Products
   2. Reliable Automatic Sprinkler
   3. Viking Corporation
   4. Allied Rubber and Gasket Company, Incorporated, dba ARGCO
   5. Fire Protection Products, Inc.
   6. Or approved equivalent.

2.02 FIRE SUPPRESSION HOSE VALVES

A. Non Adjustable Type with Cap and Chain on Hose Outlet
B. 2-1/2-inches Nominal Size
C. 300 PSIG Working Pressure
D. Thread to match fire department hardware.
E. Threaded cap and chain of same material and finish.

2.03 ROOF HYDRANT CONNECTIONS

A. Free-Standing Type
B. Ductile Iron Finish
C. 2-1/2-inch Size
D. 300 PSIG Working Pressure
E. Thread to match fire department hardware.
F. Threaded cap and chain of same material and finish.
G. Sign marked "Manual Standpipe for Fire Department Use Only."
H. Sign marked "Automatic Standpipe".
I. Provide freeze protected, supervised control valve with wall post indicator or post indicator remote actuator. Reference Section 21 05 00, Common Work Results for Fire Suppression.

2.04 HYDRAULIC INFORMATION SIGNS

A. Plastic laminate or corrosion resistant metal.
B. Corrosion-resistant chain or permanent adhesive.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Install per manufacturer's instructions and written requirements.
B. See articles below for specific requirements.
C. Connect wet standpipe system to water source ahead of domestic water connection.

D. Provide additional drains as required to achieve proper drainage of the standpipe system.

E. Provide connection for alarm and supervisory control to building alarm system.

F. Provide standpipes during construction.

G. For each connection from a standpipe that is part of a combined system to a sprinkler system, provide an individual control valve and check valve of the same size as the connection. If the control valve is a combination type pressure regulating that acts as a check valve, provide a separate isolating control valve between the pressure regulating device and the standpipe system.

3.02 FIRE SUPPRESSION HOSE VALVES

A. Locate angle valve at 60-inches above floor.

B. Provide additional drains as required to achieve proper drainage of the standpipe system.

C. Provide a minimum 2-inch drain riser with top vent and top gauge located in a freeze protected area.

D. Provide a minimum 3-inch drain riser, with top vent and top gauge, located in a freeze protected area and test connections at each hose valve, adjacent to each standpipe riser for testing of pressure reducing style hose valves.

E. Locate hose valves on floor level landings of stairwells.

F. Locate hose valves so all parts of the building can be reached by 100-feet of hose plus a 30-foot stream of water. Measure distance along path of travel originating at hose connection.

G. Locate valves in cabinets that are not located in stairwells.

H. Where residual pressure exceeds 100 PSI at any 1-1/2-inch hose connection, provide a pressure reducing valve to prevent the residual pressure at the connection at the required flow from exceeding 100 PSI.

I. Where static pressure exceeds 175 PSI, provide a pressure reducing valve to prevent the static and residual pressures at the outlet of the hose connection to 100 PSI for 1-1/2-inch hose connections and 175 PSI for 2-1/2-inch connections.

J. Hose Valve Connections: Locate with sufficient clearance from walls and obstructions so as to not interfere with the prompt use of the hose connection, hose and other equipment at the time of fire.

3.03 ROOF HYDRANT CONNECTIONS

A. Provide connection for alarm and supervisory control to building alarm system.

B. Provide freeze protected control valve with indicator post where roof hydrants are subject to freezing.

C. Locate with sufficient clearance from walls and obstructions so as to not interfere with the prompt use of the hose connection, hose and other equipment at the time of fire event.

3.04 HYDRAULIC INFORMATION SIGNS

A. Locate at water supply control valve for automatic or semiautomatic systems.

B. Include the Following Information:

1. Location, design flow rate and design residual inlet and outlet pressures for the two hydraulically most remote hose connections.

2. Design static pressure and design system demand (flow and residual pressure) at the system control valve.

END OF SECTION

SECTION 21 13 00
FIRE SUPPRESSION SPRINKLER SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Sprinklers
   2. Flexible Sprinkler Hose Fitting Assembly - For fire sprinklers in suspended ceilings which are supplied by a wet pipe system.
   3. Oversized Sprinkler Escutcheons - For dry sprinklers in suspended ceilings which are supplied by a wet pipe or dry pipe system.
   4. Riser Manifold
   5. Inspector's Test Connection
   6. Dry-Pipe Valve
   7. Dry System Drum Drip Drains
   8. Nitrogen System
   9. Wet System Air Vent
   10. Spare Sprinkler Cabinet
   11. Sprinkler Guards

B. This is a contractor designed system. Contact AHJ prior to bid to verify fire system requirements. Provide design compliant with codes as interpreted by AHJ.

C. Scope:
   1. Wet-Pipe Sprinkler System.
   2. Dry-pipe sprinkler system and/or dry barrel sprinklers for areas subject to 40 degrees F or less.
   3. Private fire service main running from 5-feet outside the building to the inlet connection inside the building. Provide required valves and appurtenances.

D. Coordinate location and type of tamper, flow and pressure switches and fire alarm system.

E. Provide electrical connections and wiring as required for a complete and operable system. Includes but is not limited to bells, air compressors, sump pumps, fire pumps, jockey pumps and pump controllers.

1.02 RELATED SECTIONS

A. Contents of Division 21, Fire Suppression and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:
   1. Division 22, Plumbing
   2. Division 23, Heating, Ventilating and Air-Conditioning
   3. Division 26, Electrical
   4. Division 28, Electronic Safety
   5. Section 21 00 00, Fire Suppression Basic Requirements
   6. Section 21 05 00, Common Work Results for Fire Suppression
   7. Section 21 12 00, Fire Suppression Standpipes

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Hydraulic calculations.
2. Sway brace calculations.
3. Details of sway bracing.
4. Details of interval and end of branch line restraints.
5. Details of flexible sprinkler hose fitting assembly, including number and radius of bends, corresponding to equivalent feet used in hydraulic calculations. Provide details of sign to be installed at each flexible sprinkler hose fitting assembly.
6. Details of oversized ceiling penetrations and oversized sprinkler escutcheons.
7. Trapeze hanger details and calculations, including size, length and material. Additionally, provide size, weight and number of pipes to be carried on the trapeze.
8. On submittal and As-Built drawings, provide text of sprinkler list to be installed in the spare sprinkler cabinet.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.07 SYSTEM DESCRIPTION

A. Provide coverage for entire building. Field verify field conditions prior to submittal of bid. Adjust bid to provide protection features in accordance with applicable codes and interpretations by AHJ. Provide design and installation based on more stringent requirements if this specification and AHJ requirements differ from Code.

B. Design Parameters:

1. Building Area: _____.
   a. Occupancy Classification: Light.
2. Building Area: _____.
   a. Occupancy Classification: Ordinary Group 1.
3. Building Area: _____.
   a. Occupancy Classification: Ordinary Group 2.
4. Design parameters above are NFPA 13 minimums. Provide increased design densities, design areas and hose allowances to meet requirements of AHJ.

C. Sprinkler system design to include a 10 percent pressure and flow cushion between system demand point and available water supplies.

D. Extend hydraulic calculations from hydraulically most remote design area back to location of pressure hydrant of flow test or effective point of water supply where characteristics of water supply are known.

1.08 EXTRA STOCK

A. Provide extra sprinklers per code.

B. Provide suitable wrenches for each sprinkler type and metal storage cabinet in riser room.

1.09 CONTROL VALVES

A. Sprinkler system control valves to be OS&Y or butterfly valves located inside building in a room with outside door.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Sprinklers:
   1. Finished Areas:
      a. Victaulic
      b. Viking
      c. Tyco
      d. Reliable
      e. Globe
      f. Senju
      g. Or approved equivalent.
   2. Nonfinished Areas:
      a. Victaulic
      b. Viking
      c. Tyco
      d. Reliable
      e. Globe
      f. Or approved equivalent.
   3. Dry Sprinklers:
      a. Victaulic
      b. Viking
      c. Tyco
      d. Reliable
      e. Or approved equivalent.

B. Flexible Sprinkler Hose Fitting Assembly:
   1. Victaulic; VicFlex.
   2. Flexhead Industries
   3. SprinkFLEX
   4. Allied Rubber and Gasket Company, Incorporated, dba ARGCO
   5. Reliable Automatic Sprinkler Company
   6. Tyco Fire and Building Products
   7. Viking Corporation
   8. Or approved equivalent.

C. Oversized Sprinkler Escutcheons:
   1. Victaulic; FireLock Expansion Plates.
   2. Viking Corporation; Expansion Plate.
   3. Tyco Fire Protection Products; Wide Adapter Plates.
   4. Reliable Automatic Sprinkler; Extender Rings.
   5. Globe Fire Sprinkler Corporation; Seismic Escutcheons.
   6. Or approved equivalent.

D. Riser Manifold:
   1. Viking EasyPac
   2. Reliable; Model CR.
   3. AGF; Model 8011.
   4. Tyco; Model RM-1

5. Or approved equivalent.

E. Inspector's Test Connection:
   1. Combination Test and Drain:
      a. Victaulic; Series 720 TestMaster II Alarm Test Module with pressure relief valve.
      b. AGF; Model 1011, 2511, 3011, with pressure relief valve.
      c. Or approved equivalent.
   2. Dry System Inspector's Test Connection:
      a. AGF; Model 3011.
      b. Or approved equivalent.

F. Dry-Pipe Valve:
   1. Victaulic; Model FireLock NXT.
   2. Viking; Model G-4000.
   3. Tyco; Model DPV-1.
   4. Or approved equivalent.

G. Dry System Drum Drip Drains:
   1. Custom Piping and Valves per NFPA 13.
   2. AGF; Collect an Drain, Model 5100A.
   3. AGF; Collect an Drain, Model 5200A.
   4. Or approved equivalent.

H. Nitrogen System:
   1. South-Tek
   2. Potter Electrical Signal
   3. Or approved equivalent.

I. Wet System Air Vent:
   1. Potter Electric Signal Company; Model PAV
   2. Or approved equivalent.

J. Spare Sprinkler Cabinet:
   1. Victaulic
   2. Fire Protection Products, Inc. (FPPI).
   3. Tyco Fire & Building Products
   4. Allied Rubber and Gasket Co.
   5. Potter Roemer Fire Pro.
   6. Or approved equivalent.

K. Sprinkler Guards:
   1. Victaulic
   2. Viking
   3. Tyco
   4. Reliable
   5. Globe
   6. Senju
   7. Or approved equivalent.

2.02 SPRINKLERS

A. Finished Areas:
   1. Type: Glass-Bulb

2. Style:
    a. Concealed
    b. Recessed
3. Response: Quick-Response
4. Finish:
    a. Chrome
    b. White Polyester
5. Escutcheon: White Polyester
6. Coverplate for Concealed Sprinklers:
    a. Flat Plate
    b. White

B. Nonfinished Areas:
1. Type: Glass-Bulb
2. Response: Quick-Response
3. Finish: Brass

C. Dry Sprinklers:
1. Type: Glass-Bulb
2. Style:
    a. Concealed
    b. Recessed
3. Response: Quick-Response
4. Finish:
    a. Chrome
    b. White Polyester
5. Escutcheon:
    a. Chrome
    b. White Polyester
6. Coverplate for Concealed Sprinklers:
    a. Flat Plate
    b. Chrome
    c. White
7. Dry Sprinkler Boot: Manufactured for use with the dry sprinkler it protects.

D. Pendent sprinklers supplied by dry or preaction piping: Dry pendent type.

2.03 FLEXIBLE SPRINKLER HOSE FITTING ASSEMBLY

A. Fully welded non-mechanical fittings, stainless steel, braided, leak-tested with minimum 1-inch true-bore internal corrugated hose diameter. 175 psi.

B. Ceiling Bracket: Galvanized steel, direct attachment type, with integrated snap-on clip ends and removable flexible hose attachment with set screw. FM1637, UL 2443.

C. Affix permanent sign, label or decal at each flexible sprinkler hose fitting assembly anchoring component limiting the relocation of the sprinkler.

2.04 OVERSIZED SPRINKLER ESCUTCHEONS

A. Metal.

B. Provide oversized ceiling penetrations and oversized sprinkler escutcheons for pendent sprinklers to comply with Building Code and ASCE-7 seismic requirements.

C. Same manufacturer as sprinklers.

2.05 RISER MANIFOLD

A. Water-flow alarm, gauge, integral pressure relief valve connected to drain, pressure gauge with 3-way gauge control valve and drain valve, integral pressure relief valve connected to drain, sight glass, smooth bore orifice union of same size as smallest orifice sprinkler installed. Provide cover tamper switch when required by AHJ.

2.06 INSPECTOR'S TEST CONNECTION

A. Combination Test and Drain: Bronze body, brass stem, impregnated Teflon seat, chrome coated brass ball, steel handle with positive stops, tamper resistant test orifice, integral tamper resistant sight glasses, tapped and plugged port for system access, steel identification plate. Provide with pressure relief valve and drainage piping with bronze body and stainless steel spring.

B. Dry System Inspector’s Test Connection: Bronze, brass stem, steel handle, chrome-plated bronze ball, Teflon valve seat, tamper and corrosion resistant orifice equivalent to smallest sprinkler orifice, sight flow connection.

2.07 DRY-PIPE VALVE

A. Differential or low pressure actuator type.

B. Trim as recommended by manufacturer for variable pressure service, including air maintenance device, electric low pressure alarm switch, priming valves and test, main drain and pressure gauges.

C. External reset.

2.08 DRY SYSTEM DRUM DRIP DRAINS

A. Normally open upper ball valve with lever handle.

B. Normally closed lower ball valve with lever handle.

2.09 NITROGEN SYSTEM

A. Complete system package from one manufacturer, consisting of: Nitrogen Generation System, Oilless Air Compressor, Building Monitoring System, Alarm Integration, Auto Purge System, Auto Purge Remote Annunciator and Supervisory Gas Monitoring and Air Maintenance Device. All components to be compatible with each other.

2.10 WET SYSTEM AIR VENT

A. Brass, UL 2573 with ball valve supervisory switch.

2.11 SPARE SPRINKLER CABINET

A. NFPA 13 Systems: Sized to accommodate a minimum of two spare sprinklers of each Sprinkler Identification Number (SIN), manufacturer, model, orifice, deflector type, temperature and thermal sensitivity, or a minimum of six sprinklers for facilities having under 300 sprinklers, or a minimum of 12 sprinklers for facilities having 300 to 1000 sprinklers, or a minimum of 24 sprinklers for facilities having over 1000 sprinklers, whichever is more.

B. Welded steel with hinged steel cover.

C. Red enamel or polyester coated finish inside and out.

2.12 SPRINKLER GUARDS

A. Metal.

B. Listed for use with sprinkler model to which it is attached.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Install per manufacturer's requirements and recommendations.

3.02 SPRINKLERS

A. Center sprinklers in center or quarter points of suspended ceiling tile.

B. Align sprinklers with architectural column lines, lighting, diffusers and other ceiling features. In unfinished ceilings, route piping to minimize visual impact. Sprinklers and piping not so aligned are to be removed and replaced at no additional cost to Owner.

C. Install dry sprinklers in a manner which does not trap water.

3.03 FLEXIBLE SPRINKLER HOSE FITTING ASSEMBLY

A. Install flexible sprinkler hose fitting assemblies where pendent sprinkler heads are located in acoustic ceiling tiles.

B. Install with no more bends than are included in equivalent footage used in hydraulic calculations.

C. Maintain manufacturer's recommended bending radius as included in equivalent footage used in hydraulic calculations.

D. Affix permanent sign, label or decal at each flexible sprinkler hose fitting assembly anchoring component limiting the relocation of the sprinkler.

3.04 OVERSIZED SPRINKLER ESCUTCHEONS

A. Coordinate oversized sprinkler escutcheons with ceiling construction and sprinkler style.

B. Provide for dry sprinkler penetrations in suspended ceilings.

3.05 RISER MANIFOLD

A. Install so valves and gauges are conveniently and accessibly located with reference to finished building for repairs, removal and service.

B. Provide connection to drain.

C. Pipe pressure relief valve to drain.

D. Install with supervised control valve(s) and check valve.

3.06 INSPECTOR'S TEST CONNECTION

A. Locate where full flow discharge or pressure relief valve discharge will not do damage, including damage to landscaping and will not cause dangerous conditions to walking surfaces or discoloration to building surfaces.

B. Locate within 5-feet of finished floor.

3.07 DRY-PIPE VALVE

A. Install with sufficient access for ease of reset.

3.08 DRY SYSTEM DRUM DRIP DRAINS

A. Locate within 7-feet of finished floor.

B. Coordinate drain locations with architect prior to design and installation of dry sprinkler system.

3.09 NITROGEN SYSTEM

A. Install per manufacturer's recommendations.

B. Provide a nitrogen purge valve at farthest point from nitrogen generator.

3.10 WET SYSTEM AIR VENT

A. Locate at a point in the system that will vent the most air.

B. Connect at top of pipe.

C. Locate so as not to interfere with sprinkler spray pattern.

D. Locate where it can be easily accessed for inspection and cleaning.

E. Pipe output of air vent to drain with an indirect connector or to exterior where it will not cause damage.

3.11 SPARE SPRINKLER CABINET

A. Attach to wall at the main sprinkler system riser.

B. Locate so cover is easy to open and readily accessible.

C. Locate in an area with a temperature between 40 and 100 degrees Fahrenheit (4 and 38 degrees Celsius).

D. Locate sprinkler wrenches inside cabinet.

E. Inside the cabinet, provide a list of sprinklers installed in the property, including sprinkler identification number, manufacturer, model, orifice, deflector type, thermal sensitivity and pressure rating, quantity of each type to be contained in the cabinet and issue or revision date of the list.

3.12 SPRINKLER GUARDS

A. Install per manufacturer's instructions and recommendations.

END OF SECTION

SECTION 22 00 00
PLUMBING BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Work included in 22 00 00, Plumbing Basic Requirements applies to Division 22, Plumbing work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of plumbing systems for proposed project.

B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.

C. Definitions:

1. Provide: To furnish and install, complete and ready for intended use.
2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.02 RELATED SECTIONS

A. Contents of Section applies to Division 22, Plumbing Contract Documents.

B. Related Work:

1. Additional conditions apply to this Division including, but not limited to:
   a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
   b. Drawings
   c. Addenda
   d. Owner/Architect Agreement
   e. Owner/Contractor Agreement
   f. Codes, Standards, Public Ordinances and Permits

1.03 REFERENCES AND STANDARDS

A. References and Standards per Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) ,Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, individual Division 22, Plumbing Sections and those listed in this Section.

B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:

1. State of Oregon:
   a. OAR - Oregon Administrative Rules

b. OESC - Oregon Electrical Specialty Code
c. OFC - Oregon Fire Code
d. OMSC - Oregon Mechanical Specialty Code
e. OPSC - Oregon Plumbing Specialty Code
f. OSSC - Oregon Structural Specialty Code
g. OEESC - Oregon Energy Efficiency Specialty Code

C. Reference standards and guidelines include but are not limited to the latest adopted editions from:

1. ABA - Architectural Barriers Act
2. ADA - Americans with Disabilities Act
3. AHRI - Air-Conditioning Heating & Refrigeration Institute
4. ANSI - American National Standards Institute
5. ASCE - American Society of Civil Engineers
6. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
7. ASHRAE Guideline 0, the Commissioning Process
8. ASME - American Society of Mechanical Engineers
9. ASPE - American Society of Plumbing Engineers
10. ASSE - American Society of Sanitary Engineering
11. ASTM - ASTM International
12. AWWA - American Water Works Association
13. CFR - Code of Federal Regulations
14. CGA - Compressed Gas Association
15. CISPI - Cast Iron Soil Pipe Institute
16. ETL - Electrical Testing Laboratories
17. EPA - Environmental Protection Agency
18. FM - FM Global
19. IAPMO - International Association of Plumbing and Mechanical Officials
20. GAMA - Gas Appliance Manufacturers Association
21. HI - Hydraulic Institute Standards
22. ISO - International Organization for Standardization
23. MSS - Manufacturers Standardization Society
24. NEC - National Electric Code
25. NEMA - National Electrical Manufacturers Association
26. NFGC - National Fuel Gas Code
27. NFPA - National Fire Protection Association
28. NRCA - National Roofing Contractors Association
29. NSF - National Sanitation Foundation
30. OSHA - Occupational Safety and Health Administration
31. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, Inc.
32. TEMA - Tubular Exchanger Manufacturers Association
33. TIMA - Thermal Insulation Manufacturers Association
34. UL - Underwriters Laboratories Inc.

D. See Division 22, Plumbing individual Sections for additional references.

1.04 SUBMITTALS

A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 22, Plumbing Sections.

B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.

C. In addition:

1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail or posted to ftp site. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. Deviations will be returned without review.
3. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 22, Plumbing Sections.
4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.
    a. Label submittal to match numbering/references as shown in Contract Documents and schedules. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
    b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference Division 22, Plumbing Sections for specific items required in product data submittal outside of these requirements.
    c. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.
    d. For vibration isolation of equipment, list make and model selected with operating load and deflection. Indicate frame type where required. Submit manufacturer's product data.
    e. See Division 22, Plumbing Sections for additional submittal requirements outside of these requirements.
5. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer’s comments. Identify Engineer’s comments and provide an individual response to each of the Engineer’s

comments. Cloud changes in the submittals and further identify changes which are in response to Engineer’s comments.

7. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-10 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
8. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 22, Plumbing Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.
9. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
10. Substitutions and Variation from Basis of Design:
    a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
    b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
11. Shop Drawings: Provide coordinated Shop Drawings which include physical characteristics of all systems, equipment and piping layout plans, and control wiring diagrams. Reference individual Division 22, Plumbing Sections for additional requirements for Shop Drawings outside of these requirements.
    a. Provide Shop Drawings indicating sanitary and storm cleanout locations and type to Architect for approval prior to installation.
    b. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.
12. Samples: Provide samples when requested by individual Sections.
13. Resubmission Requirements:
    a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
        1) Resubmit for review until review indicates no exception taken or "make corrections as noted".

2) When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.

14. Operation and Maintenance Manuals, Owner's Instructions:

a. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.

1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.

2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: belts, motors, lubricants, and filters.

3) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.

4) Include copy of startup and test reports specific to each piece of equipment.

5) Include copy of final water systems balancing log along with pump operating data.

6) Include commissioning reports.

7) Include copy of pressure, flow, leakage and purity test data and water systems test data, as applicable. Include copy of third-party and state and local jurisdiction inspection reports.

8) Include copy of valve charts/schedules.

9) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

10) Include product certificates of warranties and guarantees.

11) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.

b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 22 00 00, Plumbing Basic Requirements article titled "Demonstration".

c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.

15. Record Drawings:
    a. Maintain at site at least one set of drawings for recording “As-constructed” conditions. Indicate on Drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
    b. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.
    c. At completion of project, input changes to original project on Revit Model and make one set of black-line drawings created from Revit Model in version/release equal to contract drawings. Submit Revit disk and drawings upon substantial completion.
    d. At completion of project, show changes and deviations from the Drawings in red on one set of black-line drawings. Include written Addendums, RFIs, and change order items. Make changes to Drawings in a neat, clean, and legible manner.
    e. Provide Invert elevations and dimensioned locations for water services, building waste, and storm drainage piping below grade extending to 5-feet outside building line.
    f. See Division 22, Plumbing individual Sections for additional items to include in record drawings.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.

B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.

C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturers equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.

D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.

E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.

F. Provide products that are UL listed.

G. Piping Insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

H. All potable water system components, devices, material, or equipment containing a weighted average of greater than 0.25 percent lead are prohibited, and shall be certified in accordance with current editions of the Safe Drinking Water Act (SDWA), NSF 61 &

NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61.

I. ASME Compliance: ASME listed water heaters and boilers with an input of 200,000 BTUH and higher, hot water storage tanks which exceed 120 gallons, and hot water expansion tanks which are connected to ASME rated equipment or required by code or local jurisdiction.

J. Provide safety controls required by National Boiler Code (ASME CSD 1) for boilers and water heaters with an input of 400,000 BTUH and higher.

1.06 WARRANTY

A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Contracting and Procurement Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty in Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.07 COORDINATION DOCUMENTS

A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, plumbing equipment/fixtures, fire sprinklers, plumbing, cable trays, lights, and electrical services with architectural and structural requirements, and other trades (including ceiling suspension, and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.

B. Advise Architect in the event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.

C. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.

D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

1.08 WORK INCLUDED

A. Furnish and install sleeves, inserts and anchorage required for the installation, which are embedded in work of other trades. Sleeve, wrap and seal piping in concrete.

B. Electrical: For plumbing trim/devices/equipment, provide, from the line voltage connection by Division 26, the low voltage electrical connections and wiring as required for complete and operable system. Includes, but is not limited to: Low voltage electrical raceway, wiring and accessories, such as step-down transformers as necessary for function of sensors and automatic valve and faucet controls. Supply step-down transformers and size wiring as recommended by manufacturer of plumbing trim/faucets requiring electrical low voltage connection.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer, including but not limited to fixtures, pumps, drains and equipment.

2.02 STANDARDS OF MATERIALS AND WORKMANSHIP

A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or ETL approved or have adequate approval or be acceptable by State, County, and City authorities.

B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.

C. Hazardous Materials:

1. Comply with local, State of Oregon, and Federal regulations relating to hazardous materials.
2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.01 ACCESSIBILITY AND INSTALLATION

A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

B. Install equipment requiring access (i.e., drain pans, drains, control operators, valves, motors, cleanouts and water heaters) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.

C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.

D. Earthwork:

1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
    a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with the provisions of related earthwork Sections/divisions. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
    b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
    c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.

E. Firestopping:

1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
    a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's

installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

F. Pipe Installation:

1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating for coordinating installation of piping systems.
2. Include provisions for servicing and removal of equipment without dismantling piping.

G. Plenums:

1. Provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

3.02 SEISMIC CONTROL

A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 22 Plumbing Sections.

B. General:

1. Earthquake resistant designs for Plumbing (Division 22) equipment and distribution, i.e. motors, plumbing systems, piping, equipment, water heaters, boilers, etc. to conform to regulations of jurisdiction having authority.
2. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.
3. Provide stamped Shop Drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for piping equipment and water heaters. Submit Shop Drawings along with equipment submittals.
4. Provide stamped Shop Drawings from licensed Structural Engineer of seismic flexible joints for piping and crossing building expansion or seismic joints. Submit Shop Drawings along with seismic bracing details.

C. Piping:

1. Per "Seismic Restraints Manual Guidelines for Mechanical Systems" latest edition published by SMACNA or local requirements.

D. Provide means to prohibit excessive motion of plumbing equipment during earthquake.

3.03 REVIEW AND OBSERVATION

A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:

1. Prior to covering walls.
2. Prior to ceiling cover/installation.
3. When main systems, or portions of, are being tested and ready for inspection by AHJ.

C. Bear responsibility and cost to make piping accessible, to expose concealed lines, or to demonstrate acceptability of the system. If Contractor fails to notify Architect at times prescribed above, costs incurred by removal of such work are the responsibility of the Contractor.

D. Final Punch:

1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Plumbing Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the plumbing systems are ready for final punch.
2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.04 CONTINUITY OF SERVICE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:

1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new piping, and wiring to point of connection.
3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
    a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
4. Organize work to minimize duration of power interruption.

3.05 CUTTING AND PATCHING

A. Confirm Cutting and Patching requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:

1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing piping and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.

5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.06 EQUIPMENT SELECTION AND SERVICEABILITY

A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

3.07 DELIVERY, STORAGE AND HANDLING

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:

1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt and/or dust as a result of improper storage to be replaced before installation.
2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
3. Protect bright finished shafts, bearing housings and similar items until in service.

3.08 DEMONSTRATION

A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.09 CLEANING

A. Confirm cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.10 INSTALLATION

A. Confirm installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.

C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

1. Do not place equipment in sustained operation prior to initial balancing of plumbing systems.
2. Provide pump impellers to obtain Basis of Design design capacities.

D. Provide miscellaneous supports/metals required for installation of equipment and piping.

3.11 PAINTING

A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:

1. Ferrous Metal: After completion of plumbing work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt for exterior or black enamel for interior, suitable for hot surfaces.
2. In a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
3. See individual equipment Specifications for other painting.
4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
5. Piping: Clean, primer coat and paint exposed piping on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.
6. Covers: Covers such as manholes, cleanouts and the like will be furnished with finishes which resist corrosion and rust.

3.12 DEMOLITION

A. Confirm Demolition requirements in Division 01, General Requirements and Division 02, Existing Conditions. In absence of specific requirements, comply with individual Sections in Division 22, Plumbing and the following:

1. Scope:
   a. It is the intent of these documents to provide necessary information and adjustments to plumbing system required to meet code, and accommodate installation of new work.
   b. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas.
   c. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve underground utilities. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.
2. Equipment: Unless otherwise directed, equipment, fixtures, or fittings being removed as part of demolition process are Owner's property. Remove other items not scheduled to be reused or relocated from job site as directed by Owner.
3. Unless specifically indicated on Drawings, remove exposed, unused piping to behind finished surfaces (floor, walls, ceilings, etc.). Cap piping and patch surfaces to match surrounding finish.
4. Unless specifically indicated on Drawings, remove unused equipment, fixtures, fittings, rough-ins, and connectors. Removal is to be to a point behind finished surfaces (floors, walls, and ceilings).

3.13 ACCEPTANCE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Sections in Division 22, Plumbing and the following:

1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
   a. Testing and Balancing Reports
   b. Cleaning
   c. Operation and Maintenance Manuals
   d. Training of Operating Personnel
   e. Record Drawings
   f. Warranty and Guaranty Certificates
   g. Start-up/Test Document and Commissioning Reports

3.14 FIELD QUALITY CONTROL

A. Confirm Field Quality Control requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

B. Tests:
   1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in operation and maintenance manuals.
   2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.15 LETTER OF CONFORMANCE

A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that plumbing items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

3.16 ELECTRICAL INTERLOCKS

A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize plumbing equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

END OF SECTION

SECTION 22 05 16
EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Flexible Pipe Connectors, Steel Piping
   2. Flexible Pipe Connectors, Copper Piping
   3. Flexible Expansion Loop (for Thermal and Seismic Applications), Copper Piping
   4. Expansion Joints, Single Sphere, Flexible Compensator
   5. Expansion Joints, Two-Ply Bellows Type Copper Pipe

1.02 RELATED SECTIONS

A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilites-development/technical-standards) Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements. Include items listed below.

B. In addition, provide:
   1. Shop drawings for review and approval by Engineer. Illustrate Design Data and Expansion Joints items below on the Shop Drawing Submittal.
   2. Design Data: Indicate selection calculations.
   3. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
   4. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.
   5. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
      a. Extra Packing for Packed Expansion Joints: One set for each joint.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Flexible Pipe Connectors, Steel Piping:
   1. Mercer Rubber Company
   2. Metraflex Company
   3. Mason
   4. Hyspan
   5. Or approved equivalent.

B. Flexible Pipe Connectors, Copper Piping:
   1. Mercer Rubber Company

2. Metraflex Company
3. Mason
4. Hyspan
5. Or approved equivalent.

C. Flexible Expansion Loop (for Thermal and Seismic Applications), Copper Piping:
1. Mercer Rubber Company
2. Metraflex Company
3. Mason
4. Hyspan
5. Or approved equivalent.

D. Expansion Joints, Single Sphere, Flexible Compensator:
1. Mercer Rubber Company
2. Metraflex Company
3. Mason
4. Hyspan
5. Or approved equivalent.

E. Expansion Joints, Two-Ply Bellows Type Copper Pipe:
1. Mercer Rubber Company
2. Metraflex Company
3. Mason
4. Hyspan
5. Or approved equivalent.

2.02 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

A. 304 stainless steel, close pitch, annular corrugated hose.

B. Exterior Sleeve: Single braided (for higher pressure systems), 304 stainless steel.

C. Pressure Rating: 125 psi at 70 degrees F for 12-inch pipe (single braid) (862 kPa and 232 degrees C).

D. Joint: ANSI Class 150 carbon steel flanges.

E. Size: Use pipe sized units.

F. Maximum Offset: 3/4 inch (20 mm) on each side of installed center line.

G. Basis of Design: Metraflex Model MLP.

2.03 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

A. Inner Hose: Bronze, close pitch, annular corrugated hose.

B. Exterior Sleeve: Braided bronze (piping over 2-inches to be 3 pound braided stainless steel).

C. Pressure Rating: 125 PSI at 70 degrees F with a 4 to 1 safety factor.

D. Joint: Sweat ends.

E. Size: Use pipe sized units.

F. Maximum offset: 3/8-inch on each side of installed center line.

G. Basis of Design: Metraflex Model BBS.

2.04 FLEXIBLE EXPANSION LOOP (FOR THERMAL AND SEISMIC APPLICATIONS) - COPPER PIPING

A. Construction: Two flexible Sections of hose and braid, two 90 degree elbows and a 180 degree return designed so piping does not change direction, but maintains course along a single axis. Use Vee Loop where space is limited. System to import no thrust loads to system support anchors or building structure.

B. Inner Hose: Bronze, close pitch, annular corrugated hose.

C. Exterior Sleeve: Braided bronze.

D. Pressure Rating: 125 PSI at 70 degrees F with a 4 to 1 safety factor.

E. Joint: Sweat ends.

F. Size: Use pipe sized units.

G. Support: Center support at bottom of 180 degree return.

H. Basis of Design: Metraflex Metraloop. Vee configuration Mason-Mercer VCPSB.

2.05 EXPANSION JOINTS - SINGLE SPHERE, FLEXIBLE COMPENSATOR

A. Body: Teflon.

B. Pressure Rating, Sizes 3/4-inch to 2-inch: 150 psi and 210 degrees F.

C. Pressure Rating, Sizes 1-1/2-inch to 12-inch: 150 psi and 250 degrees F (1040 kPa and 121 degrees C).

D. Pressure Rating, Sizes 14-inch to 24-inch: 105 psi and 250 degrees F (725 kPa and 121 degrees C).

E. Maximum Compression: 1/2-inch ().

F. Maximum Elongation: 3/8-inch (10 mm).

G. Maximum Offset: 3/8-inch (10 mm).

H. Maximum Angular Movement: 15 degrees.

I. Joint: Tapped steel flanges.

J. Size: Use pipe sized units.

K. Accessories: Control rods.

L. Application: Steel piping 2-inches and over.

2.06 EXPANSION JOINTS - TWO PLY BELLOWS TYPE COPPER PIPE

A. Construction: Laminated bellows ASTM A240 Type 321 stainless steel, copper tube ASTM B88, ASTM A240 Type 321 stainless steel housing and guide, anti torque device, limit stops, internal guides

B. Working Pressure: 200 PSI.

C. Maximum Temperatures: 500 degrees F.

D. Maximum Compression: 2-inches.

E. Maximum Extension: 1/2-inch.

F. Joint: Sweat ends. ASME B16.22.

G. Size: Use pipe sized units. Maximum 4-inch pipe.

H. Basis of Design: Hyspan Model 8509, 8510.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Expansion/Contraction Fitting Installation:

1. Install expansion/contraction fittings according to manufacturer's written instructions.
2. Install expansion/contraction fittings in sizes matching pipe size in which they are installed.
3. Align expansion/contraction fittings to avoid end-loading and torsional stress.
4. Install in accordance with EJMA (Expansion Joint Manufacturer's Association) Standards.
5. Wood structures: install expansion/contraction fittings and guides at every floor.
6. Concrete structures: install expansion/contraction fittings and guides at interval spacing recommended by the manufacturers.

B. Pipe Bend and Loop Installation:
   1. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
   2. Attach pipe bends and loops to anchors.
      a. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code Section IX, "Welding and Brazing Qualifications."
      b. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

C. Swing Connections:
   1. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
   2. Connect mains, risers and branch connections to equipment with at least four pipe fittings, including tee in riser.

D. Guide Installation:
   1. Install guides on piping adjoining expansion fittings and loops.
   2. Attach guides to pipe and secure to building structure.

E. Anchor Installation:
   1. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
   2. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
   3. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
   4. Install pipe anchors according to expansion fitting manufacturer's written instructions if expansion fittings are indicated.
   5. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

F. Painting:
   1. Touch Up: 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-PA1 requirements for touching up field-painted surfaces.
      a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
   2. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

3.02 FLEXIBLE PIPE CONNECTORS, STEEL PIPING

A. See General Installation Requirements above.

B. Install per manufacturers written recommendations and requirements.

3.03 FLEXIBLE PIPE CONNECTORS, COPPER PIPING

A. See General Installation Requirements above.

B. Install per manufacturers written recommendations and requirements.

3.04 FLEXIBLE EXPANSION LOOP (FOR THERMAL AND SEISMIC APPLICATIONS), COPPER PIPING

A. See General Installation Requirements above.

B. Install per manufacturers written recommendations and requirements.

3.05 EXPANSION JOINTS, SINGLE SPHERE, FLEXIBLE COMPENSATOR

A. See General Installation Requirements above.

B. Install per manufacturers written recommendations and requirements.

3.06 EXPANSION JOINTS, TWO-PLY BELLOWS TYPE COPPER PIPE

A. See General Installation Requirements above.

B. Install per manufacturers written recommendations and requirements.

END OF SECTION

SECTION 22 05 19
PLUMBING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Pressure Gauges
   2. Thermometers
   3. Separable Sockets
   4. Thermometer Wells
   5. Pressure-Gauge Fittings
   6. Flow Indicators
   7. Thermometer Supports
   8. Trap Primers

1.02 RELATED SECTIONS

A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements apply to this Section.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Pressure Gauges:
   1. Dwyer Instruments, Inc.
   2. Moeller Instrument Co., Inc.
   3. Omega Engineering, Inc.
   4. Trerice
   5. Or approved equivalent.

B. Thermometers:
   1. Ashcroft
   2. Trerice
   3. Weiss
   4. Marshaltown
   5. Weksler
   6. Or approved equivalent.

C. Separable Sockets:

1. Kimray
2. Weiss
3. Trerice
4. Or approved equivalent.

D. Thermometer Wells:
1. Ashcroft
2. Omega
3. Weiss
4. Or approved equivalent.

E. Pressure Gauge Fittings:
1. Omega
2. Weiss
3. Trerice
4. Or approved equivalent.

F. Flow Indicators:
1. LJ Starr
2. Dwyer
3. Or approved equivalent.

G. Thermometer Supports:
1. Taylor USA
2. Weiss
3. Or approved equivalent.

H. Trap Primers:
1. Wade
2. Zurn
3. J.R. Smith
4. PPP
5. Or approved equivalent.

2.02 PRESSURE GAUGES

A. Pressure Gauges: ASME B40.100, phosphor-bronze bourdon type, dry type.
1. Case: Cast aluminum, stem-mounted, flange less.
2. Size: 4-1/2-inch diameter.
3. Window: Clear glass.
4. Connector: Brass.
5. Scale: White aluminum with black graduation and markings.
6. Pointer: Black, adjustable.
7. Mid-Scale Accuracy: One percent.
8. Scale: PSI.
9. Basis of Design: Trerice Model 600CB.

2.03 THERMOMETERS

A. Thermometers - Adjustable Angle: Red or blue appearing organic liquid in glass, ASTM E 1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
1. Size: 9-inch scale.

2. Window: Acrylic.
3. Scale: Aluminum, white background, black graduations and markings.
4. Stem: 3/4-inch NPT brass (aluminum for installation in air ducts).
5. Accuracy: 2 percent, per ASTM E 77.
6. Calibration: 0-160 with 2 Degrees F graduations.
7. Basis of Design: Trerice BX9.

2.04 SEPARABLE SOCKETS

A. Description: Fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.
1. Material: Brass, for use in copper piping.
2. Material: Stainless steel, for use in steel piping.
3. Extension-Neck Length: Nominal thickness of 2-inches, but not less than thickness of insulation. Omit extension neck for sockets for piping not insulated.
4. Insertion Length: To extend to center of pipe.
5. Cap: Threaded, with chain permanently fastened to socket.
6. Heat Transfer Fluid: Oil or graphite.

2.05 THERMOMETER WELLS

A. Description: Fitting with protective well for installation in threaded pipe fitting to hold test thermometer.
1. Material: Brass for use in copper piping.
2. Material: Stainless steel, for use in steel piping.
3. Extension Neck Length: Nominal thickness of 2-inches, but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.
4. Insertion Length: To extend to center of pipe.
5. Cap: Threaded, with chain permanently fastened to socket.
6. Heat Transfer Fluid: Oil or graphite.

2.06 PRESSURE-GAUGE FITTINGS

A. Valves: NPS 1/4 (DN8) brass or stainless-steel needle type.
B. Siphons: NPS 1/4 (DN8) coil of brass turbine with threaded ends.
C. Snubbers: ASME B40.5, NPS 1/4 (DN8) brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

2.07 FLOW INDICATORS

A. Description: Instrument for visual verification of flow; made for installation in piping systems.
1. Construction: Bronze or stainless steel body, with sight glass and plastic pelton-wheel indicator.
2. Pressure Rating: 125 PSIG.
3. Temperature Rating: 200 degrees F.

2.08 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

2.09 TRAP PRIMERS

A. Trap automatic primer valve with integral anti siphon protection. Code approval required.
B. Flush valve tail-piece trap primer. PPP FVP-1VB.
C. Electronic trap seal automatic primer valve with integral anti siphon protection and timer. Coordinate quantity, locations and voltage characteristics for control points.

D. Trap seal primer valve (low lead) with integral automatic anti-siphon protection. The priming valve to discharge on both pressure drop and pressure spike. PPP CPO 500.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. For plumbing devices requiring access from access panels (i.e. trap primers, water hammer arrestors and the like) submit location/size of all access panels to Architect for approval prior to purchase and installation of access panel. See Section 22 00 00, Plumbing Basic Requirements for additional requirements.

B. Provide instruments with scale ranges selected according to service with largest appropriate scale.

C. Install per manufacturer recommendations.

3.02 PRESSURE GAUGES

A. Install pressure gauge where exposure to heat and vibration are minimal and where the dial can be easily read. It is also important to install the gauge in a location with undisturbed and continuous flow of the pressure medium.

B. Provide a needle valve or gauge cock, installed between the process and the pressure gauges.

C. Install pressure gauges in piping tee with pressure gauge cock, in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

D. Locations: Install in the following locations, and elsewhere as indicated.

1. At each pump inlet and outlet.
2. At inlet and discharge of each pressure reducing valve.
3. At make-up water service outlets.

E. Adjust gauges to final angle, clean windows and lenses, and calibrate to zero.

F. Install per manufacturer recommendations.

G. Pressure Gauge Range/Graduations:

1. Cold Water: 0-100 PSI; graduation 1 PSI
2. Hot Water: 0-100 PSI; graduation 1 PSI

3.03 THERMOMETERS

A. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2-inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

B. Install thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

C. Adjust thermometers to final angle, clean windows and lenses, and calibrate to zero.

D. Install per manufacturer recommendations.

E. Thermometer Range/Graduations:

1. Cold Water: 25-125 degrees F; graduation 1 degree F
2. Hot Water: 30-240 degrees F; graduation 2 degrees F

3.04 SEPARABLE SOCKETS

A. Inspect the openings in the vessel for foreign material and clean the connection ports to remove scale, chips and debris.

B. Install thermostats with separable sockets. Install the separable socket using good piping practice. Be sure to use TFE tape or pipe thread sealant on external pipe threads.

C. Never stand directly over or in front of a valve or controller when the system is pressurized.

D. Assure the separable socket is completely submerged in liquid or flow stream. Partial submersion will give erratic temperature transfer to thermostat.

E. Pack separable socket full with high temp bearing grease. This helps in heat transfer and prevents air space.

3.05 THERMOMETER WELLS

A. See "Thermometers" Article above.

B. Install in piping in vertical upright position. Fill well with oil or graphite, secure cup.

C. Install per manufacturer recommendations.

3.06 PRESSURE-GAUGE FITTINGS

A. See "Pressure Gauges" Article above.

B. Install per manufacturer recommendations.

3.07 FLOW INDICATORS

A. Check all components carefully for damage incurred during shipment. If damage is discovered or suspected, do not attempt installation.

B. Ensure the visual flow indicator is free of any damage due to mishandling or improper storage before proceeding with installation. Specific areas of concern are the window and pipe connections.

C. Examine the window for evidence of scratches, chips or cracks. If any are present, do not proceed with installation. Surface abrasions weaken the window and it will not be able to support the listed design rating.

D. The pipe connections, flanged or threaded, must be free of any foreign material. The presence of foreign material may prevent the unit from sealing.

E. Install per manufacturer recommendations.

3.08 THERMOMETER SUPPORTS

A. See "Thermometers" Article above.

B. Install per manufacturer recommendations.

3.09 TRAP PRIMERS

A. Flush supply line prior to installation.

B. Install valve plumb using caution to not over tighten. Tightening to more than 55 ft. lbs. can damage valve and void the warranty. Do not wrench on hex.

C. Effective operating range 20 to 80 PSIG (138 to 552 kPa).

D. Do not subject trap primer valve to pressure in excess of 125 PSI.

END OF SECTION

SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Valves, General
   2. Balancing Valves
   3. Ball Valves
   4. Swing Check Valves
   5. Pressure Regulating Valve-Domestic Water
   6. Thermostatic Master Mixing Valves (ASSE 1017 Rated)
   7. Thermostatic Point-of-Use Mixing Valves (ASSE 1070 Rated)

1.02 RELATED SECTIONS

A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. NSF 61, Annex G and/or NSF/ANSI 372 for potable water services. Valves must be 3rd-party certified.
   2. ISO 9001 Certified.
   3. IAPMO Certified for Low Lead.

C. Source Limitations for Valves: Obtain each type of valve from a single source and from a single manufacturer.

D. Model numbers indicated as Basis-of-Design indicate valve characteristics. All valves are to meet code Low Lead/Lead Free Standards.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations for Valves: Obtain each type of valve from a single source and from a single manufacturer.

B. Valves, General:
   1. Apollo
   2. Armstrong
   3. ASCO
   4. Cla-Val

5. Conbraco
6. Crane
7. Clow
8. Griswold
9. Hammond
10. Hays
11. Jenkins
12. Josam
13. Kennedy
14. Milwaukee
15. Mueller
16. Nibco
17. Red-White Valve
18. Smith
19. Stockham
20. Tour Anderson
21. Wade
22. Watts
23. Wilkins
24. Zurn

C. Balancing Valves:
1. Caleffi
2. Griswold
3. Hays
4. Armstrong CBV
5. Tour Anderson

D. Ball Valves:
1. See Valves General above.
2. NSF Valves:
a. Clow
b. Kennedy
c. Nibco

E. Swing Check Valves:
1. See Valves General above.

F. Pressure Regulating Valve-Domestic Water:
1. Cash Acme
2. Cla-Val
3. Watts
4. Wilkins
5. Or approved equivalent.

G. Thermostatic Master Mixing Valves (ASSE 1017 Rated):
1. Holby Tempering Valve
2. Lawler Series 66
3. Leonard Type TM
4. Powers LFMM430 (Lead Free)

5. Symmons Temp Control Series 5
6. Or approved equivalent.

H. Thermostatic Point-of-Use Mixing Valves (ASSE 1070 Rated):
1. Lawler
2. Leonard
3. Powers Hydroguard
4. Or approved equivalent.

2.02 VALVES - GENERAL

A. General:
1. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
2. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves 6-inches and smaller. Provide gear operators for quarter-turn valves 8-inches and larger and plug valves installed over 5-feet above finished floor.
3. Valve Identification: Manufacturer's name (or trademark) and pressure rating clearly marked on valve body.

B. Valves in Insulated Piping: With 2-inch stem extension and following features:
1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation on valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied.

C. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With thread according to ASME B1.20.1.

D. Valve Bypass and Drain Connections: MSS SP-45.

E. Building Service:
1. Shutoff and Isolation Valves:
a. Pipe Sizes 3-inches and Smaller: Ball Valve.
2. Drain Service: Ball Valves.
3. Strainer Blow-Off: Ball Valve.
4. Check Valves: Swing.

2.03 BALANCING VALVES

A. Maximum 125 PSIG System Working Water Pressure.

B. Manual Set Balancing Valves:
1. Valves are to be of the "Y" pattern, equal percentage globe-style and provide three functions:
a. Precise flow measurement.
b. Precision flow balancing.
c. Positive drip-tight shut-off.
2. Valve to provide multi-turn, 360 degree adjustment with micrometer type indicators located on the valve handwheel. Valves have a minimum of five full 360 degree handwheel turns. 90 degree circuit-setter style ball valves are not acceptable. Valve handle to have hidden memory feature, which will provide a means for locking the valve position after the system is balanced. Valves to be furnished with precision machined venturi built into the valve body to provide highly accurate flow measurement and flow balancing. The venturi to have two

1/4-inch threaded brass metering ports with check valves and gasketed caps located on the inlet side of the valve. Valves to be furnished with flow smoothing fins downstream of the valve seat and integral to the forged valve body to make the flow more laminar. The valve body, stem and plug to be brass. The handwheel to be high-strength resin.

3. 2-1/2-inch and Larger: Valves are to be of the "Y" pattern, equal percentage globe-style and provide three functions:
   a. Precise flow measurement.
   b. Precision flow balancing.
   c. Positive drip-tight shut off. Valve to provide multi-turn, 360 degree adjustment with micrometer type indicators location on the valve handwheel. Valves to have a minimum of five full 360 degree handwheel turns. 90 degree circuit-setter style ball valves are not acceptable. Valve handle to have hidden memory feature, which will provide a means for locking the valve position after the system is balanced. Valve body to be either cast iron with integrated cast iron flanges (2-1/2-inch to 12-inch) or ductile iron with industrial standard grooved ends (2-1/2-inch to 12-inch). Valve stem and plug disc to be bronze with handwheel that permits multi-turn adjustments. Sizes 2-1/2-inch and 3-inch - five turns, sizes 4-inch to 6-inch - 6 turns, sizes 8-inch to 10-inch - 12 turns and size 12-inch - 14 turns. Flange adapters to be provided to prevent rotation.

2.04 BALL VALVES

A. All ball valves on brazed piping are to be three-piece.

B. 2-1/2 Inches and Smaller: MSS SP-110, 400-600 PSI, two-piece full port ball configuration, bronze body, extended soldered ends for copper pipe and threaded ends for iron pipe, lead-free brass or stainless steel ball, lead-free brass stem, Teflon seat, extended steel handle. Apollo 77CLF 100 Series two-piece.

C. 3 Inches and Larger: MSS SP-110, 400-600 PSI, three-piece full port ball configuration, bronze body, extended soldered ends for copper pipe and threaded ends for iron pipe, lead-free brass or stainless steel ball, lead-free brass stem, Teflon seat, extended steel handle. Apollo 82-100/82A 140 Series three-piece.

D. Full Port Ball Valve: 2- to 4-inch ductile iron, ASTM A536, micro finish steel chrome plated or stainless steel ball and stem. TFE seats, 600 PSI.

2.05 SWING CHECK VALVES

A. 2-inches and Smaller: Class 125, bronze body, horizontal swing, regrinding type, Y-pattern, renewable disc. Nibco 413. MSS SP-80.

B. 2-1/2-inches and Larger: Class 125, iron body, bolted bonnet, horizontal swing, renewable seat and disc, flanged ends. Nibco F918. MMS SP-71.

C. Rubber Flapper Check Valve: Horizontal or vertical upward flow installation. Working pressure to 175 PSI. Ductile iron or cast iron body. Steel reinforced Buna-N rubber flapper epoxy coating on wetted parts. MSS SP-80.

D. Gruvlok Series 7800 Check Valve: Horizontal installation. Working pressure to 300 PSI, Type 304/302 Stainless Steel conforming to ASTM 167. Ductile body, ASTM A536, and stainless clapper, EPDM, nitrile or optional viton bumper and bonnet seals. Stainless wetted parts.

2.06 PRESSURE REGULATING VALVE-DOMESTIC WATER

A. Water: Bronze body, diaphragm or piston type, spring actuated, with separate or integral stainless steel strainer, pressure range to suit conditions, approved for potable water use, low lead. Provide shutoff valves, pressure relief valves, unions, drain valve and bypass.

B. Water: Automatic control pressure regulating valve, stainless steel seat, stem and spring, diaphragm actuated with brass body, hydraulic control pilots with effluent operating temperature range 32 degrees F to 180 degrees F, FDA and AWWA approved.

C. Water: Bronze body construction, stainless steel strainer screen, thermal expansion bypass with renewable stainless steel seat and high temperature resisting diaphragm.

2.07 THERMOSTATIC MASTER MIXING VALVES (ASSE 1017 RATED)

A. Thermostatic type with bronze body construction, corrosion resistant materials, union end stops, check inlets with strainers, 0-200 degree F dial thermometer and discharge shut-off valve. Mixing valves to meet ASSE 1017.

B. Maximum required delta temperature differential between hot water supply temperature and delivery temperature is 15 degrees F. Set valve outlet temperature per drawing requirements.

C. Flow from the tempered water circulating pump to be split to mixing valve and building hot water heating system.

2.08 THERMOSTATIC POINT-OF-USE MIXING VALVES (ASSE 1070 RATED)

A. Thermostatic type with bronze body construction, corrosion resistant materials, union end stops, check inlets with strainers, 0-200 degree F dial thermometer and discharge shut-off valve. Mixing valves to meet ASSE 1070.

B. Maximum required delta temperature differential between hot water supply temperature and delivery temperature is 15 degrees F. Set valve outlet temperature per drawing requirements.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

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.
4. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Inspect the shipping container before unpacking to look for damage that could have occurred during transport, and report it to the transportation company immediately. After visual inspection, remove the valve from the shipping container. Make sure the faces are free of any scratches and that there is not any obvious damage to the actuator assembly or valve body.

D. Make sure to note the valve's model number during the unpacking process. The model number will need to be provided when purchasing replacement parts.

E. Purge and clean all piping to be connected to valve.

F. Install per manufacturer's recommendations.

G. Determine that the valve and its plumbing piping is adequately supported when installed. If a valve is not adequately supported, this could prevent the valve from operating and sealing correctly. Be sure that all mating flanges are in line and parallel to minimize straining on joints and valve body.

H. 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.

I. Do not attempt to repair defective valves; replace with new valves.

J. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.

K. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane unless unavoidable. Install valve drains with hose end adapter and cap on chain for each valve that must be installed with stem below horizontal plane. Ensure installation provides full stem movement.

L. Insulation: Where insulation is indicated, install extended stem valves, arranged in proper manner to receive insulation.

M. Mechanical Actuators: Install with chain operators where indicated. Extend chains to 5-feet above floor and hook to clips to clear aisle passage.

N. Stem Selection: Outside screw and yoke stems, except provide inside screw, non-rising stem where space prevents full opening of OS&Y valves.

O. Seats: Renewable seats, except where otherwise indicated.

P. When soldering, use paste flux that are approved by the manufacturer for use with lead free alloys.

Q. If valve applications are not indicated on Drawings, use the following:

1. Shutoff Service: Butterfly valves.

R. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

S. Valves, except wafer/butterfly types, with the following end connections:

1. For Copper Tubing, 2-inches and Smaller. Threaded ends except where solder-joint valve-end.
2. For Copper Tubing, 2-1/2-inches to NPS 4-inches. Flanged ends except where threaded valve-end.
3. For Copper Tubing: 5-inches and Larger: Flanged ends.
4. For Steel Piping, 2-inches and Smaller: Threaded ends.
5. For Steel Piping, 2-1/2-inches to NPS 4-inches: Flanged ends except where threaded valve-end.
6. For Steel Piping, 5-inches and Larger: Flanged ends.

T. Valve Adjusting and Cleaning:

1. Inspect valves for leaks. Adjust or replace packing to stop leaks. Replace valve if leak persists.
2. Valve Identification. Tag valves per Section 22 05 53, Identification for Plumbing Piping and Equipment.

3.02 BALANCING VALVES

A. See General Installation Requirements above.

B. Install with flow in the direction of the arrow on the valve body and installed at least five pipe diameters downstream from any fitting, and at least ten pipe diameters downstream from any pump. Two pipe diameters downstream from the balancing valve should be free of any fittings. When installed, easy and unobstructed access to the valve handwheel and metering ports for adjustment and measurement are to be provided. Mounting of valve in piping must prevent sediment build-up in metering ports.

3.03 BALL VALVES

A. See General Installation Requirements above.

3.04 SWING CHECK VALVES

A. See General Installation Requirements above.

B. Swing Check Valve Installation: Install in horizontal position with hinge pin horizontally perpendicular to centerline of pipe. Install for proper direction of flow. Only install where there are 10 pipe diameters of straight pipe upstream of valve.

C. Domestic Water and Circulation Pump Discharge Check Valves:

1. 2-inches and Smaller: Bronze body, spring loaded, lead free, lift check.

2. 2-1/2-inches and Larger: Wafer style, silent lift check valve, lead free.

3.05 PRESSURE REGULATING VALVE-DOMESTIC WATER

A. See General Installation Requirements above.

B. Install valve in the line with arrow on valve body pointing in the direction of flow. This valve should be installed where it is accessible with sufficient clearance for cleaning, service or adjustment. Install the reducing valve before a sill cockline if possible. Before installing the reducing valve hose bibb, flush out the line to remove loose dirt and scale which might damage valve disc and seat.

C. Horizontal installation is recommended. However, valve can be installed in a vertical position. Regulator must be installed in an accessible location to facilitate servicing the regulator.

D. To readjust reduced pressures, loosen adjusting screw nut and turn adjusting screw clockwise to raise reduced pressure and counterclockwise to lower reduced pressure.

E. When reducing valve is used, it makes a closed system; therefore, pressure relief protection must be provided on the downstream side of the reducing valve to protect equipment.

F. Provide pressure relief valve and terminate discharge to indirect waste receiver.

G. Anytime a reducing valve is adjusted, the use of a pressure gauge is recommended to verify correct pressure setting. Do not bottom out adjusting screw or spring cage.

H. Provide inlet and outlet ball valves, and globe valve bypass. Provide pressure gauge on valve outlet.

I. Provide pressure relief valve piped full size to indirect waste receiver or floor drain.

J. Provide factory startup on automatic control valves.

3.06 THERMOSTATIC MASTER MIXING VALVES (ASSE 1017 RATED)

A. See General Installation Requirements above.

B. Install mixing valve per manufacturer's instruction manual.

3.07 THERMOSTATIC POINT-OF-USE MIXING VALVES (ASSE 1070 RATED)

A. See General Installation Requirements above.

B. Install mixing valve per manufacturer's instruction manual.

END OF SECTION

SECTION 22 05 29
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Pipe Hangers and Supports for Plumbing Piping and Equipment
   2. Wall and Floor Sleeves
   3. Building Attachments
   4. Flashing
   5. Miscellaneous Metal and Materials

1.02 RELATED SECTIONS

A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. ASCE 7-10, Minimum Design Loads for Buildings and Other Structures.
   2. Hanger spacing installation and attachment to meet all manufacturer's requirements and MSS SP-58.
   3. Terminology: As defined in MSS SP-90 "Guidelines on Terminology for Pipe Hangers and Supports".
   4. Install piping per SMACNA's requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.07 PERFORMANCE REQUIREMENTS

A. General - Provide pipe and equipment hangers and supports in accordance with the following:
   1. When supports, anchorages, and seismic restraints for equipment, and supports, anchorages, and seismic restraints for piping are not shown on the Drawings, the contractor is responsible for their design.
   2. Connections to structural framing are not to introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.

B. Engineered Support Systems:
   1. Support frames such as pipe racks or stanchions for piping and equipment which provide support from below.
   2. Equipment and piping support frame anchorage to supporting slab or structure.

C. Provide channel support systems, for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents and test water.

D. Provide heavy-duty steel trapezes for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents and test water.

E. Provide seismic restraint hangers and supports for piping and equipment. See Section 22 05 48, Vibration and Seismic Controls for Plumbing Piping and Equipment.

F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment. See Section 22 05 48, Vibration and Seismic Controls for Plumbing Piping and Equipment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Pipe Hangers and Supports for Plumbing Piping and Equipment:
   1. Pipe Hangers/Supports:
      a. B-Line Systems, Inc.
      b. Anvil International
      c. HOLDRITE
      d. Erico Co., Inc.
      e. Snappitz Thermal Pipe Shield Manufacturing
      f. Rilco Manufacturing Co. Inc.
      g. Nelson-Olson Inc.
      h. Or approved equivalent.
   2. Channel Support Systems:
      a. B-Line Systems, Inc.
      b. Anvil International, Anvit-Strut
      c. Erico Hanger Co., Inc.; O-Strut Div.
      d. Unistrut Corp.
      e. HOLDRITE EZ-Strut Systems
      f. Or approved equivalent.
   3. Thermal-Hanger Shield Inserts:
      a. Erico Hanger Co., Inc.
      b. Pipe Shields, Inc.
      c. Rilco Manufacturing Co., Inc.
      d. HOLDRITE Insulation Couplings
      e. Or approved equivalent.

B. Wall and Floor Sleeves:
   1. Below Grade and High Water Table Areas:
      a. Modular Link Sealing System at Pipe Sleeves:
         1) Thunderline Corporation
         2) Or approved equivalent.
   2. Pre-Engineered Firestop Pipe Penetration Systems:
      a. HOLDRITE HydroFlame
      b. Proset
      c. Or approved equivalent.

C. Building Attachments:
   1. Anchor-It
   2. Gunnebo Fastening Corp.
   3. ITW Ramset/Red Head
   4. Masterset Fastening Systems, Inc.

5. Or approved equivalent.

D. Flashing:
   1. Fastenal
   2. Or approved equivalent.

E. Miscellaneous Metal and Materials:
   1. See Miscellaneous Metal and Materials article below.
   2. Powder-Actuated Fastener Systems:
      a. Gunnebo Fastening Corp.
      b. Hilti, Inc.
      c. ITW Ramset/Red Head.
      d. Masterset Fastening Systems, Inc.
      e. Or approved equivalent.

2.02 PIPE HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

A. Horizontal Piping Hangers and Supports - Horizontal and Vertical Piping, and Hanger Rod Attachments:
   1. Factory fabricated horizontal piping hangers and supports to suit piping systems in accordance manufacturer's published product information.
   2. Use only one type by one manufacturer for each piping service.
   3. Select size of hangers and supports to exactly fit pipe size for bare piping and to exactly fit around piping insulation with saddle or shield for insulated piping.
   4. Provide copper-plated hangers and supports for uninsulated copper piping systems.
   5. Provide padded pipe hangers, clamps and supports for thermoplastic piping system.
   6. Install no hub cast iron pipe and fittings per CISPI 301-09 Installation Procedures for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain Waste and Vent Piping Applications. Brace hubless cast iron pipe and fittings 5-inch and larger with HOLDRITE No Hub Pipe Restraints or approved equivalent.

B. Pipe Hangers, Guides and Channel Systems:
   1. Hanger Rods: Hanger rods continuously threaded or threaded ends only in concealed spaces and threaded ends only in exposed spaces; finish electro-galvanized or cadmium-plated in concealed spaces and prime painted in exposed spaces; sizes per MSS.
   2. Hanger Rod Couplings: Malleable iron rod coupling with elongated center sight gap for visual inspection; to have same finish as hanger rods.
   3. Pipe Rings for Hanger Rods: Pipe sizes 2-inch and smaller, MSS SP Type 6 or Type 10, or approved equivalent. Pipe sizes 2-1/2-inches and larger, clevis type hangers with adjustable nuts on rod. MSS SP Type 1. Pipe rings to have same finish as hanger rods.
   4. Pipe Slides: Type 35 reinforced Teflon slide material (3/32-inch minimum thickness) bonded to steel; highly finished steel or stainless steel contact surfaces to resists corrosion; 60-80 PSI maximum active contact surface loading; steel parts 3/16-inch minimum thickness; attachment to pipe and framing by welding.
   5. Pipe Guides:
      a. Furnish and install pipe guides on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides securely to pipe and structure. Any contact with chilled water pipe

is not to permit heat to be transferred in sufficient quantity to cause condensation on any surface.

b. Furnish and install guides approximately 4 pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Guides are not to be used as supports and are in addition to other pipe hangers and supports.

6. Channel Type Pipe Hanging System: Framing members No. 12 gauge formed steel channels, 1-5/8-inch square, conforming to ASTM A570 GR33; one side of channel to have a continuous slot with in-turned lips; framing nut with grooves and spring 1/2-inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A307; fittings conforming to ASTM A575; parts enamel painted or electro-galvanized.

C. Pipe Saddles and Shields:

1. Factory fabricated saddles or shields under piping hangers and supports for insulated piping.
2. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12-inches in length (4-inch pipe and larger to be three times longer than pipe diameter).

D. Thermal-Hanger Shield Inserts: 100-PSI (690-kPa) minimum compressive strength insulation, encased in sheet metal shield.

1. Material for Cold Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with vapor barrier.
2. Material for Hot Piping: Water-repellent-treated ASTM C533, Type 1 calcium silicate.
3. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
4. For Clevis or Band Hanger: Insert and shield to cover lower 180 degrees of pipe.
5. Insert Length: Extend 2-inches beyond sheet metal shield for piping operating below ambient air temperature.
6. Thermal Hanger Shield Inserts should be provided at the hanger points and guide locations on pipes requiring insulation. The Inserts should consist of Polyisocyanurate (urethane or phenolic insulation) encircling the entire circumference of the pipe with a 360 degree PVC (1.524 mm thick) with a living hinge and J lock and installed during the installation of the piping system.

E. Concrete Inserts:

1. Malleable iron body, hot dipped galvanized finish. Lateral adjustment. MSS Type 18.

F. Continuous Concrete Insert:

1. Steel construction, minimum 12 gauge. Electrogalvanized finish. Pipe clamps and insert nuts to match.

G. Below Ground:

1. Pipe Hangers: Adjustable Clevis type, Federal Specification WW-H-171 (Type 1), UL listed, stainless steel Type 316. MSS Type 1. If PVC piping to be used, provide Type 1 hanger, coated for PVC piping.
2. Rod: 5/8-inch stainless steel Type 316.
3. Eyebolt: Stainless steel Type 316.
4. Nuts and Washers: Stainless steel Type 316.

H. Hangers for Pipe Size 2-inches and Smaller:

1. Adjustable swivel ring hanger, UL listed, Type 6 or Type 10.

I. Hangers for Pipe Size 2-1/2-inches and Larger:

1. Adjustable clevis type, UL listed, Type 1.

J. Plumbers Tape:

1. Not permitted as pipe hangers or pipe straps.

2.03 WALL AND FLOOR SLEEVES

A. Below Grade and High Water Table Areas:

1. Modular Link Sealing System at Pipe Sleeves: Neoprene gasket links bolted together around an interior sleeve forming a watertight seal. Use a modular link sealing system at sleeves to continuously fill the annular space between the pipe and the wall opening. Provide Link-seal Type C unless otherwise noted. OS with S-316 stainless construction for continuous water/tank walls.
2. Sleeves through concrete foundation walls and floors. Ductile iron pipe. Class 50 or 51 pipe conforming to ANSI/AWWA C151/A21.51, cement lined. Pipe sleeve will extend a minimum of 6-inches beyond outside perimeter of foundation. Final placement of sleeve will be confirmed with project's structural engineer. In areas with a high water table, provide AWWA C900, Class 235 plastic pipe in lieu of ductile iron pipe.

B. Pre-Engineered Firestop Pipe Penetration Systems: UL listed assemblies for maintaining fire rating of piping penetrations through fire-rated assemblies. Comply with ASTM E814.

C. Insulating Caulking: Eagle or Pitcher Super 66 high temperature cement.

D. Fabricated Accessories:

1. Steel Pipe Sleeves: Fabricate from Schedule 40 black or galvanized steel pipe. Remove end burrs by grinding.
2. Sheet Metal Pipe Sleeves: Fabricate from G-90 galvanized sheets closed with lock-seam joints. Provide following minimum gauges for sizes indicated:
   a. Sleeve Size 4-inches in Diameter and Smaller: 18 gauge.
   b. Sleeve Sizes 5-inches to 6-inches: 16 gauge.
   c. Sleeve Sizes 7-inches and Larger: 14 gauge.
   d. Fire-Rated Safing Material:
      1) Rockwool Insulation: Complying with FS-HH-I-558, Form A, Class IV, 6 lbs./cu.ft. density with melting point of 1985 degrees F and K value of 0.24 at 75 degrees F.
      2) Calcium Silicate Insulation: Noncombustible, complying with FS-HH-I-523, Type II, suitable for 100 degrees F to 1200 degrees F service with K value of 0.40 at 150 degrees F.

2.04 BUILDING ATTACHMENTS

A. General: Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project Structural Engineer. Provide anchor bolts suitable for cracked concrete.

B. Anchor Bolts:

1. Anchor Bolts (Cast-In-Place): Steel bolts, ASTM A307. Nuts to conform to ASTM A194. Design values for shear and tension not more than 80 percent of the allowable listed loads.
2. Anchor (Expansion) Bolts: Carbon steel to ASTM A307; nut to conform to ASTM A194; drilled-in type. Design values for shear and tension not more than 80 percent of the allowable listed loads.
3. Anchor (Adhesive) Bolts: Consisting of two-part adhesive cartridge and zinc-plated Type A307 steel anchor bolt rod assembly with ASTM A194 nut.

C. Powder-Actuated Drive Pin Fasteners:

1. Powder-Actuated Drive-Pin Fasteners: Powder actuated type, drive pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

E. Grout: ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.

1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
2. Properties: Nonstaining, noncorrosive, and non-gaseous.
3. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

2.05 FLASHING

A. Steel Flashing: 26 gauge galvanized steel.

B. Safes: 8 mil thick neoprene.

C. Caps: Steel, 22 gauge minimum, 16 gauge at fire-resistant structures.

D. Provide hot dipped galvanized components for items exposed to weather.

2.06 MISCELLANEOUS METAL AND MATERIALS

A. Miscellaneous Metal: Provide miscellaneous metal items specified hereunder, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on Drawings or otherwise not shown on drawings, that are necessary for completion of the project. The Contractor is responsible for their design.

1. Fabricate miscellaneous units to size, shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.

B. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.

C. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.

D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.

E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.

F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods and equipment required for fabrication.

G. Provide hot dipped galvanized components for items exposed to weather.

H. Use straps, threshold rods and wire with sizes required by SMACNA to support piping.

I. Grout: ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.

1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
2. Properties: Nonstaining, noncorrosive, and non gaseous.
3. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Examination:

1. Verify building materials to have hangers and attachments affixed in accordance with hangers to be used. Provide supporting calculations.

B. Preparation:

1. Examine Drawings and coordinate for verification of exact locations of fire and smoke rated walls, partitions, floors and other assemblies. Indicate, by shading and labeling on Record Drawings such locations and label as "1-Hour Wall," "2-Hour Fire/Smoke Barrier," and the like. Determine proper locations for piping penetrations. Set sleeves in place in new floors, walls or roofs prior to concrete pour or grouting.

C. Install hangers, supports, anchors and sleeves after required building structural work has been completed in areas where the work is to be installed. Coordinate with project structural engineer proper placement of inserts, anchors and other building structural attachments.

3.02 PIPE HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

A. Hangers and Supports:

1. Comply with MSS SP-58. Pipe Hanger and Support Installation: Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. For horizontally hung grooved-end piping, provide a minimum of 2 hangers per pipe section.
2. Pipe Ring Diameters:
   a. Uninsulated and Insulated Pipe, except where oversized pipe rings are specified: Ring inner diameter to suit pipe outer diameter.
   b. Insulated Piping Where Oversized Pipe Rings are Specified and Vibration Isolating Sleeves: Ring inner diameter to suit outer diameter of insulation or sleeve.
3. Oversize Pipe Rings: Provide oversize pipe rings of 2-inch and larger size.
4. Pipe Support Brackets: Support pipe with pipe slides.
5. Steel Backing in Walls: Provide steel backing in walls to support fixtures and piping hung from steel stud walls.
6. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
   a. Field assemble and install according to manufacturer's written instructions.
7. Pipe Guides:
   a. Install on continuous runs where pipe alignment must be maintained. Provide a minimum of two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides to pipe structure. Any contact with chilled water pipe should not permit heat to be transferred in sufficient quantity to cause condensation on any surface.
   b. Install approximately 4 pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Do not use as supports. Provide in addition to other required pipe hangers and supports.
8. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field -fabricated, heavy-duty trapezes.

a. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

b. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1

9. Group parallel runs of horizontal piping to be supported together on trapeze-type hangers.

10. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe.

11. Do not support piping from other piping.

12. Fire protection piping will be supported independently of other piping.

13. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated.

14. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.

15. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchor, and to facilitate the action of expansion joints, expansion loops, expansion bends and similar units.

16. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

17. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping" is not exceeded.

18. Insulated Piping: (comply with the following)

a. Attach clamps and spacers to piping.

1) Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

2) Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

3) Do not exceed pipe stress limits according to ASME B31.9.

b. Install MSS SP-58, Type 39 protection saddles, if insulation without a vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

1) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.

c. Install MSS SP-58, Type 40 protective shields on cold piping having a vapor barrier. Shields to span arc of 180 degrees.

1) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.

d. Shield Dimensions for Pipe, not less than the following:

1) NPS 1/4 to NPS 3-1/2 (DN8 to DN 90): 12-inches long and 0.048-inch thick.

2) NPS 4 (DN100): 12-inches long and 0.06-inch thick.

3) NPS 5 and NPS 6 (DN125 and DN150): 18-inches long and 0.06-inch thick.

4) NPS 8 to NPS 14 (DN200 to DN350): 24-inches long and 0.075-inch thick.

5) NPS 16 to NPS 24 (DN400 to DN600): 24-inches long and 0.105-inch thick.

e. Pipes NPS 8 (DN200) and Larger: Include wood inserts.

f. Insert Material: Length at least as long as protective shield.

g. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

19. Equipment Clearances: Do not route equipment or piping through electrical rooms, transformer vaults, elevator equipment rooms, IT rooms, MPOE rooms, or other electrical or electronic equipment spaces and enclosures and the like. Within equipment rooms, provide minimum 3-feet lateral clearance from all sides of electric switchgear panels. Do not route piping or equipment above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with Electrical and coordinate exact equipment or pipe routing to provide proper clearance with such items.

20. Pipe supports and hanger spacing (pipe supported from structure or floor-supported) to meet the requirements of References and Standards Article in Part 1 above.

B. Pipe Curb Assemblies:

1. Provide for piping and electrical conduit which penetrates the structural roof deck to service equipment above the roof level (i.e., piping, electrical power and control wiring). Meet requirements of roof warranty.

2. Provide prefabricated units for roof membrane and insulation penetrations related to equipment. Coordinate with roofing system. Set supports on the structural deck. Do not set supports on insulation or roofing. Provide level supports by prefabricated pitch built into the curb.

3. Piping above roof to be supported with freestanding roof pipe supports unless detailed otherwise. At roofing applications, the adhesion mastic is to be specifically submitted to and approved by the roofing system manufacturer/installer to maintain the integrity of all warranties.

4. At concrete floors, install a polyurethane mastic to the support block and adhere in place.

C. Vertical Piping:

1. Support with U-clamps fastened to wall to hold piping away from wall unless otherwise approved.

2. Riser clamps to be directly under fitting or welded to pipe. Provide neoprene pads for all systems except natural gas.

3. Riser to be supported at each floor penetration.

4. Provide structural steel supports at the base of pipe risers. Size supports to carry forces exerted by piping system when in operation.

D. Adjusting and Painting:

1. Adjust hangers so as to distribute loads equally on attachments. Provide grout under supports to bring piping and equipment to proper level and elevations.

2. Prime paint ferrous nongalvanized hangers, accessories, and supplementary steel which are not factory painted.

3.03 WALL AND FLOOR SLEEVES

A. "Link-Seal" Pipe Sleeves: Install at slab on grade floor/below grade piping penetrations. Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations (except for DWV piping at slab on grade). Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations.

B. Fabricated Pipe Sleeves:

1. Provide either steel or sheet metal pipe sleeves accurately centered around pipe routes. Size such that piping and insulation, if any, will have free movement within the sleeve, including allowance for thermal expansion. Sleeve diameter to be determined by local seismic clearance requirement, and by waterproofing requirements.
2. Length: Equal to thickness of construction penetrated, except extend floor sleeves 1-inch above floor finish.
3. Provide temporary support of sleeves during placement in concrete and other work around sleeves. Provide temporary end closures to prevent concrete and other materials from entering pipe sleeves.
4. Seal each end airtight with a resilient nonhardening sealer, UL listed and fire rated per ASTM 814.

3.04 BUILDING ATTACHMENTS

A. Install within concrete slabs or attach to structural steel or wood. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints and at changes in direction of piping.

B. Attachment to Wood Structure: Provide MSS Type 34 for attachment to wooden beam or approved attachment for a wood structure.

C. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

D. Install concrete inserts before concrete is placed; fasten insert secure to forms. Where concrete with compressive strength less than 2500 PSI is indicated, install reinforcing bars through openings at top in inserts.

E. Install powder-actuated drive pin fasteners 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. Test powder-actuated insert attachments with a minimum load of 100 pounds.

F. Bolting: Provide bored, drilled or reamed holes for bolting to miscellaneous structural metals, frames or for mounts or supports. Flame cut, punched or hand sawn holes will not be accepted.

G. Anchor Bolts:

1. Install anchor bolts for mechanical equipment and piping as required. Tightly fit and clamp base-supported equipment anchor bolts at equipment support points. Provide locknuts where equipment and piping are hung.
2. Anchor Bolts (Cast-In-Place): Embed anchor bolts in new cast-in-place concrete to anchor equipment. Install a pipe sleeve around the anchor bolt for adjustment of the top 1/3 of the bolt embedment; sizes and patterns to suit the installation conditions of the equipment to be anchored.

H. Pipe Anchors: Provide anchors to fasten piping which is subject to expansion and contraction, and adjacent to equipment to prevent loading high forces onto the equipment.

I. Escutcheon Plates: Install around horizontal and vertical piping at visible penetrations through walls, partitions, floors, or ceilings, including penetrations through closets, through below ceiling corridor wall, and through equipment room walls and floors.

J. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:

1. Install fabricated pipe sleeve.
2. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification with specified material.
3. Seal each end airtight with a resilient nonhardening UL listed fire resistant ASTM 814 sealant.

K. Piping Penetrations Through Fire-rated (1 to 3 hour) Assemblies:

1. Select and install pre-engineered pipe penetration system in accordance with the UL listing and manufacturer's recommendation.
2. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814. Use HOLDRITE HydroFlame or approved equivalent.

L. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.

3.05 FLASHING

A. Flash and counterflash where piping passes through weather or waterproofed walls, floors and roofs.

B. Flash vent soil pipes with flashings per Division 01, General Requirements.

C. Flash floor drains over finished areas and roof drains, 10-inches clear on sides, minimum 36-inches x 36-inches sheet size. See Division 01, General Requirements. Fasten flashing to drain with clamping device.

D. Install built up fixtures (mop sinks, shower stalls, shower floors) with water sealing systems/membranes to meet Code and as prescribed by Division 01, General Requirements and Section 22 00 00, Plumbing Basic Requirements. Meet all Code testing requirements. Provide drainage devices with appropriate flanges, clamps, etc. to meet these installation requirements and ensure a water-tight installation.

3.06 MISCELLANEOUS METAL AND MATERIALS

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required. Avoid cutting concrete reinforcing when drilling for inserts. Reference structural drawings and reinforcing shop drawings and determine locations of stirrups prior to drilling into concrete.

C. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete masonry or similar construction.

D. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

E. Setting Loose Plates: Clean concrete and masonry bearing surfaces of any bond reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.

1. Set loose leveling and bearing plates on wedges or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut-off flush with edge of the bearing plate before packing with grout. Use metallic non-shrink grout in concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed locations, unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

F. Fabrication:

1. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on Drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates and similar devices. Hot dip galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.
2. Finishes:
   a. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with 1 coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas with primer of same material before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.
   b. Metal in contact with Concrete, Masonry and Other Dissimilar Materials:
      1) Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.
   c. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

G. Metal Fabrication:

1. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
2. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
3. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of weld and methods used in correcting welding work, and with the following:
   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. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.
4. Provide hot dipped galvanized components for items exposed to weather.

END OF SECTION

SECTION 22 05 48
VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Vibration Isolation
   2. Seismic Bracing/Restraint Devices/Systems for Equipment and Piping

1.02 RELATED SECTIONS

A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.
   1. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
   2. Section 22 30 00 - Plumbing Equipment

1.03 REFERENCES AND STANDARDS

A. References and standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Vibration Isolation:
      a. Product Data: Provide catalog data indicating size, type, load and deflection of each isolator; and percent of vibration transmitted based on lowest disturbing frequency of equipment.
      b. Shop Drawings: Showing complete details of construction for steel and concrete bases including:
         1) Equipment mounting holes.
         2) Dimensions.
         3) Isolation selected for each support point.
         4) Details of mounting brackets for isolator.
         5) Weight distribution for each isolator.
         6) Details of seismic snubbers.
         7) Code number assigned to each isolator.
   2. Seismic Restraint:
      a. Shop Drawings: Show compliance with requirements of Quality Assurance article of this Section. Shop Drawings will be stamped by professional structural engineer licensed in state of Oregon.
      b. Calculations: Submit seismic calculations indicating restraint loadings resulting from design seismic forces. Include anchorage details. Calculations will be certified by professional structural engineer licensed in the state of Oregon.
      c. Certifications: For restraining devices submit pre-approval certification number from government agency. Where pre-approval is not available, submit testing performed by independent laboratory or calculations sealed by professional structural engineer licensed in state of Oregon certifying isolators and restraints will withstand seismic forces encountered.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Vibration Isolation:
    a. Except for packaged equipment with integral isolators, single manufacturer will select and furnish isolation required.
    b. Deflections indicated will be minimum actual static deflections for specific equipment supported.
    c. Isolator Stability:
        1) Size springs of sufficient diameter to maintain stability of equipment being supported with minimum horizontal to vertical stiffness ratio not less than 1:1. Spring diameters will be not less than 0.8 of the compressed height at rated load.
        2) Springs will have minimum additional travel to solid equal to 50 percent of the rated defection.
        3) Springs will support 200 percent of rated load when fully compressed without deformation or failure.
    d. Maximum Allowable Vibration Levels: Peak vibration velocities not to exceed 0.08 in/sec. correct equipment operating at vibration velocities that exceed this criteria.
2. Seismic Restraint:
    a. Seismic restraint and anchorage of permanent equipment and associated systems listed below to building structure will be designed to resist total design seismic force prescribed in local building code:
        1) Floor- or roof-mounted equipment weighing 400 pounds or greater.
        2) Suspended, wall-mounted or vibration isolated equipment weighing 20 pounds or greater.
        3) Housekeeping slabs: provide reinforcement and anchorage to building structure.
    b. Where required, seismic sway bracing of suspended piping will meet the following:
        1) Pipe runs requiring seismic bracing will have a minimum of two traverse braces and one longitudinal brace. A longitudinal (or a traverse) brace at 90 degree change in direction may act as traverse (or longitudinal) brace if located within 2-feet of change in direction.
        2) Seismic bracing may not pass through seismic separation joint. Pipe runs that pass through seismic separation joints must be restrained within 5-feet of both sides of the separation.
        3) Seismic brace assembly spacing will not exceed 40-feet transverse and 80-feet longitudinal.
    c. Seismic sway bracing of suspended piping will be performed for the following:
        1) Piping 8-inches nominal diameter and larger and trapeze systems where total area of pipe exceeds 28 square inches.
        2) Piping 2-1/2-inches nominal diameter and larger and trapeze systems where total area of pipe exceeds 3 square inches.

3) Piping 4-inches nominal diameter and larger, all cast iron and PVC piping and trapeze systems with total aggregate weight of 10 pounds/foot or greater.

4) Piping 1-1/4-inches nominal diameter and larger and trapeze systems with total aggregate weight of 10 pounds/foot or greater.

d. Seismic restraints may be omitted from suspended piping if the following conditions are satisfied:

1) For piping supported by individual rod hangers 12-inches or less in length from top of pipe to bottom of structural support. Top connections to structure will have swivel joints, eye bolts, or vibration isolation hangers for the entire length of the system run.

2) Lateral motion of the system will not cause damaging impact with surrounding systems or cause loss of system vertical support.

3) System must be welded steel pipe, brazed copper pipe, or similar ductile material with ductile connections.

e. Seismic restraints, including anchors to building structure, will be designed by registered professional structural engineer licensed in state of Oregon. Design will include:

1) Number, size, capacity, and location of anchors for floor- or roof-mounted equipment. For curb-mounted equipment, provide design of attachment of both unit to curb and curb to structure.

2) Number, size, capacity, and location of seismic restraint devices and anchors for vibration-isolation and suspended equipment. Provide calculations, test data verifying the horizontal and vertical ratings of the seismic restraint devices.

3) Number, size, capacity, and location of braces and anchors for suspended piping and ductwork on as-built plan drawings.

4) Maximum seismic loads will be indicated on Drawings at each brace location. Drawings will bear stamp and signature of registered professional structural engineer who designed layout of braces.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Vibration Isolation:

1. Amber-Booth.
2. California Dynamics Corporation.
3. Mason Industries, Inc.
4. Kinetics Noise Control.
5. Vibro-Acoustics.
6. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.
7. Or approved equivalent.

B. Seismic Bracing/Restraint Devices/Systems for Equipment and Piping:

1. Amber-Booth.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.

4. Hilti, Inc.
5. Mason Industries, Inc.
6. Kinetics Noise Control.
7. Unistrut.
8. ISAT, Inc.
9. Or approved equivalent.

2.02 VIBRATION ISOLATION

A. Type 1 - Neoprene Pad: Rubber or neoprene waffle pads, single layer, 5/16-inch thick with pattern repeating on 1/2-inch centers; 40 to 50 durometer hardness; maximum loading 50 PSI, 1/4-inch thick steel load distribution plate. Mason Type SWM.

B. Type 2 - Neoprene Mount: Double-deflection type, with steel or ductile-iron housing containing two separate and opposing, oil-resistant rubber or neoprene elements, factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Minimum static deflection of 0.20-inches. Mason Type BR.

C. Type 3 - Spring: Freestanding, laterally stable, open-spring isolators, factory drilled for bolting to structure, if needed, and bonded to 1/4-inch thick rubber isolator pad attached to baseplate underside, mounts with leveling bolts. Mason Type SLFH or Type SLF.

D. Type 4 - Spring with Restraints: Laterally stable, open-spring isolators, factory drilled for bolting to structure and bonded to 1/4-inch thick rubber isolator pad attached to baseplate underside; mounts with leveling bolts; steel or cast iron housing for directional seismic snubbing with resilient vertical-limit stops. Mason Type SLR or SSLFH.

E. Type 5 - Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression; designed for 30-degree angular movement before hanger-rod misalignment without binding; seismic rebound washer; 1-inch minimum deflection. Mason Type PC30N.

F. Seismic Snubbers: Directional interlocking steel members restrained by one-piece molded neoprene bushing, minimum of 3/4-inch thick with minimum 1/8-inch air gap in all directions, capable of withstanding 3 times the rated load capacity. Mason Type Z-1225.

2.03 SEISMIC BRACING/RESTRAINT DEVICES/SYSTEMS FOR EQUIPMENT AND PIPING

A. General Requirements for Restraint Components: Rated strengths, features, and applications will be as defined in reports by agency acceptable to authorities having jurisdiction.

B. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components will be at least four times the maximum seismic forces to which they will be subjected.

C. Anchor bolts for attaching to concrete will be seismic-rated, drill-in, and stud-wedge or female-wedge type. Provide anchor bolts suitable for cracked concrete.

D. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.

E. Maximum 1/4-inch air gap, and minimum 1/4-inch thick resilient cushion.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Vibration isolators and seismic restraint systems must be installed in strict accordance with manufacturers written instructions and certified submittal data.
2. Set floor-mounted equipment on minimum 4-inch-high concrete housekeeping pads. Extend pad at least 6-inches beyond footprint of equipment in each direction.
3. Provide mounts for equipment installed outdoors for wind loads of 30 lbs. psf applied to any exposed surface of isolated equipment.

4. Do not install equipment or pipe which makes rigid contact with building slabs, beams, studs, walls, etc.
5. Anchor baseplate to floor or structure. Provide rubber grommets and washers to isolate bolt from base plate. Under no circumstances will isolation efficiency be destroyed when bolting the isolators to floor.
6. Building Penetrations: Isolate water piping penetrating wall, ceilings, floors or shafts from the structure by piping isolator or by 3/8-inch thick foamed rubber insulation. Install units flush with finished structure face, using one for each side as required. Cut units to length if longer than structure thickness. Caulk around pipe at equipment room wall.
7. Pipe Hangers in Equipment Rooms: Support water and gas piping connected to rotating equipment within equipment rooms on spring and neoprene hangers. The first three hangers from a piece of vibrating equipment are to have a minimum of 1/2 static deflection of equipment isolators. Other isolators should have a minimum of 1/4 static deflection of equipment isolators.

3.02 VIBRATION ISOLATION EQUIPMENT INSTALLATION

A. Install isolation as indicated on Drawings by type and location and where indicated below.

B. Isolation Mounts:

1. Position vibration isolation hanger elements as high as possible in hanger rod assembly but not in contact with building structure. Install hangers so that hanger housing may rotate full 360 degrees about rod axis without contacting any object.
2. Where parallel running pipes are hung together on a trapeze which is isolated from the building, provide isolator deflections for largest determined by provisions for pipe isolation. Do not mix isolated and non-isolated pipes in the same trapeze.
3. Install Type 3 and 4 isolators such that installed and operating heights of vibration isolated equipment is identical. Install limit stops so that they are out of contact during normal operation.
4. Adjust leveling bolts and hanger rod bolts so isolated equipment is level and in proper alignment with connecting pipes.

C. Isolating Pipe Hangers:

1. Install on compressed air and water piping connected to rotating equipment in the mechanical rooms. Provide isolating hanger supports for each piece of isolated equipment outside of mechanical rooms and where indicated.
2. Isolated equipment items include base mounted pumps and line mounted pumps.

D. Pump Inertia Bases:

1. Fill with concrete to provide base weight equal to 2 times combined pump, motor, pipe, and water weight.
2. Provide a minimum operating clearance of 1-inch between structural steel frames and concrete housekeeping pads or floor beneath equipment.
3. Support heels of suction and discharge elbows from base.
4. Secure pump and heel supports with inserts and grout.

E. Other Inertia Bases: Unless otherwise indicated, provide a minimum operating clearance of 1-inch between structural steel frames and the concrete housekeeping pad or floor beneath equipment. Position isolator mounting brackets so that the required clearance is maintained.

F. Vibration isolators must not cause change of position of equipment or piping which would stress piping connections or misalign shafts or bearings.

G. Vibration isolators and seismic restraint systems must be installed in strict accordance with manufacturers written instructions and certified submittal data.

H. Anchor baseplate to floor or structure. Provide rubber grommets and washers to isolate bolt from base plate. Under no circumstances will isolation efficiency be destroyed when bolting the isolators to floor.

I. Anchorage: Adequately anchor or brace plumbing equipment and piping to resist displacement due to seismic action, include snubbers on equipment mounted on spring isolators, pumps and the like.

3.03 SEISMIC RESTRAINTS

A. General:

1. Install and adjust seismic restraints so that equipment and piping supports are not degraded by restraints.
2. Restraints must not short circuit vibration isolation systems or transmit objectionable vibration or noise.

B. Supported Equipment: Each vibration isolation frame for supported equipment will have a minimum of four seismic snubbers mounted as close as possible to vibration isolators and/or frame extremities.

C. Bracing of Pipes: Branch lines may not be used to brace main lines.

D. Suspended Equipment and Piping Cable Method:

1. Cables will be adjusted to the degree of slackness approved by Structural Engineer of Record.
2. Uplift and downward restraint nuts and washers for Type 5 spring hangers will be adjusted so that there is a minimum 1/4-inch clearance.

E. Vibration isolators and seismic restraint systems must be installed in strict accordance with manufacturers written instructions and certified submittal data.

END OF SECTION

SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Plastic Nameplates
   2. Tags
   3. Plastic Pipe Markers

1.02 RELATED SECTIONS

A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Standards (https:www.beaverton.k12.or.us/departments/facilites-development/technical-standards), Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01. General Requirements.

B. In addition, submit Valve Schedule for each piping system, in tabular format using Microsoft Word or Excel software. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shutoff and similar special uses by special "flags" in margin of schedule. In addition to mounted copies, furnish extra copies for maintenance manuals. Provide schedules organized as follows:
   1. Equipment Type:
      a. Identification:
      b. Background:
         1) Size:
         2) Color:
      c. Lettering:
         1) Size:
         2) Color:

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
   2. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 22, Plumbing Sections. Where more than a single type is specified for application, provide single selection for each product category.

B. Plastic Nameplates:
   1. Brady Corporation
   2. Or approved equivalent.

C. Tags:
   1. Brady Corporation
   2. Brimer
   3. Champion America Inc.
   4. Craftmark
   5. Seton Identification Products
   6. Or approved equivalent.

D. Plastic Pipe Markers:
   1. Brady Corporation
   2. Brimer
   3. Champion America Inc.
   4. Craftmark
   5. Seton Identification Products
   6. Or approved equivalent.

2.02 PLASTIC NAMEPLATES

A. Description: Engraving stock melamine plastic laminate 1/8-inch thick, engraved with engraver's standard letter style of the sizes and wording indicated.
   1. Letter Color: White.
   2. Letter Height: 1/2 inch (13 mm).
   3. Background Color: Black.
   4. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
   5. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve or devices/equipment. Include center hole to allow attachment.
   6. Signage for hot water outlets on 140 degree F hot water systems not protected by ASSE 1070 mixing valves; hose bibbs, janitor sinks, and fixtures used by trained personnel.
      a. Manufacturer's standard 1/8-inch thick engraved plastic laminate signage 4 by 4-inches.
      b. Letter Color: Red.
      c. Letter Height: 1/2 inch (13 mm).
      d. Background Color: White.
      e. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.03 TAGS

A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2-inch diameter.

B. Metal Tags: Polished Brass with stamped letters; tag size minimum 1-1/2-inch diameter with smooth edges.

C. Valve designations to be coordinated with existing valve identifications to ensure no repetitive designations are utilized.

D. Chart/Schedules: Valve Schedule Frames. For each page of a valve schedule, provide glazed display frame with removable mounting as appropriate for wall construction upon which frame is to be mounted. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

E. Valve Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks.

F. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7-inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
4. Color: Yellow background with black lettering.

2.04 PLASTIC PIPE MARKERS

A. Color: Conform to ASME A13.1 and ANSI Z535.1.

B. Plastic Pipe Markers (for external diameters of 6-inches and larger including insulation): Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers (for external diameters less than 6-inches including insulation): Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Minimum information indicating flow direction arrow and identification of fluid being conveyed.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Lettering and Graphics:

1. General: Coordinate names, abbreviations and other designations used in plumbing identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
2. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples: Chiller No. 3, Air Handling Unit No. 42, Standpipe F12, and the like).

B. Preparation: Degrease and clean surfaces to receive adhesive for identification materials.

C. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

D. Install valve schedule at each mechanical room.

E. Access Doors: Provide markers on each access door and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions.

3.02 PLASTIC NAMEPLATES

A. Identify pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates riveted to equipment body.

B. Identify control panels and major control components outside panels with plastic nameplates riveted to equipment body.

C. Install plastic nameplates with corrosive-resistant mechanical fasteners.

3.03 TAGS

A. Small devices, such as in-line pumps, may be identified with tags. Use metal tags on piping 3/4-inch diameter and smaller.

B. Identify valves in main and branch piping with metal tags. Indicate valve function and the normally open or closed positions on the valve tag.

C. Coordinate with the facility maintenance personnel to ensure consistency with the existing tagging system.

D. Tag balancing valves with balanced GPM or CFM indicated after balancing is completed and accepted.

E. Install tags with corrosion resistant chain.

3.04 PLASTIC PIPE MARKERS

A. Install plastic pipe markers in accordance with manufacturer's instructions.

B. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

C. For exterior underground piping installations, install underground plastic pipe markers with tracer wire 6 to 8-inches below finished grade directly above buried pipe.

D. Identify piping, concealed or exposed, with plastic tape pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20-feet (reduced to 10-feet in congested areas and mechanical equipment rooms) on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction. Locate near branches, valves, control devices, equipment connections, access doors, floor/wall penetrations.

END OF SECTION

SECTION 22 07 00
PLUMBING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Type 1, Glass Wool Pipe Insulation
   2. Type 2, Flexible Elastomeric Insulation
   3. Type 5, Glass Wool Equipment Insulation
   4. Type 7, ADA Accessible Lavatory/Sink Insulation Kit
   5. Accessories
   6. Pipe Fitting Insulation Covers

1.02 RELATED SECTIONS

A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Piping insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.04 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Installer qualifications.
   2. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
   3. 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.
   4. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.
   5. Submit manufacturer's installation instructions.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements apply to this Section.

B. In addition, meet the following:
   1. Formaldehyde Free: Should be third-party certified with UL Environment Validation.
   2. Recycled Content: A minimum of 40 percent post-consumer recycled glass content certified and UL validated.
   3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.

4. Installer to have minimum 5 years' experience in the business of installing insulation.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.07 FIRE HAZARD CLASSIFICATION

A. Maximum fire hazard classification of the composite insulation construction as installed to be not more than a Flame Spread Index (FSI) of 25 and Smoke Developed Index (SDI) of 50 as tested by current edition of ASTM E84 (NFPA 255) method.

B. Test pipe insulation in accordance with requirements of current edition of UL "Pipe and Equipment Coverings".

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Type 1, Glass Wool Pipe Insulation:
   1. Owens-Corning
   2. Johns Manville
   3. Or approved equivalent.

B. Type 5, Glass Wool Equipment Insulation:
   1. Knauf
   2. Owens-Corning
   3. Johns Manville
   4. Or approved equivalent.

C. Type 7, ADA Accessible Lavatory/Sink Insulation Kit:
   1. IPS/Truebro
   2. McGuire/Pro-Wrap
   3. Plumberex/Pro-Extreme
   4. Brocar Trap Wrap
   5. Or approved equivalent.

D. Accessories:
   1. ITW Insulation Systems
   2. Or approved equivalent.

E. Pipe Fitting Insulation Covers:
   1. Zeston Johns Manville
   2. ITW Insulation Systems
   3. Or approved equivalent.

2.02 TYPE 1, GLASS WOOL PIPE INSULATION

A. Glass Fiber: ASTM C547 Type I and IV; rigid molded, noncombustible.
   1. Thermal Conductivity Value: 0.27 BTU*in/(hr*sf*F) at 75 degrees F.
   2. Maximum Service Temperature: 850 degrees F to 1000 degrees F.
   3. Vapor Retarder Jacket: White Kraft paper reinforced with glass fiber and bonded to aluminum foil, with self-sealing longitudinal laps and butt strips or vapor barrier mastic.

2.03 TYPE 5, GLASS WOOL EQUIPMENT INSULATION

A. Flexible Glass Wool Blanket: ASTM C612; flexible.
   1. Thermal Conductivity Value: 0.24 BTU*in/(hr*sf*F) at 75 degrees F.
   2. Maximum Service Temperature: 450 degrees F.

2.04 TYPE 7, ADA ACCESSIBLE LAVATORY/SINK INSULATION KIT

A. P-traps, trap arms, tail pieces, hot water and cold water insulating guards meeting ASTM C1822. Molded closed cell insulation with vinyl cover and nylon fasteners, paintable. Thermal conductivity; K = 1.17 (BTU*in/(hr*sf*F) at 75 degrees F mean temperature. Provide accessories as required for complete installation covering all exposed waste piping, water piping, stops and supplies. Color white.

2.05 ACCESSORIES

A. Equipment Insulation Compounds: Provide adhesives, cement, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

B. Provide staples, bands, wire, wire netting, tape corner angles, anchors, stud pins and metal covers as recommended by insulation manufacturer for applications indicated. Accessories, i.e., adhesives, mastics, cements and tape to have same flame and smoke component ratings as insulation materials with which they are used. Shipping cartons to bear a label indicating that flame and smoke ratings do not exceed those listed above. Provide permanent treatment of jackets or facings to impart flame and smoke safety. Provide non-water soluble treatments. Provide UV protection recommended by manufacturer for outdoor installation.

2.06 PIPE FITTING INSULATION COVERS

A. PVC Plastic Fitting Covers: Schuller Zeston 2000, Knauf Proto Fitting or approved equivalent. One-piece molded type fitting covers and jacketing material, gloss white. Connections: Tacks; pressure sensitive color matching vinyl tape.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION INFORMATION

A. Verification of Conditions:

1. Do not apply insulation until pressure testing and inspection of piping has been completed.
2. Examine areas and conditions under which insulation will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Preparation: Clean and dry surfaces to be insulated.

C. Installation:

1. Insulation: Continuous through walls, floors and partitions except where noted otherwise.
2. Piping and Equipment:
   a. Install insulation over clean, dry surfaces with adjoining sections firmly butted together and covering surfaces. Fill voids and holes. Seal raw edges. Install insulation in a manner such that insulation may be split, removed, and reinstalled with vapor barrier tape on strainer caps and unions. Do not install insulation until piping has been leak tested and has passed such tests. Do not insulate manholes, equipment manufacturer's nameplates, handholes, and ASME stamps. Provide beveled edge at such insulation interruptions. Repair voids or tears.

D. Provide accessories as required. See Part 2 Article "Accessories" above.

E. Protection and Replacement: Protect installed insulation during construction. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

F. Labeling and Marking: Provide labels, arrows and color coding on piping. Attach labels and flow direction arrows to jacketing per Section 22 05 53, Identification for Plumbing Piping and Equipment.

G. Insulation Shields: Provide hangers and shields (18 gauge minimum) outside of insulation for cold piping (<60 degrees F). Hot water piping hangers may penetrate insulation to

contact pipe directly. Provide 18-inch long, noncompressible insulation section at insulation shields for lines 1-1/2-inches and larger (hot and cold piping).

H. Piping Surfaces to be Insulated:

Item to be Insulated	System Insulation Type	Pipe Size	Insulation Thickness
Hot Water Piping Above Grade (105F to 140F)	1	Runouts up to 1-1/2-inch (uncirculated branches) Mains =<1-1/4-inch Mains >1-1/4-inch	1-inch 1-inch 1-1/2-inch
Hot Water Circulation Piping Above Grade (105F to 140F)	1	Runouts up to 1-1/2-inch Mains =<1-1/4-inch Mains >1-1/4-inch	1-inch 1-inch 1-1/2-inch
Hot Water Piping Above Grade (141F to 200F)	1	Runouts up to 1-1/2-inch Mains =<1-1/4-inch Mains >1-1/4-inch	1-inch 1-1/2-inch 2-inch
Hot Water Circulation Piping Above Grade (141F to 200F)	1	Runouts up to 1-1/2-inch Mains =<1-1/4-inch Mains >1-1/4-inch	1-inch 1-1/2-inch 2-inch
Cold Water Piping Above Grade	1	=<1-1/2-inch >1-1/2-inch	1/2-inch 1-inch
Hot Water Piping Below Grade	2	=<1-1/2-inch >1-1/2-inch	1-inch 1-1/2-inch
Hot Water Circulation Piping Below Grade	2	=<1-1/2-inch >1-1/2-inch	1-inch 1-1/2-inch
Water Piping Exposed to Weather	1, 2, 4	All	1-1/2-inch
ADA Accessible Lavatory/Sink	7	All	As Listed

3.02 TYPE 1, GLASS WOOL PIPE INSULATION

A. See General Installation Requirements above.

B. Install in accordance with manufacturer's instructions for below grade installation.

C. Lap seal insulation with waterproof adhesive. Do not use staples or other methods of attachment which would penetrate vapor barrier. Apply fitting covers with seated tacks and vapor barrier tape.

D. Apply insulation to pipe and seal with self-sealing lap. Use self-sealing butt strips to seal butt joints. Insulate fittings, valves and unions with single or multiple layers of insulation and cover to match pipe or use preformed PVC molded insulation covers.

3.03 TYPE 5, GLASS WOOL EQUIPMENT INSULATION

A. See General Installation Requirements above.

B. Apply insulation and accessories to roof drain underbodies per manufacturer's recommendations.

C. Roof Drain/Overflow Drain Underbodies: Cover underside of drain body with glass wool insulation; attached with adhesive and supported externally with 26 gauge galvanized flat strapping anchored to structure.

D. Storage Tanks: Cover with glass wool, 2-inches thick. Finish with canvas jacket and adhesive. Overlap joints minimum of 4-inches. Apply two coats latex paint; color selected by Architect.

3.04 TYPE 7, ADA ACCESSIBLE LAVATORY/SINK INSULATION KIT

A. See General Installation Requirements above.

B. Install in accordance with manufacturer's instructions.

C. Provide lavatory/sink insulation kit. Install on waste fittings, hot and cold water stops and supplies.

3.05 ACCESSORIES

A. See General Installation Requirements above.

B. Install in accordance with manufacturer's instructions.

C. Provide and install accessories for all insulation types listed in this Section.

3.06 PIPE FITTING INSULATION COVERS

A. See General Installation Requirements above.

B. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 22 10 00
PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Hot and Cold Domestic Water Above Grade
   2. Condensate Piping
   3. Primer Piping

1.02 RELATED SECTIONS

A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. NSF 61, Annex G.
   2. Steel pipe to conform to ASTM and ANSI Standards as specified in this Section.
   3. Copper piping to conform to ASTM B88, B306 and B208 and the standards of Copper Development Association (CDA), and American Welding Society, (AWS).
   4. Cast Iron Piping to conform to standards of ASTM A-74, CISPI 301 and FM 1680.
   5. Manufacturer's Standards Society (MSS) for valving and support reference standard.
   6. American Water Works Association (AWWA) for Valving Assembly Standards.
   7. American Society of Sanitation Engineers (ASSE) for Valving Standards.
   8. American National Standards Institute (ANSI) for Piping Standards.
   9. NFPA Standard 51B - “Fire Prevention in Use of Cutting and Welding Processes”.
   10. Crosslinked polyethylene (PEX) pipe conforming to ASTM F876, F877 and CSA B1375, or DIN 16892 and 16893.

1.04 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. See component manufacturers listed in individual articles below.
B. Uponor
C. Cerro
D. ADS
E. Elkhart
F. Enfield

G. Gruvlok
H. Spears
I. Nibco
J. Orion
K. American-USA
L. Viega
M. Mueller
N. Firestopping Penetrations in Fire Rated Wall Floor Assemblies:
1. Hilti
2. Proset
3. Or approved equivalent.

2.02 GENERAL

A. Provide pipe, tube and fittings of the same type, fitting requirements, grade, class and the size and weight indicated or required for each service, as indicated in other Division 22, Plumbing Specifications. Where type, grade, or class is not indicated, provide proper selection as determined by installer for installation requirements, and comply with governing regulations and industry standards.
B. Manufactured materials delivered, new to the project site and stored in their original containers.
C. Product Marking: Furnish each item with legible markings indicating name brand and manufacturer, manufacturing process, heat number and markings as required per ASTM and UL/FM Standards.

2.03 HOT AND COLD DOMESTIC WATER ABOVE GRADE

A. Copper Tube: 3-inches and above. ASTM B88 (ASTM BA88m), Type L (B), Drawn.
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
2. Joints: Brazed BCuP2.
B. Copper Tube: 2-1/2-inches and smaller. ASTM B88 (ASTM B88M), Type L (B), Drawn.
1. Fittings: ASME B16.18 copper.
2. Joints: ASTM B32, alloy Sn95 solder.
C. Copper Tube: Water pressures up to 250 PSI gauge. ASTM B 88 (ASTM BA 88m), Type K (A), Drawn.
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
2. Joints: Brazed BCuP2.
D. Stainless Tube:
1. Piping 3-inch and Larger: Grade H, ASTM A268/A268M-91, roll-grooved joint.
2. Fittings: Schedule 10S Type 304L stainless steel fittings, ISO 9001, ASTM A-403.
3. Couplings: Anvil or Gruvlok grooved system, IPS stainless steel grooved coupling with EPDM gasket, stainless steel nuts and bolts, ASTM-A351, A743 AND A744-CF-8M, ISO 9001.
E. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), Drawn.
1. Fittings: ASME B16.22, wrought copper.
2. Joints: Roll grooved mechanical coupling. ASTM A536.
F. Cross-Linked Polyethylene Tubing, Fittings and Accessories (except exposed locations).
1. Tubing:

a. Cross-linked polyethylene (PEX) tubing complies with requirements of ASTM F876 and F877, and cross-linking method must be Type A (hot)method.

b. PEX tubing to have minimum working pressure of not less than 160 PSI for water at 73.4 degrees F, 100 PSI for water at 180 degrees F and 80 PSI for water at 200 degrees F determined in accordance with Plastic Pipe Institute Technical Report TR-3/92, and listed in Plastic Pipe Institute Technical Report TR-4/95.

2. Fittings:

a. Fittings: Engineered Plastic Fittings for above grade applications. Engineered plastic fittings for below grade applications. Serrated type with reinforcement rings.

b. Reinforcement Rings: Manufactured using "Engel Method" to ensure that viscoelastic stress regenerative properties are sufficient to produce pressure tight seal.

c. Fitting Insert: Of such dimension in that tubing must be expanded in order to facilitate insertion of fitting into tube.

d. Accomplish expansion of tubing and ring by an expansion tool designed expressly for that purpose.

e. Fittings complies with requirements of ASTM F877.

3. Manifolds: Provide premanufactured copper manifolds of same manufacturer as piping.

4. Stub-out Ells and Stub-out Brackets: Provide premanufactured Type L copper stub-out ells and copper stub-out brackets.

G. Mechanical Press Fittings (1/2-Inch Through 2-Inch):

1. Mechanical press-connect fittings made out of bronze or copper conforming to the performance requirements of IAPMO PS117, ANSI/ICC LC1002, ASME B16.51and NSF 61-G. Fittings with EPDM sealing element and leak detection feature that identifies un-pressed fittings during testing (Smart Connect).

2.04 CONDENSATE PIPING

A. Copper Tube: ASTM B 88 (ASTM B898M), Type L (B).

1. Fittings: ASME B16.29, wrought copper.

2. Joints: ASTM B32, alloy Sn50 solder.

B. Use chemical resistant piping for drainage of condensate from combustion fuel sources (such as condensing boilers and water heaters), as noted in this Section for area of application.

C. CPVC (Chlorinated Poly Vinyl Chloride) Pipe and Fittings:

1. Pipe and Fittings: Schedule 40, NSF-14, ASTM 439, IAPMO IS20-96, socket fittings, solvent weld.

2.05 PRIMER PIPING

A. Above Ground: Type L hard-drawn copper tubing with wrought sweat fittings and soldered joints.

B. Belowground: Type L soft annealed copper tubing with wrought sweat fittings and brazed joints.

C. Belowground: Cross-linked polyethylene (PEX) and engineered plastic fittings.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. General Installation:

1. Work performed by experienced journeyman plumbers. No exceptions.

2. Provide access panels for concealed valves, shock arrestors, trap primers and the like.
3. Install pipes and pipe fittings in accordance with recognized industry practices and manufacturer's recommendations.
4. Align piping accurately at connections, within 3/32-inch misalignment tolerance. Comply with ANSI B31 Code for Pressure Piping.
5. Locate piping runs, as indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details, and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2-inch where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1-inch clearance outside insulation. Whenever possible in finished and occupied spaces, conceal piping from view by locating it in column enclosures, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as indicated.
    a. Do not run piping through transformer vaults, telephone, elevator, electrical or electronic equipment spaces or enclosures unless indicated on Drawings.
    b. Concealed Piping Above Suspended Ceiling: Plan and coordinate to avoid interferences; install to maintain suspended ceiling heights shown on Architectural Drawings. Allow sufficient space above removable ceiling panels for panel removal. Locate piping so that valves are visible and accessible within 24-inches horizontally and vertically from point of access to the ceiling space. Provide plenum rated materials for ceiling spaces which are being used as plenums.
    c. Exposed Work: Run pipes parallel to the closest wall unless otherwise shown on Drawings; maintain maximum headroom; avoid light fixtures.
    d. Insulation Space Allowance: In piping work, allow space for pipe insulation and jackets. If interferences occur, move the piping to accommodate insulation thickness specified.
    e. Pipe Lengths: Do not use short lengths or nipples at locations where a full length of pipe will fit.
    f. Alignment Prior to Supporting and Anchoring: Place piping in proper alignment and position prior to connection to anchors, expansion loops, and equipment. Furnish jacking devices, temporary steel structural members, and assembled structures as necessary. Remove temporary equipment and structures supplied by contractor at completion; such items to remain Contractor property.
    g. Valve and Equipment Connections: Piping not to place undue stress on flanged valves and equipment connections. Install mating flange faces true and parallel to each other and not requiring springing of piping for assembly. Pipe hangers and supports to carry the full weight of the pipe and fluid.
    h. Piping Leaks: Correct immediately; use new materials; leak-sealing compounds or peening not permitted.
    i. Pressure Ratings of Fittings, Valves, and Devices in Piping Systems: Pressure rating to be equal to, or greater than, the maximum working pressure of the system.

j. Equipment Vents and Drains: Provide for coils and vessels which contain water. Provide isolation valves and outlet valves at piping high and low points to permit venting and draining of the vessel without venting and draining connected piping. Provide hose connections and caps on drain lines.

k. Escutcheon Plates: Where exposed insulated and uninsulated piping passes through walls, floors or ceilings; provide spring clip type. Provide plates on both sides of wall or floor.

B. Testing:

1. General:

a. Provide temporary equipment for testing, including pumps, compressors, tanks, and gauges, as required. Test piping systems before insulation (if any) is installed and remove or disengage control devices before testing. Where necessary, test sections of each piping system independently, but do not use piping valves to isolate sections where test pressures exceed local valve operating pressure rating. Fill each section with water, compressed air, or nitrogen and pressurize for the indicated pressure and time.

b. Notify Architect and local Plumbing Inspector 2 days before tests.

c. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.

d. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.

e. Send test results to Architect for review and approval and include in Operation and Maintenance Manual.

2. Testing of Pressurized Systems:

a. Test each pressurized piping system at 150 percent of operating pressure indicated, but not less than 125 PSIG test pressure.

b. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.

3. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at hydrostatic pressure of 125 PSIG.

C. Corrosive Soil Conditions:

1. Wrap steel, iron, copper or other metal piping materials/fittings with Protecto Wrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per manufacturer's recommendations.

2. Provide epoxy coated cast iron pipe and fittings for drainage systems.

3. Obtain and review project soils report for verification of requirements concerning corrosive soils.

D. Protection:

1. Keep pipe openings closed by means of plugs or caps to prevent entrance of foreign matter. Protect piping, ductwork, fixtures, equipment and apparatus against dirty water, chemical or mechanical damage both before and after

installation. Restore to its original condition or replace fixtures, equipment or apparatus damaged prior to final acceptance of work.

E. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:

1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.

F. Cut piping squarely, free of rough edges and reamed to full bore. Insert piping fully into fittings.

G. Provide joints of type indicated in each piping system.

H. Thread pipe in accordance with ANSI/ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Remove excess cutting oil from piping prior to assembly. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

I. Sleeves:

1. Pipe Sleeves:

a. Layout work in advance of pouring concrete, furnish, and set sleeves necessary to complete work.

b. Floor Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Extend sleeve 1-inch above finished floor. Caulk pipes passing through floor with non-shrinking grout or approved caulking compound (Except DWV Piping penetrating a concrete slab set on finish grade), provide "Link-Seal" sleeve sealing system for concrete/slab penetrations which are below grade. Caulk/seal piping passing through fire rated building assembly with UL rated assemblies. Provide fire-rated assemblies per local AHJ requirements

c. Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk pipes passing through walls with non-shrinking caulking compound. Provide modular link sealing system for concrete penetrations which are below grade. Caulk/seal piping passing through fire-rated assemblies per local AHJ requirements.

d. Beam Sleeves: Coordinate with trades for locations of pipe sleeves in reinforced concrete and steel beams. Indicate penetrations on structural shop drawings. See Drawings and Specifications for specific sleeve location limitations. Plumbing Drawings are diagrammatic. Offset piping as required to meet these limitations. Pipe sleeve locations must be indicated on reinforced concrete and steel beam shop drawings. Field cutting of beams not allowed without written approval of structural engineer. No extra costs allowed for failure to coordinate beam penetrations prior to reinforced concrete and steel beam shop drawing submittal.

2. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:

a. Install fabricated pipe sleeve.

b. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification.

c. Seal each end airtight with a resilient nonhardening seal per code.

3. Piping penetrations through fire-rated (1 to 3 hour) assemblies:

a. Select and install pre-engineered pipe penetration system in accordance with UL listing and manufacturer's recommendation.

b. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E84.

3.02 HOT AND COLD DOMESTIC WATER ABOVE GRADE

A. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.

B. Testing of Pressurized Systems:

1. Test each pressurized piping system at 150 percent of operating pressure indicated, but not less than 125 PSIG test pressure.
2. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.

C. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at hydrostatic pressure of 125 PSIG.

D. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:

1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.

E. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM Std. B-32, in accordance with IAPMO Is 3-93, ASTM B-828 and Copper Development Association recommended procedures. Clean joints by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes to be water soluble for copper and brass potable water applications, and meeting CDA standard test method 1.0 and ASTM B813-91. Apply solder until a full fillet is present around the joint. Do not apply solder and flux in such excessive quantities as to run down interior of pipe. Lead solder or corrosion flux not to be present at the jobsite.

F. Braze copper tube and fitting socket with BCuP series filler metal without flux. Use listed brazing flux for joining of copper tube to brass or bronze fittings, meeting AWS FB3A or FB3C. "Shock" cooling is prohibited. A continuous fillet is to be visible around the completed joint. After cooling, thoroughly remove flux residue with warm water and a brush prior to testing. Do not use BCuP filler on copper alloys containing over 10 percent nickel. Cap or plug piping during construction to prevent entry of foreign material.

G. Domestic Water:

1. "Piping" to include pipes, fittings, nipples, valves and accessories connected thereto.
2. Run piping generally parallel to the axis of the building, arranged to conform to the building requirements and to suit the necessities of clearance for other mechanical ducts, flues, conduits and work of other trades, and as close to ceiling or other construction as practical, free of unnecessary traps or bends.
3. Grade water supply piping for complete drainage of the system. Install hose bibbs at low points.
4. Use unions for piping connections to equipment.
5. Provide sufficient elbows, swings and offsets to permit free expansion and contraction.
6. Use reducers or increasers. Use no bushings.
7. Ream or file each pipe to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageways.
8. Cover, cap or otherwise protect open ends of piping during construction to prevent damage to threads or flanges and prevent entry of foreign matter. Disinfect and sterilize water supply piping as specified. Furnish written report on final water quality results.

9. Install exposed connections to equipment with special care, showing no tool marks or threads at fittings and piping. No bowed or bent piping permitted.
10. Make ferrous to non-ferrous connections with dielectric fittings.
11. Use extra heavy pipe for nipples, where unthreaded portion is less than 1-1/2-inches. Use no close nipples. Use only shoulder-type nipples.
12. Through-Wall Pipes: Type 'L' copper tubing for through-wall pipes which connect to exposed stops at wall surface. Anchor the pipes in the wall; attach pipe with U-bolts to steel back-up plates or steel angles anchored in the wall. Provide wrought copper elbow which securely anchors ears in wall at through-wall pipes.
13. Provide drain valves at base of risers and at low points on the system.
14. Backflow Preventers: Pipe relief to nearest drain. Slope at 2 percent.

H. Installation of Press Fittings:

1. Make copper and copper alloy press connections in accordance with the manufacturer’s installation instructions. Obtain training from the manufacturer’s representative on the use and installation of the system.
2. Visually examine fitting to ensure that sealing element is not damaged and that it is properly seated into the fitting. Fully insert tubing into the fitting. Mark the tubing with a felt tip pen at the face of the fitting to indicate fully seated fitting.
3. Check fitting alignment against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting.
4. Press joints using the tool(s) recommended by the manufacturer.
5. Quality Assurance:
   a. Pressure test to identify un-pressed connections. After press-connect fittings have been installed, perform a step test. Utilizing air or water, pressurize the system, not to exceed 85 psi.
   b. If there is a significant drop in pressure, walk the system to check for un-pressed fittings. Should an un-pressed fitting be located, release the pressure from the system and press the un-pressed fitting. If no un-pressed fitting is identified, pressurize the system to test pressures required by code.

I. Sterilization of Domestic Water System:

1. General: Upon completion of tests and necessary replacements, thoroughly flush and disinfect domestic water piping.
2. Method: After thoroughly flushing system with water to remove sediment, fill system with a solution containing 50 parts per million of chlorine for not less than 24 hours or 200 parts per million of chlorine for not less than 3 hours. After retention, drain, reflush and return system to service.
3. Certification: Provide copy of domestic water chlorination certificate in each operations and maintenance manual.
4. Provide water line disinfections performed by a licensed contractor with training in potable water line disinfections.

3.03 CONDENSATE PIPING

A. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:

1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.

3.04 PRIMER PIPING

A. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.

END OF SECTION

SECTION 23 00 00
HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Work included in 23 00 00, HVAC Basic Requirements applies to Division 23, HVAC work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of heating, ventilating and air conditioning systems for proposed project.

B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.

C. Definitions:

1. Provide: To furnish and install, complete and ready for intended use.
2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work provided.
4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.02 RELATED SECTIONS

A. Contents of Section applies to Division 23, HVAC Contract Documents.

B. Related Work:

1. Additional conditions apply to this Division including, but not limited to:
   a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
   b. Drawings
   c. Addenda
   d. Owner/Architect Agreement
   e. Owner/Contractor Agreement
   f. Codes, Standards, Public Ordinances and Permits

1.03 REFERENCES AND STANDARDS

A. References and Standards per Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) ,Division 01, General Requirements, individual Division 23, HVAC Sections and those listed in this Section.

B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:

1. State of Oregon:
   a. OAR - Oregon Administrative Rules

b. OESC - Oregon Electrical Specialty Code
c. OFC - Oregon Fire Code
d. OMSC - Oregon Mechanical Specialty Code
e. OPSC - Oregon Plumbing Specialty Code
f. OSSC - Oregon Structural Specialty Code
g. OEESC - Oregon Energy Efficiency Specialty Code

C. Reference standards and guidelines include but are not limited to the latest adopted editions from:

1. ABA - Architectural Barriers Act
2. ABMA - American Bearing Manufacturers Association
3. ADA - Americans with Disabilities Act
4. AHRI - Air-Conditioning Heating & Refrigeration Institute
5. AMCA - Air Movement and Control Association
6. ANSI - American National Standards Institute
7. ASCE - American Society of Civil Engineers
8. ASHRAE - American Society of Heating, Refrigeration and Air-Conditioning Engineers
9. ASHRAE Guideline 0, The Commissioning Process
10. ASME - American Society of Mechanical Engineers
11. ASPE - American Society of Plumbing Engineers
12. ASSE - American Society of Sanitary Engineering
13. ASTM - ASTM International
14. AWWA - American Water Works Association
15. CFR - Code of Federal Regulations
16. CGA - Compressed Gas Association
17. CISPI - Cast Iron Soil Pipe Institute
18. EPA - Environmental Protection Agency
19. ETL - Electrical Testing Laboratories
20. FM - FM Global
21. GAMA - Gas Appliance Manufacturers Association
22. HI - Hydraulic Institute Standards
23. IAPMO - International Association of Plumbing & Mechanical Officials
24. IFGC - International Fuel Gas Code
25. ISO - International Organization for Standardization
26. MSS - Manufacturers Standardization Society
27. NEC - National Electric Code
28. NEMA - National Electrical Manufactures Association
29. NFPA - National Fire Protection Association
30. NFGC - National Fuel Gas Code
31. NRCA - National Roofing Contractors Association
32. NSF - National Sanitation Foundation
33. OSHA - Occupational Safety and Health Administration
34. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, Inc.
35. TEMA - Tubular Exchanger Manufactures Association

36. TIMA - Thermal Insulation Manufactures Association
37. UL - Underwriters Laboratories, Inc.

D. See Division 23, HVAC individual Sections for additional references.

1.04 SUBMITTALS

A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 23, HVAC Sections.

B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.

C. In addition:

1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail or posted to ftp site. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. Deviations will be returned without review.
3. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 23, HVAC Sections.
4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.
    a. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
    b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference individual Division 23, HVAC Specification Sections for specific items required in product data submittal outside of these requirements.
    c. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.
    d. For vibration isolation of equipment, list make and model selected with operating load and deflection.
    e. See Division 23, HVAC individual Sections for additional submittal requirements outside of these requirements.
5. Maximum of two reviews of submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of these additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.

6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.
7. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-10 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
8. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required by Division 23, HVAC Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.
9. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
10. Substitutions and Variation from Basis of Design:
    a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
    b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
11. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, equipment, ductwork and piping layout plans, and control wiring diagrams. Reference individual Division 23, HVAC Specification Sections for additional requirements for shop drawings outside of these requirements.
    a. Provide Shop Drawings indicating access panel locations for items that require Code or maintenance access, size and elevation for approval prior to installation.
12. Samples: Provide samples when requested by individual Sections.
13. Resubmission Requirements:
    a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.

1) Resubmit for review until review indicates no exception taken or make "corrections as noted".

2) When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.

14. Operation and Maintenance Manuals, Owner's Instructions:

a. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.

1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.

2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: belts, motors, lubricants, and filters.

3) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Sections.

4) Include product certificates of warranties and guarantees.

5) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.

6) Include copy of startup and test reports specific to each piece of equipment.

7) Include copy of final air and water systems balancing log along with pump, fan and distribution system operating data.

8) Include commissioning reports.

9) Include copy of valve charts/schedules.

10) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.

b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 23 00 00, HVAC Basic Requirements Article titled "Demonstration".

c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.

15. Record Drawings:

a. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical items. Include items changed by field orders, supplemental instructions, and constructed conditions.

b. Record Drawings are to include equipment and fixture/connection schedules, control dampers, fire smoke dampers, fire dampers, valves, bottom of pipe, duct and equipment elevations and dimensioned locations for all distribution systems (hydronic and air). Invert elevations and dimensioned locations for underground systems below grade to 5-feet outside building that accurately reflect "as constructed or installed" for project.

c. At completion of project, input changes to original project Revit Model and make one set of black-line drawings created from Revit Model in version/release equal to contract drawings. Submit Revit disk and drawings upon substantial completion.

d. At completion of project, show changes and deviations from the Drawings in red on one set of black-line drawings. Include written Addendums, RFIs, and change order items. Make changes to Drawings in a neat, clean, and legible manner.

e. See Division 23, HVAC individual Sections for additional items to include in record drawings.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.

B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.

C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.

D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.

E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.

F. Provide products that are UL listed.

G. Piping and duct insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

H. ASME Compliance: ASME listed water heaters and boilers with an input of 200,000 BTUH and higher, hot water storage tanks which exceed 120 gallons, and hot water expansion tanks which are connected to ASME rated equipment or required by code or local jurisdiction.

I. Provide safety controls required by National Boiler Code (ASME CSD 1) for boilers and water heaters with an input of 400,000 BTUH and higher.

1.06 WARRANTY

A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Contracting and Procurement Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.07 COORDINATION DOCUMENTS

A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, equipment, fire sprinklers, plumbing, cable trays, lights, and electrical services with architectural and structural requirements, and other trades (including ceiling suspension, and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.

B. Advise Architect in event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.

C. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.

D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer, including but not limited to pumps, fans, valves, control devices, air handlers, vibration isolation devices, etc.

2.02 STANDARDS OF MATERIALS AND WORKMANSHIP

A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or ETL approved or have adequate approval or be acceptable by State, County, and City authorities.

B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.

C. Hazardous Materials:

1. Comply with local, State of Oregon, and Federal regulations relating to hazardous materials.
2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.01 ACCESSIBILITY AND INSTALLATION

A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Install equipment having components requiring access (i.e., drain pans, drains, control operators, valves, motors and vibration isolation devices) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.

C. Install equipment and products complete as directed by manufacturer's installation instructions including all appurtenances recommended in manufacturer's installation instructions, at no additional charge to Owner. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing and coordination with other trades and disciplines.

D. Earthwork:

1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:

   a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork Sections. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.

   b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.

   c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.

E. Firestopping:

1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:

   a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

F. Pipe Installation:

1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building, as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, seismic flexible joints, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating for coordinating installation of piping systems.

2. Include provisions for servicing and removal of equipment without dismantling piping.

G. Plenums:

1. Plenums: Materials within plenums shall be noncombustible or shall have a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E 84 or UL 723. Immediately notify Architect / Engineer of any discrepancy.

3.02 SEISMIC CONTROL

A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 23 HVAC Sections.

B. General:

1. Earthquake resistant designs for HVAC (Division 23) equipment and distribution, i.e. motors, ductwork, piping, equipment, etc. to conform to regulations of jurisdiction having authority.

2. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.

3. Provide stamped Shop Drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for piping equipment and water heaters. Submit Shop Drawings along with equipment submittals.

4. Provide stamped Shop Drawings from licensed Structural Engineer of seismic flexible joints for piping and crossing building expansion or seismic joints. Submit Shop Drawings along with seismic bracing details.

C. Piping and Ductwork:

1. Per "Seismic Restraints Manual Guidelines for Mechanical Systems" latest edition published by SMACNA or local requirements.

D. Provide means to prohibit excessive motion of mechanical equipment during earthquake.

3.03 REVIEW AND OBSERVATION

A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:

1. Prior to covering walls.

2. Prior to ceiling cover/installation.

3. After major equipment is installed.

4. When main systems, or portions of, are being tested and ready for inspection by AHJ.

C. Final Punch:

1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Mechanical Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the mechanical systems are ready for final punch.

2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.04 CONTINUITY OF SERVICE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:

1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new piping and ductwork, and wiring to point of connection. Where existing systems are being utilized, clean existing distribution systems (ductwork, piping, fans, air handlers) prior to connecting new ductwork or piping.
3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
    a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
4. Organize work to minimize duration of power interruption.

3.05 CUTTING AND PATCHING

A. Confirm Cutting and Patching requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:

1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.06 EQUIPMENT SELECTION AND SERVICEABILITY

A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

B. Maintain design intent where equipment other than as shown as Basis of Design in Contract Documents is provided. Where equipment requires ductwork or piping arrangement, controls/control diagrams, or sequencing different from that indicated in Contract Documents, provide at no additional cost to Owner.

3.07 DELIVERY, STORAGE AND HANDLING

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:

1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt, and/or dust as a result of improper storage to be replaced before installation.
2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
3. Protect bright finished shafts, bearing housings and similar items until in service.

3.08 DEMONSTRATION

A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.09 CLEANING

A. Confirm Cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.10 INSTALLATION

A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.

C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

1. Do not place equipment in sustained operation prior to initial balancing of HVAC systems.

D. Provide miscellaneous supports/metals required for installation of equipment, piping and ductwork.

3.11 PAINTING

A. Confirm Painting requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:

1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces in mechanical rooms, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
2. After acceptance by Authority Having Jurisdiction (AHJ), In a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
3. See individual equipment Specifications for other painting.
4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
5. Piping and Ductwork: Clean, primer coat and paint exposed piping and ductwork on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.
6. Covers: Covers such as manholes, cleanouts and the like will be furnished with finishes which resist corrosion and rust.

3.12 DEMOLITION

A. Confirm requirements in Division 01, General Requirements and Division 02, Existing Conditions. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:

1. Scope:
   a. It is the intent of these documents to provide necessary information and adjustments to the HVAC system required to meet code, and accommodate installation of new work.
   b. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas.
   c. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve utilities. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.
2. Equipment: Unless otherwise directed, equipment, fixtures, or fittings being removed as part of demolition process are Owner's property. Remove other items not scheduled to be reused or relocated from job site as directed by Owner.
3. Unless specifically indicated on Drawings, remove exposed, unused ductwork and piping to behind finished surfaces (floor, walls, ceilings, etc.). Cap and patch surfaces to match surrounding finish.
4. Unless specifically indicated on Drawings, remove unused equipment, fixtures, fittings, rough-ins, and connectors. Removal is to be to a point behind finished surfaces (floors, walls, and ceilings).

3.13 ACCEPTANCE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:

1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with

Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:

a. Testing and Balancing Reports
b. Cleaning
c. Operation and Maintenance Manuals
d. Training of Operating Personnel
e. Record Drawings
f. Warranty and Guaranty Certificates
g. Start-up/Test Document
h. Commissioning Reports

3.14 FIELD QUALITY CONTROL

A. Confirm Field Quality Control requirements in Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Tests:

1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in Operation and Maintenance Manuals.
2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.15 LETTER OF CONFORMANCE

A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that HVAC items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

3.16 ELECTRICAL INTERLOCKS

A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

3.17 TEMPORARY HEATING, COOLING AND HUMIDITY CONTROL

A. Provide temporary heating, cooling, controls, humidification and dehumidification as required to facilitate the construction of the project. Size and select temporary system based on the requirements of the various trades during construction. This includes, but is not limited to, drywall, case work, wood flooring and wood finishes that are subject to warping. Size and install system to prevent mold growth. Coordinate the location of the temporary system. The house system can be used. Develop a procedure for how the house system will be used including a sketch depicting the house system, how filtration will be used to prevent construction debris from entering the system and how often the filters will be changed, how the ductwork will be cleaned after use to ensure a clean system is turned over to the Owner and how the units are sized. Submit this procedure to the Mechanical Engineer for review. Follow National Air Duct Cleaners Association (NADCA) duct cleaning procedures and guidelines. Warranties for the house system, if new, to commence when the Owner moves in if house system is used as the means to maintain the climate within the building during construction. Include this warranty requirement in the original bid or proposal amount. Coordinate and provide any temporary power, controls, ductwork, piping, plumbing anchorage, miscellaneous steel and structural supports required to support the temporary system. Installation of the system to comply with all applicable codes and be acceptable to the Authority Having Jurisdiction (AHJ).

END OF SECTION

SECTION 23 05 16
EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Flexible Expansion Loop (For Thermal and Seismic Applications), Steel Piping
   2. Flexible Expansion Loop (For Thermal and Seismic Applications), Copper Piping
   3. Accessories

1.02 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.03 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.05 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Flexible Expansion Loop (for Thermal and Seismic Applications), Steel Piping:
   1. Mercer Rubber Company
   2. Metraflex Company
   3. Mason
   4. Hyspan
   5. Or approved equivalent.

B. Flexible Expansion Loop (for Thermal and Seismic Applications), Copper Piping:
   1. Mercer Rubber Company
   2. Metraflex Company
   3. Mason
   4. Hyspan
   5. Or approved equivalent.

C. Accessories
   1. Mercer Rubber Company
   2. Metraflex Company
   3. Mason
   4. Hyspan
   5. Or approved equivalent.

2.02 FLEXIBLE EXPANSION LOOP (FOR THERMAL AND SEISMIC APPLICATIONS) - STEEL PIPING

A. Construction: Two flexible sections of hose and braid, two 90 degree elbows and a 180 degree return designed so piping does not change direction, but maintains course along a

single axis. Use Vee Loop where space is limited. No thrust loads to be imported to system support anchors or building structure.

B. Inner Hose: 304 stainless steel, close pitch, annular corrugated hose.

C. Exterior Sleeve: Single braided, 304 stainless steel.

D. Minimum Pressure Rating: 125 PSI at 70 degrees F with a 4-to-1 safety factor.

E. Joint: ANSI Class 150 carbon steel flanges.

F. Size: Use pipe sized units.

G. Support: Center support at bottom of 180 degree return.

H. Drain/Air Release: At bottom of 180 degree return.

I. For Natural Gas: Approved by the CSA and complying with UL536.

J. Basis of Design: Metraflex Metraloop, for Vee configuration Mason-Mercer VFL.

2.03 FLEXIBLE EXPANSION LOOP (FOR THERMAL AND SEISMIC APPLICATIONS) - COPPER PIPING

A. Construction: Two flexible sections of hose and braid, two 90 degree elbows and a 180 degree return designed so piping does not change direction, but maintains course along a single axis. Use Vee Loop where space is limited. No thrust loads to be imported to system support anchors or building structure.

B. Inner Hose: Bronze, close pitch, annular corrugated hose.

C. Exterior Sleeve: Braided bronze.

D. Minimum Pressure Rating: 125 PSI at 70 degrees F.

E. Joint: Sweat ends.

F. Size: Use pipe sized units.

G. Support: Center support at bottom of 180 degree return.

H. Basis of Design: Metraflex Metraloop, for Vee configuration Mason-Mercer VCPSB.

2.04 ACCESSORIES

A. Stainless Steel Pipe: ASTM A 269.

B. Pipe Alignment Guides:

1. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1-inch thick insulation, minimum 3-inches travel.

C. Swivel Joints:

1. Fabricated steel, cast steel or bronze body, double ball bearing race, field lubricated, with rubber (Buna-N) O-ring seals.
2. Basis of Design: OPW Engineered Systems.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Expansion Fitting Installation:

1. Install expansion fittings according to manufacturer's written instructions.
2. Install expansion fittings in sizes matching pipe size in which they are installed.
3. Align expansion fittings to avoid end-loading and torsional stress.
4. Install in accordance with EJMA (Expansion Joint Manufacturer's Association) Standards.

B. Pipe Bend and Loop Installation:

1. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
2. Attach pipe bends and loops to anchors.

a. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code Section IX, "Welding and Brazing Qualifications."

b. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

C. Swing Connections:

1. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
2. Connect mains, risers and branch connections to equipment with at least four pipe fittings, including tee in riser.

D. Guide Installation:

1. Install guides on piping adjoining expansion fittings and loops.
2. Attach guides to pipe and secure to building structure.

E. Anchor Installation:

1. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
2. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
3. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
4. Install pipe anchors according to expansion fitting manufacturer's written instructions if expansion fittings are indicated.
5. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

F. Painting:

1. Touch Up: 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-PA1 requirements for touching up field-painted surfaces.

a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

2. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION

SECTION 23 05 29
HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Hangers and Supports for HVAC Piping, Ductwork and Equipment
   2. Wall and Floor Sleeves
   3. Building Attachments
   4. Flashing
   5. Miscellaneous Metal and Materials

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. ASCE 7-10, Minimum Design Loads for Buildings and Other Structures.
   2. Terminology: As defined in MSS SP-90 "Guidelines on Terminology for Pipe Hangers and Supports".
   3. Install ductwork and piping per SMACNA's requirements.
   4. Hanger spacing installation and attachment to meet all manufacturer's requirements and MSS SP-58.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Welding:
      a. Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications".
   2. Welding for Hangers:
      a. Qualify procedures and personnel according to AWS D9.1, Sheet Metal Welding Code for duct joint and seam welding.
   3. Engineering Responsibility:
      a. Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, duct support equipment hangers/supports, and seismic restraint by a qualified Structural Professional Engineer.
         1) Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

4. Manufacturers regularly engaged in the manufacture of bolted metal framing support systems, whose products have been in satisfactory use in similar service for not less than 10 years.
5. Support systems to be supplied by a single manufacturer.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 PERFORMANCE REQUIREMENTS

A. Provide pipe, ductwork and equipment hangers and supports in accordance with the following:
   1. When supports, anchorages, and seismic restraints for equipment, and supports, anchorages, and seismic restraints for conduit, piping, and ductwork are not shown on the Drawings, the contractor is responsible for their design.
   2. Connections to structural framing not to introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.

B. Engineered Support Systems:
   1. Support frames such as pipe racks or stanchions for piping, ductwork, and equipment which provide support from below.
   2. Equipment, ductwork and piping support frame anchorage to supporting slab or structure.

C. Provide channel support systems, for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

D. Provide heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

E. Provide seismic restraint hangers and supports for piping, ductwork and equipment. See Section 23 05 48, Vibration and Seismic Controls for HVAC Equipment.

F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment. See Section 23 05 48, Vibration and Seismic Controls for HVAC Equipment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Hangers and Supports for HVAC Piping, Ductwork and Equipment:
   1. Anvil International
   2. B-Line Systems, Incorporated
   3. Erico Company, Incorporated
   4. Nelson-Olsen Incorporated
   5. Rilco Manufacturing Company, Incorporated
   6. Snappitz Thermal Pipe Shield Manufacturing
   7. Unistrut Corporation
   8. Or approved equivalent.

B. Wall and Floor Sleeves:
   1. Thunderline Corporation “Link Seal”.
   2. Or approved equivalent.

C. Building Attachments:
   1. Anchor-It
   2. Gunnebo Fastening Corporation
   3. Hilti Corporation
   4. ITW Ramset/Red Head

5. Masterset Fastening Systems, Incorporated
6. Or approved equivalent.

2.02 HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

A. Hanger Rods: Hanger rods continuously threaded or threaded ends only in concealed spaces and threaded ends only in exposed spaces; finish electro-galvanized or cadmium-plated in concealed spaces and prime painted in exposed spaces; sizes per MSS.

B. Hanger Rod Couplings: Anvil Figure 136, B-Line Figure B3220, or approved equivalent; malleable iron rod coupling with elongated center sight gap for visual inspection; to have same finish as hanger rods.

C. Channel Hanging System:

1. Framing members No. 12 gauge formed steel channels, 1-5/8-inch square, conforming to ASTM A570 GR33, one side of channel to have a continuous slot within turned lips; framing nut with grooves and spring 1/2-inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A307; fittings conforming to ASTM A575; parts enamel painted or electro-galvanized.
2. Concrete Inserts: Malleable iron body, hot dipped galvanized finish. Lateral adjustment. MSS Type 18.

D. Continuous Concrete Insert: Steel construction, minimum 12 gauge. Electrogalvanized finish. Pipe clamps and insert nuts to match.

E. Pipe Hangers:

1. Pipe Rings for Hanger Rods:
   a. Pipe Sizes 2-inches and Smaller: Adjustable swivel ring hanger, UL listed. Erico 100 or 101, Anvil Figures 69 or 104, or approved equivalent.
   b. Pipe Sizes 2-1/2-inches and Larger: Clevis type hangers with adjustable nuts on rod, UL listed. Anvil figure 260, Erico 400, or approved equivalent.
   c. Pipe hangers to have same finish as hanger rods.

F. Pipe Saddles and Shields:

1. Factory fabricated saddles or shields under piping hangers and supports for insulated piping.
2. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12-inches in length (4-inch pipe and larger to be three times longer than pipe diameter).

G. Riser Clamps: Steel, UL listed. MSS Type 8. Erico 510 or 511. Copper coated; Erico 368.

H. Pipe Slides: Anvil, reinforced Teflon slide material (3/32-inch minimum thickness) bonded to steel; highly finished steel or stainless steel contact surfaces to resists corrosion; 60-80 PSI maximum active contact surface loading; steel parts 3/16-inch minimum thickness; attachment to pipe and framing by welding.

I. Pipe Guides:

1. Furnish and install pipe guides on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides securely to pipe and structure. Contact with chilled water pipe not to permit heat to be transferred in sufficient quantity to cause condensation on any surface.
2. Furnish and install guides approximately four pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Guides are not to be used as supports and are in addition to other pipe hangers and supports.

J. Pipe Roller Hangers: Adjustable roller hanger. Black steel yoke, cast iron roller. MSS Type 41.

K. Below Ground Pipe Supports:

1. Pipe Hangers All Sizes: Adjustable Clevis type, Federal Specification WW-H-171 (Type 1), UL listed, stainless steel Type 304. MSS Type 1. Erico 406.
2. Rod: 5/8-inch stainless steel Type 18-8.
3. Eyebolt: Stainless steel Type 18-8.
4. Nuts and Washers: Stainless steel Type 18-8.

L. Thermal Hanger Shield Inserts:

1. 100-PSI (690-kPa) minimum compressive strength calcium silicate insulation, encased in sheet metal shield or polyisocyanurate rigid foam exceeding the load bearing weight of the pipe at the hanger point with a PVC vapor barrier.
2. Material for Cold Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with vapor barrier or polyisocyanurate rigid foam with a PVC vapor barrier.
3. Material for Hot Piping: Water-repellent-treated ASTM C533, Type 1 calcium silicate or polyisocyanurate rigid foam with a PVC vapor barrier.
4. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
5. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
6. Insert Length: Extend 2-inches beyond sheet metal shield for piping operating below ambient air temperature.
7. Thermal Hanger Shield Insulation Operating Temperature: Meet or exceed fluid temperature in pipe.

M. Freestanding Roof Supports: Polyethylene high-density UV resistant quick "pipe" block with foam pad.

2.03 WALL AND FLOOR SLEEVES

A. Below Grade or High Water Table Areas:

1. "Link-Seal" Pipe Sleeves: Neoprene gasket links bolted together around an interior sleeve forming a watertight seal.
2. Provide Type S unless otherwise noted.

B. Pre-Engineered Firestop Pipe Penetration Systems: UL listed assemblies for maintaining fire rating of piping penetrations through fire-rated assemblies. Comply with ASTM E814.

C. Fabricated Accessories:

1. Steel Pipe Sleeves: Fabricate from Schedule 40 black or galvanized steel pipe. Remove end burrs by grinding.
2. Sheet Metal Pipe Sleeves: Fabricate from G-90 galvanized sheets closed with lock-seam joints. Provide the following minimum gauges for the sizes indicated:
   a. Sleeve Size 4-inches in Diameter and Smaller: 18 gauge.
   b. Sleeve Sizes 5-6-inches: 16 gauge.
   c. Sleeve Sizes 7-inches and Larger: 14 gauge.
   d. Fire-Rated Safing Material.
      1) Rockwool Insulation: Complying with FS-HH-I-558, Form A, Class IV, 6 pounds per cubic foot density with melting point of 1985 degrees F and K value of 0.24 at 75 degrees F.
      2) Calcium Silicate Insulation: Noncombustible, complying with FS-HH-I-523, Type II, suitable for 100 degrees F to 1200 degrees F service with K value of 0.40 at 150 degrees F.

2.04 BUILDING ATTACHMENTS

A. Beam Clamps:
   1. MSS Type 19 and 23, wide throat, with retaining clip.
   2. Universal Side Beam Clamp: MSS Type 20.

B. Powder-Actuated Drive Pin Fasteners: Powder actuated type, drive pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

C. Anchor Bolts:
   1. Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project structural engineer. Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
   2. Anchor Bolts (Cast-In-Place): Steel bolts, ASTM A307. Nuts to conform to ASTM A194. Design values for shear and tension not more than 80 percent of the allowable listed loads.
   3. Anchor (Expansion) Bolts: Carbon steel to ASTM A307; nut to conform to ASTM A194; drilled-in type. Design values for shear and tension not more than 80 percent of the allowable listed loads.
   4. Anchor (Adhesive) Bolts: Consisting of two-part adhesive cartridge and zinc-plated Type A307 steel anchor bolt rod assembly with ASTM A194 nut.

2.05 FLASHING

A. Steel Flashing: 26 gauge galvanized steel.

B. Safes: 8 mil thick neoprene.

C. Caps: Steel, 22 gauge minimum, 16 gauge at fire-resistant structures.

2.06 MISCELLANEOUS METAL AND MATERIALS

A. General:
   1. Provide miscellaneous metal items specified, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on drawings or otherwise not shown on drawings that are necessary for completion of the project. Contractor is responsible for their design.
   2. Fabricate miscellaneous units to size shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.

B. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.

C. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.

D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.

E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.

F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.

G. Provide hot dipped galvanized components for items exposed to weather. Cold galvanize field-welded joints and components. Use materials compatible with system being

supported (i.e. aluminum for aluminum ductwork, stainless steel for stainless steel ductwork).

H. Use straps, threshold rods and wire with sizes required by SMACNA to support ductwork.

I. Grout:

1. ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
2. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
3. Properties: Nonstaining, noncorrosive, and non gaseous.
4. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Verify building materials to have hangers and attachments affixed in accordance with hangers to be used. Provide supporting calculations.

B. Examine Drawings and coordinate for verification of exact locations of fire and smoke rated walls, partitions, floors and other assemblies. Indicate, by shading and labeling on Record Drawings such locations and label as "1-Hour Wall", "2-Hour Fire/Smoke Barrier", and the like. Determine proper locations for piping penetrations. Set sleeves in place in new floors, walls or roofs prior to concrete pour or grouting.

C. Install hangers, supports, anchors and sleeves after required building structural work has been completed in areas where the work is to be installed. Coordinate proper placement of inserts, anchors and other building structural attachments.

D. Equipment Clearances: Do not route ductwork, equipment, or piping through electrical rooms, transformer vaults, elevator equipment rooms, IT rooms, MPOE rooms, or other electrical or electronic equipment spaces and enclosures and the like. Within equipment rooms, provide minimum 3-feet lateral clearance from all sides of electric switchgear panels. Do not route ductwork, equipment, or piping above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with Electrical and coordinate exact ductwork, equipment or pipe routing to provide proper clearance with such items.

3.02 HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

A. Hang rectangular sheet-metal ducts with a cross sectional area of less than 7 SF with galvanized strips of No. 16 USS gauge steel 1-inch wide, and larger ducts with steel angles and adjustable hanger rods similar to piping hangers. Support at a maximum of 8-feet on center.

B. Support horizontal ducts within 24-inches of each elbow and within 48-inches of each branch intersection.

C. Provide aluminum supports for aluminum ductwork.

D. Provide stainless steel supports for stainless steel ductwork.

E. Support vertical ducts at maximum intervals of 16-feet and at each floor.

F. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

G. Use double nuts and lock washers on threaded rod supports.

H. Floor supports in mechanical rooms to be elevated 1-inch above finish floor and void space filled with masonry grout.

I. Anchor ducts securely to building in such a manner as to prevent transmission of vibration to structure. Do not connect duct hanger straps to roof deck. Do not support ducts from other ducts, piping or equipment.

J. Attach strap hangers installed flush with end of sheet-metal duct run to duct with sheet-metal screws.

K. Construct exterior ductwork or ductwork which is otherwise exposed to weather watertight and slope 1/4-inch per foot to avoid standing water.

L. Exposed ductwork hung in clean areas such as sanitary areas, pharmaceutical areas, wash down areas or food process areas to be installed using double end, food grade trapeze hanger rods suitable for use with food grade strut.

M. Channel Support System Installation:

1. Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
2. Field assemble and install according to manufacturer's written instructions.

N. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

O. 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.

P. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

Q. Adjust hangers so as to distribute loads equally on attachments. Provide grout under supports to bring piping, ductwork and equipment to proper level and elevations.

R. Prime paint ferrous nongalvanized hangers, accessories, and supplementary steel which are not factory painted.

S. Horizontal Piping Hangers and Supports; Horizontal and Vertical Piping, and Hanger Rod Attachments:

1. Factory fabricated horizontal piping hangers and supports complying with MSS SP-58, to suit piping systems and in accordance with manufacturer's published product information.
2. Use only one type by one manufacturer for each piping service.
3. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping.
4. Pipe support spacing (pipe supported in ceiling or floor-supported) to meet latest applicable Code and manufacturer's requirements.
5. Provide copper-plated hangers and supports for uninsulated copper piping systems.

T. Plumber's Tape not permitted as pipe hangers or pipe straps.

U. Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. For horizontally hung grooved-end piping, provide a minimum of 2 hangers per pipe section.

V. Pipe Ring Diameters:

1. Uninsulated and Insulated Pipe, Except Where Oversized Pipe Rings are Specified: Ring inner diameter to suit pipe outer diameter.
2. Insulated Piping Where Oversized Pipe Rings are Specified and Vibration Isolating Sleeves: Ring inner diameter to suit outer diameter of insulation or sleeve.

W. Oversize Pipe Rings: Provide oversize pipe rings of 2-inch and larger size.

X. Pipe Support Brackets: Support pipe with pipe slides.

Y. Steel Backing in Walls: Provide steel backing in walls to support fixtures and piping hung from steel stud walls.

Z. Pipe Guides:

1. Install on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides to pipe structure. Contact with

chilled water pipe does not permit heat to be transferred in sufficient quantity to cause condensation on any surface.

2. Install approximately four pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Do not use as supports. Provide in addition to other required pipe hangers and supports.

AA. Heavy-Duty Steel Trapeze Installation:

1. Arrange for grouping of parallel runs of horizontal piping and support together on field fabricated, heavy-duty trapezes.
2. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
3. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

AB. Group parallel runs of horizontal piping to be supported together on trapeze-type hangers. Maximum spacings: MSS SP-58.

AC. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe.

AD. Do not support piping from other piping.

AE. Fire protection piping will be supported independently of other piping.

AF. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated.

AG. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping" is not exceeded.

AH. 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.
2. Do not exceed pipe stress limits according to ASME B31.9.
3. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
4. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields to span arc of 180 degrees.
5. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.
6. Shield Dimensions for Pipe, not less than the following:
   a. NPS 1/4 to NPS 3-1/2 (DN8 to DN 90): 12-inches long and 0.048-inch thick.
   b. NPS 4 (DN100): 12-inches long and 0.06-inch thick.
   c. NPS 5 and NPS 6 (DN125 and DN150): 18-inches long and 0.06-inch thick.
   d. NPS 8 to NPS 14 (DN200 to DN350): 24-inches long and 0.075-inch thick.
   e. NPS 16 to NPS 24 (DN400 to DN600): 24-inches long and 0.105-inch thick.
7. Pipes NPS 8 (DN200) and Larger: Include wood inserts.

a. Insert Material: Length at least as long as protective shield.

8. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

AI. Pipe Anchors: Provide anchors to fasten piping which is subject to expansion and contraction, and adjacent to equipment to prevent loading high forces onto the equipment.

AJ. Pipe Curb Assemblies:

1. Provide prefabricated units for roof membrane and insulation penetrations related to equipment. Coordinate with roofing system. Set supports on the structural deck. Do not set supports on insulation or roofing. Provide level supports by prefabricated pitch built into the curb.

2. Provide for piping and electrical conduit which penetrates the structural roof deck to service equipment above the roof level (i.e., piping, electrical power and control wiring). Meet requirements of roof warranty.

AK. Escutcheon Plates: Install around horizontal and vertical piping at visible penetrations through walls, partitions, floors, or ceilings, including penetrations through closets, through below ceiling corridor walls, and through equipment room walls and floors.

AL. Vertical Piping:

1. Support with U-clamps fastened to wall to hold piping away from wall unless otherwise approved.

2. Riser clamps to be directly under fitting or welded to pipe.

a. Riser to be supported at each floor of penetration.

b. Provide structural steel supports at the base of pipe risers. Size supports to carry forces exerted by piping system when in operation.

AM. Piping above roof to be supported with freestanding roof pipe supports unless detailed otherwise.

3.03 WALL AND FLOOR SLEEVES

A. "Link-Seal" Pipe Sleeves: Install at floor/below grade piping penetrations. Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations.

B. Fabricated Pipe Sleeves:

1. Provide either steel or sheet metal pipe sleeves accurately centered around pipe routes. Size such that piping and insulation, if any, will have free movement within the sleeve, including allowance for thermal expansion. Sleeve diameter to be determined by local seismic clearance requirements, and by waterproofing requirements.

2. Length: Equal to thickness of construction penetrated, except extend floor sleeves 1-inch above floor finish.

3. Provide temporary support of sleeves during placement in concrete and other work around sleeves. Provide temporary end closures to prevent concrete and other materials from entering pipe sleeves.

4. Seal each end airtight with a resilient nonhardening sealer, UL listed, fire rated ASTM 814.

C. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:

1. Install fabricated pipe sleeve.

2. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification with specified material.

3. Seal each end airtight with a resilient nonhardening UL listed fire resistant ASTM 814.

D. Piping Penetrations Through Fire-Rated (One to Three Hour) Assemblies:

1. Select and install pre-engineered pipe penetration system in accordance with the UL listing and manufacturer's recommendation.
2. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814.

3.04 BUILDING ATTACHMENTS

A. Factory fabricated attachments complying with MSS SP-58, selected to suit building substructure conditions and in accordance manufacturer's published product information.

B. Select size of building attachments to suit hanger rods.

C. Space attachments within maximum piping span length indicated in MSS SP-58.

D. Install building attachments within concrete slabs or attach to structural steel or wood. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping.

E. Attachment to Wood Structure: Anvil side beam bracket Figure 202 for attachment to wooden beam or approved attachment for a wood structure.

F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Install concrete inserts before concrete is placed; fasten inserts to forms. Where concrete with compressive strength less than 2500 PSI is indicated, install reinforcing bars through openings at top in inserts.

H. Install powder-actuated drive-pin fasteners 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. Test powder-actuated insert attachments with a minimum load of 100 pounds.

I. Do not use powder-actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4-inches thick.

J. Bolting: Provide bored, drilled or reamed holes for bolting to miscellaneous structural metals, frames or for mounts or supports. Flame cut, punched or hand sawn holes will not be accepted.

K. Anchor Bolts:

1. Install anchor bolts for mechanical equipment, piping and ductwork as required. Tightly fit and clamp base-supported equipment anchor bolts at equipment support points. Provide locknuts where equipment, piping and ductwork are hung.
2. Anchor Bolts (Cast-In-Place): Embed anchor bolts in new cast-in-place concrete to anchor equipment. Install a pipe sleeve around the anchor bolt for adjustment of the top 1/3 of the bolt embedment; sizes and patterns to suit the installation conditions of the equipment to be anchored.

3.05 FLASHING

A. Flash and counterflash where piping, ductwork and equipment passes through weather or waterproofed walls, floors, and roofs.

B. Provide 12-inch minimum height curbs for roof-mounted mechanical equipment. Flash and counter flash with galvanized steel, soldered and waterproofed.

3.06 MISCELLANEOUS METAL AND MATERIALS

A. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates, and similar devices. Hot dipped galvanize after fabrication items installed in

exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.

B. Finishes:

1. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with 1 coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas in primer with same material, before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.
2. Metal in Contact with Concrete, Masonry and Other Dissimilar Materials: Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.
3. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

C. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required. Avoid cutting concrete reinforcing when drilling for inserts. Reference structural drawings and reinforcing shop drawings and determine locations of stirrups prior to drilling into concrete.

E. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items, which are to be built into concrete masonry or similar construction.

F. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

G. Setting Loose Plates: Clean concrete and masonry bearing surfaces of any bond reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.

H. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut-off flush with edge of the bearing plate before packing with grout. Use metallic non-shrink grout in concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed locations, unless otherwise indicated.

I. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

J. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.

K. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

L. Field Welding: Comply with AWS D1.1 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 contours of welded surfaces match adjacent contours.

M. Provide galvanized components for items exposed to weather.

END OF SECTION

SECTION 23 05 48
VIBRATION AND SEISMIC CONTROLS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Vibration Isolation
   2. Seismic Restraint Devices
   3. Factory Finishes
   4. Seismic-Bracing/Restraint Devices/Systems for Equipment, Piping and Ductwork

B. General:
   1. Vibration isolation for mechanical ductwork, piping and equipment.
   2. Seismic restraint for mechanical ductwork, piping and equipment.
   3. Seismic Certification for equipment, hangers and systems
   4. Special inspections for systems.

C. Scope of Work:
   1. Vibration isolation and seismic restraint of new equipment and systems within project boundary defined in architectural drawings.
   2. Vibration isolation and seismic restraint of new equipment and systems in existing buildings to points of connection with existing systems.
   3. Seismic restraint of existing systems and equipment shown on drawings, within project boundary defined in architectural drawings.
   4. Provide supplementary structural steel for seismic restraint systems. No hanging from roof deck is permitted on this project, unless specifically allowed by Structural Engineer of Record in writing prior to bid.

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Vibration Isolation:
      a. Product Data: Provide catalog data indicating size, type, load and deflection of each isolator; and percent of vibration transmitted based on lowest disturbing frequency of equipment.
      b. Shop Drawings: Showing complete details of construction for steel and concrete bases including:
         1) Fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment and cantilever loads.
         2) Equipment mounting holes.
         3) Dimensions.

4) Size and location of concrete and steel bases and curbs.
5) Isolation selected for each support point.
6) Details of mounting brackets for isolator.
7) Weight distribution for each isolator.
8) Details of seismic snubbers.
9) Code number assigned to each isolator.

c. Design calculations: Provide calculations for selecting vibration isolators and for designing vibration isolation bases.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

3. Seismic Restraint:

a. Shop Drawings: Show compliance with requirements of Quality Assurance article of this Section. Shop drawings to be stamped by a professional Structural Engineer licensed in State of Oregon.

b. Calculations: Submit seismic calculations indicating restraint loadings resulting from design seismic forces. Include anchorage details and indicate quantity, diameter and depth of penetration of anchors. Calculations certified by professional Structural Engineer licensed in State of Oregon.

4. Seismic Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter and depth of penetration of anchors.

5. Submittals for Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y and z planes.

6. Welding certificates.

7. Equipment Certification: Provide seismic certification for equipment as noted in Seismic Design Summary or schedules on Drawings.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Vibration Isolation:

a. Except for packaged equipment with integral isolators, single manufacturer selects and furnishes isolation required.

b. Deflections indicated on drawings are minimum actual static deflections for specific equipment supported.

c. Isolator Stability:

1) Size springs of sufficient diameter to maintain stability of equipment being supported. Spring diameters not less than 0.8 of compressed height at rated load.

2) Springs have minimum additional travel to solid equal to 50 percent of rated defection.

3) Springs support 200 percent of rated load, fully compressed, without deformation or failure.

d. Maximum Allowable Vibration Levels: Peak vibration velocities not exceed 0.08 in/sec. Correct equipment operating at vibration velocities that exceed this criteria.

2. Seismic Restraint:
   a. Code and Standard Requirements:
      1) Seismic restraint of equipment, piping and ductwork to be in accordance with latest enacted version of ASCE 7-10.
   b. Confirm Seismic Control requirements in Division 01, General Requirements and Structural documents.
   c. Building Occupancy Category: III or IV.
   d. Certification: See Seismic Design Table or schedules on Drawings for equipment, systems and seismic-restraint devices designated to have seismic certification/qualification. Horizontal and vertical load testing and analysis performed according to ASCE 7-10. Anchorage systems to bear anchorage preapproval number from an agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing or calculations, if preapproved ratings are not available. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be sealed by qualified licensed professional engineer in State of Oregon. Testing and calculations must include both shear and tensile loads and one test or analysis at 45 degrees to weakest mode.
   e. Seismic restraint and anchorage of permanent equipment and associated systems listed below to building structure be designed to resist total design seismic force prescribed in local building code:
      1) Floor- or roof-mounted equipment weighing 400 pounds or greater.
      2) Suspended, wall-mounted or vibration isolated equipment weighing 20 pounds or greater.
      3) In-line duct devices connected to ductwork weighing 75 pounds or greater.
      4) Housekeeping slabs: provide reinforcement and anchorage to building structure.
   f. Where required, seismic sway bracing of suspended duct and piping meet following:
      1) Pipe and duct runs requiring seismic bracing have minimum of two traverse braces and one longitudinal brace. Longitudinal (or traverse) brace at 90 degree change in direction may act as traverse (or longitudinal) brace if located within 2-feet of change in direction.
      2) Seismic bracing may not pass through seismic separation joint. Pipe or duct runs that pass through seismic separation joint must be restrained within 5-feet of both sides of separation.
      3) Seismic brace assembly spacing not to exceed 40-feet transverse and 80-feet longitudinal.
   g. Seismic restraints may be omitted from suspended piping and duct if following conditions are satisfied:
      1) For piping or ducts supported by rod hangers 12-inches or less in length from top of duct to bottom of structural support. Top connections to structure have swivel joints, eye bolts, or vibration isolation hangers for entire length of system run.
      2) Lateral motion of system will not cause damaging impact with surrounding systems or cause loss of system vertical support.
      3) System must be welded steel pipe, brazed copper pipe, sheet metal duct or similar ductile material with ductile connections.

C. Seismic restraints, including anchors to building structure, be designed by registered professional Structural Engineer licensed in State of Oregon. Design includes:

1. Number, size, capacity and location of anchors for floor- or roof-mounted equipment. For curb-mounted equipment, provide design of attachment of both unit to curb and curb to structure.
2. Number, size, capacity and location of seismic restraint devices and anchors for vibration-isolation and suspended equipment. Provide calculations and test data verifying horizontal and vertical ratings of seismic restraint devices.
3. Number, size, capacity and location of braces and anchors for suspended piping and ductwork on as-built plan drawings.
4. Maximum seismic loads to be indicated on drawings at each brace location. Drawings bear stamp and signature of registered professional Structural Engineer who designed layout of braces.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Seismic Snubber Units: Furnish replacement neoprene inserts for snubbers.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Vibration Isolation:

1. The VMC Group
2. B-Line Systems, Inc.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.
5. M.W. Saussé - Vibrex
6. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.
7. Or approved equivalent.

B. Seismic Restraint Devices:

1. The VMC Group
2. B-Line Systems, Inc.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.
5. M.W. Saussé - Vibrex
6. California Dynamics Corporation
7. Cooper B-Line Tolco
8. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
9. Hilti, Inc.
10. Or approved equivalent.

C. Factory Finishes:

1. Kynar 500 Fluoropolymer Coating
2. Or approved equivalent.

D. Seismic-Bracing/Restraint Devices/Systems for Equipment, Piping and Ductwork:

1. The VMC Group
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. Hilti, Inc.
5. Cooper B-Line, Inc.
6. California Dynamics Corporation
7. Unistrut
8. ISAT, Inc.
9. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.
10. Or approved equivalent.

2.02 VIBRATION ISOLATION

A. Type 1 - Neoprene Pad: Natural rubber waffle pads, arranged in single or multiple layers, 3/4-inch thick per layer with pattern repeating on 1/2-inch centers; 50 durometer hardness; maximum loading 60 PSI. Minimum 1/4-inch thick steel load distribution plate and 1/16-inch shim plates between layers, factory cut to sizes matching requirements of supported equipment. Molded bridge with neoprene anchor bolt bushing and flat washer face to prevent metal to metal contact. Number of layers required for equipment scheduled. Mason Type: Super WMH.

B. Type 2 - Neoprene Mount: Double-deflection type, with ductile-iron housing containing two separate and opposing, oil-resistant natural rubber or bridge bearing neoprene elements, factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Neoprene elements to prevent metal to metal contact during normal operation. Minimum static deflection of 0.20-inches. Mason Type: BR.

C. Type 3 - Spring: Freestanding, laterally stable, open-spring isolators.
   1. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
   2. Minimum Additional Travel: 50 percent of required deflection at rated load.
   3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, natural rubber or bridge bearing neoprene isolator pad attached to baseplate underside. Baseplates limit floor load to 100 PSIG (690 kPa).
   6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
   7. Brackets: Manufacturer's standard bracket, utilize height saving brackets to accommodate height restrictions.
   8. Mason Type: SLFH or SLF.

D. Type 4a - Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
   1. Housing: Steel with resilient vertical-limit stops (out of contact during normal operation) to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch thick, natural rubber or bridge bearing neoprene isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation. Restraining bolts have large rubber grommets to provide cushioning in vertical and horizontal directions. A minimum clearance of 3/8-inch maintained around restraining bolts so as not to interfere with spring action.

2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
3. Minimum Additional Travel: 50 percent of required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Brackets: Manufacturer's standard bracket, utilize height saving brackets to accommodate height restrictions.
7. Mason Type: SLR.

E. Type 4b - Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint with neoprene acoustical cup, spring inspection ports and rebound adjustment ports.
2. Base: Factory drilled for bolting to structure.
3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel before contacting a resilient collar.
4. Brackets: Manufacturer's standard bracket, utilize height saving brackets to accommodate height restrictions.
5. Mason Type: SSLFH.

F. Type 5a - Restrained Elastomeric Hangers: Double-deflection type, with molded, oil-resistant natural rubber or bridge bearing neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range. Seismic rebound steel and bonded LDS rubber washer to limit upward seismic movement. Mason Type: RWHD.

G. Type 5b- Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 15 degrees of angular hanger-rod misalignment from vertical without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
3. Minimum Additional Travel: 50 percent of required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Mason Type: 30N.

H. Type 6 - Horizontal Thrust Restraints: Combination coil spring and elastomeric insert with spring and insert in compression and with a load stop. Include rod and angle-iron brackets for attaching to equipment.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
3. Minimum Additional Travel: 50 percent of required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.
8. Mason Type: WBI or WBD.

I. Type 7 - Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch thick, 60-durometer neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on isolation material of 500 PSIG (3.45 MPa) and for equal resistance in all directions. Mason Type: ADA.

J. Type 8 - Resilient Pipe Vertical Sliding Guide: Telescopic arrangement of 2 steel tubes separated by a minimum of 1/2-inch thick, 60-durometer neoprene. Factory set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction. Shear pin be removable and reinsertable to allow for selection of pipe movement. Guides be capable of motion to meet location requirements. Mason Type: VSG. Provide pipe expansion hangers to control load shifts as the riser expands or contracts, Mason HES.

K. Type FC-1, Flexible duct connectors. See Specification Section 23 33 00 Air Duct Accessories.

L. Type FC-2A, Flexible Pipe Connector, Steel:
1. 321 stainless steel, close pitch, annular corrugated hose.
2. Exterior Sleeve: 304 stainless steel, braided.
3. Pressure Rating: 125 PSI at 70 degrees F for 12-inch and smaller pipe.
4. Joint: ANSI Class 150 carbon steel flanges.
5. Size: Use pipe sized units.
6. Minimum Allowable Offset: 3/4-inch on each side of installed center line.
7. Basis of Design: Metraflex Model MLP.

M. Type FC-2B, Flexible Pipe Connector, Copper:
1. Inner Hose: Bronze, close pitch, annular corrugated hose.
2. Exterior Sleeve: Braided bronze (for piping over 2-inches, to be 3 pound braided stainless steel).
3. Minimum Allowable Pressure Rating: 125 PSI at 70 degrees F.
4. Joint: Sweat ends.
5. Size: Use pipe sized units.
6. Minimum Allowable Offset: 3/8-inch on each side of installed center line.
7. Basis of Design: Metraflex Model BBS.

N. Type FC-2C, Flexible Pipe Connector, Gas:
1. Inner Hose: 304 stainless steel.
2. Exterior Sleeve: Braided, 304 stainless steel.
3. Minimum Allowable Pressure Rating: 150 PSI at 70 degrees F up to 4-inch pipe.
4. Joint: Threaded carbon steel.
5. Minimum Allowable Offset: 3/4-inch on each side of installed center line.
6. Basis of Design: Metraflex GASCT.

O. Type FC-3, Flexible Compensator, Double Sphere:
1. Body: Molded twin spherical type. Neoprene with internal cord or wire.
2. Minimum Pressure Rating, Sizes 2-inch to 12-inch: 225 PSI at 170 degrees F.
3. Minimum Pressure Rating, Sizes 14-inch to 20-inch: 125 PSI at 170 degrees F.

4. Minimum Allowable Compression: 1-1/2 inches.
5. Minimum Allowable Elongation: 1-1/8 inches.
6. Minimum Allowable Offset: 1-1/8 inches.
7. Minimum Allowable Angular Movement: 20 degrees.
8. Joint: Steel flanges.
9. Accessories: Galvanized aircraft-type cable or control rods to prevent over extension.
10. Basis of Design: Metraflex Doublesphere.

2.03 SEISMIC RESTRAINT DEVICES

A. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5, with a flat washer face.

B. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts and replaceable resilient isolation washers and bushings. Snubber load rating to match equipment size. Mason Type: Z-1011 or Z-1225.
1. Anchor bolts for attaching to concrete be seismic-rated, drill-in and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5.

C. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement. Mason Type: SCB.

D. Anchor Bolts: Seismic-rated, drill-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.

2.04 FACTORY FINISHES

A. Provide manufacturer's standard prime-coat finish ready for field painting. Units mounted outdoors exposed to weather: Epoxy powder coated, with 1000 hour salt spray rating per ASTM B-117. For high levels of corrosion protection utilize:
1. Conform to AAMA 605.2.
2. Apply coating following cleaning and pretreatment.
3. Cleaning: AA-C12C42R1X.
4. Dry system before final finish application.
5. Total Dry Film Thickness: Approximately 1.2 mils, when baked at 450 degrees F for 10 minutes.

B. Finish:
1. Manufacturer's standard paint applied to factory-assembled and factory-tested equipment before shipping.
2. Powder coating on springs and housings.
3. Hardware be electrogalvanized. Hot-dip galvanize metal components for exterior use.
4. Baked enamel for metal components on isolators for interior use.
5. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

2.05 SEISMIC-BRACING/RESTRAINT DEVICES/SYSTEMS FOR EQUIPMENT, PIPING AND DUCTWORK

A. General Requirements for Restraint Components: Rated strengths, features and applications to be as defined in reports by agency acceptable to authorities having jurisdiction.

B. Structural Safety Factor: Allowable strength in tension, shear and pullout force of components be at least four times maximum seismic forces to which they will be subjected.

C. Anchor bolts for attaching to concrete to be seismic-rated, drill-in and stud-wedge or female-wedge type.

D. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.

E. Maximum 1/4-inch air gap and minimum 1/4-inch thick resilient cushion.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Set floor-mounted equipment with steel base rails on minimum 4-inch-high concrete housekeeping pads. Extend pad minimum 6-inches beyond footprint of equipment in each direction, but not less than twice the embedment depth of concrete anchors.

B. Provide mounts for equipment installed outdoors for wind loads of 30 lbs. psf applied to any exposed surface of isolated equipment.

C. Do not install equipment or pipe which makes rigid contact with building slabs, beams, studs, walls, etc.

D. Anchor baseplate to floor or structure. Provide rubber grommets and washers to isolate bolt from base plate. Under no circumstances is isolation efficiency to be destroyed when bolting isolators to floor.

E. Building Penetrations: Isolate water piping and ductwork penetrating wall, ceilings, floors or shafts from structure by piping isolator or by 3/8-inch thick foamed rubber insulation. Install units flush with finished structure face, using one for each side as required. Cut units to length if longer than structure thickness. Caulk around pipe or duct at equipment room wall.

F. Provide roof curbs, equipment supports and roof penetrations. Work to maintain roof warranty. Coordinate location, size, structural connections/requirements and flashing prior to installation.

G. Vibration isolators must not cause change of position of equipment or piping which would stress piping connections or misalignment shafts or bearings. Isolated equipment is to be level and in proper alignment with connecting ducts and pipes.

H. Pipe Hangers in Equipment Rooms: Support water and gas piping connected to rotating equipment within equipment rooms on spring and neoprene hangers. The first three hangers from a piece of vibrating equipment are to have a minimum of 1/2 static deflection of equipment isolators. Other isolators should have a minimum of 1/4 static deflection of equipment isolators.

I. Examination:

1. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements, installation tolerances and other conditions affecting performance.
2. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

J. Testing: Perform following field quality-control testing:

1. Isolator seismic-restraint clearance.
2. Isolator deflection.
3. Snubber minimum clearances.

K. Adjusting:

1. Adjust snubbers according to manufacturer's written recommendations.
2. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

L. Cleaning: After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt and debris.

M. Demonstration: Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain air-mounting systems. Reference Division 01, General Requirements.

3.02 VIBRATION ISOLATION

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Vibration isolators must be installed in strict accordance with manufacturer's written instructions and certified submittal data.

D. Install isolation as indicated on drawings by type and location and where indicated below.

E. Equipment Vibration Isolation Schedule:

Equipment	Size	Vibration Isolator Type	Minimum Deflection (in)
Boilers	All	Type 1 or 2, FC-2	0.2
Base-Mounted Pumps	0 to 5 HP	B-1, Type 1, FC-3	0.2
Base-Mounted Pumps	7.5+ HP	B-2, Type 1, FC-3	1.5
Inline Pumps	All	Type 4A, 4B, 5B, or 5C, FC-2	1.5
Fan-coils, Unit Heaters, Fan-Powered Terminal Units	All	Type 5B, or 5C, FC-1,2	0.75
Condensing Units	0 to 4.5 tons	Type 1 or 2	0.2
Condensing Units	5+ tons	Type 4A	2.5
Rooftop Air Handlers, AC, Heat Pump Units	0 to 19.5 tons	RC-1, FC-1,2	0.75
Rooftop Air Handlers, AC, Heat Pump Units	20+ tons	RC-2, FC-1,2	1.5
Utility Set Centrifugal Fans	All	4A	1.5
Axial, Cabinet, Centrifugal Inline Fans	0 to 23.5-inch diameter	Type 3, 4A, 4B, 5B, or 5C, FC-1	0.75
Axial, Cabinet, Centrifugal Inline Fans	24-inch+ diameter	Type 3, 4A, 4B, 5B, or 5C, FC-1	1.5

F. Isolation Mounts:

1. Install minimum of four seismic snubbers on isolated equipment. 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.
3. Provide flexible piping connection and flexible ductwork connection to equipment with isolation mounts or bases.

G. Isolating Hangers:

1. Support piping and ductwork connected to isolated equipment within equipment rooms on isolating hangers as scheduled on drawings. Unless otherwise noted, first three hangers from isolated equipment to have a minimum of 1/2 static deflection of equipment isolators. Other isolating hangers to have a minimum of 1/4 static deflection of equipment isolators.

2. Position isolating hanger elements as high as possible in hanger rod assembly, but not in contact with building structure. Install hangers so that hanger housing may rotate full 360 degrees about rod axis without contacting any object.
3. Unless otherwise noted, air supply units with internally isolated fans do not require isolating hangers for connecting pipes and ductwork.
4. Where parallel running pipes are hung together on an isolated trapeze, provide isolator deflections for largest determined by provisions for pipe isolation. Do not mix isolated and non-isolated pipes in same trapeze.
5. Install limit stops so they are out of contact during normal operation.

H. Adjusting:
1. Adjust isolators after piping systems have been filled and equipment is at operating weight.
2. 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. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.

3.03 SEISMIC RESTRAINT DEVICES

A. Reference 3.01, General Installation Requirements.

B. Install in strict accordance with manufacturer's written instructions and certified submittal data.

C. Install and adjust seismic restraints so equipment, piping and ductwork supports are not degraded by restraints.

D. Restraints must not short circuit vibration isolation systems or transmit objectionable vibration or noise.

E. Install restraining cables at each trapeze, individual pipe hanger and hanging vibration isolated equipment. Provide restraining cables in each of the four directions of movement. Install restraining cables no less than 45 Degrees from vertical. At trapeze anchor locations, shackle piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.

F. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods.

3.04 FACTORY FINISHES

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Finishes to be factory-applied. No field patching or holidays allowed.

3.05 SEISMIC-BRACING/RESTRAINT DEVICES/SYSTEMS FOR EQUIPMENT, PIPING AND DUCTWORK

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. General Requirements and Procedures
   2. Fundamental Air Systems Balancing Procedures
   3. Temperature Control Verification
   4. Constant Volume Air Systems Balancing Procedures
   5. Pre-Balance Reporting
   6. Final Reports:
      a. Report Requirements
      b. General Report Data
      c. System Diagrams
      d. Air Handling Units
      e. Fans
      f. Duct Traverses
      g. Diffusers/Registers/Grilles
      h. Instrument Calibration
   7. Additional Tests

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Quality-Assurance Submittals: Submit two copies of evidence that the Testing, Adjusting, and Balancing (TAB) Agent and this Project's TAB team members meet the qualifications specified in the "Quality Assurance" Article below.
   2. Pre-Construction Phase Report:
      a. Provide a pre-construction phase TAB Plan at least two weeks prior to the commencement of TAB work. This report is to include:
         1) A complete set of report forms intended for use on the project, with data filled in except for the field readings. Forms to be Project-specific.
         2) Marked up shop drawings identifying all HVAC equipment to be balanced, and associated outlets and terminal devices.
         3) Identification of the type, manufacturer, and model of the actual instruments to be used, and clear indication of which instrument will be used to take each type of reading. Calibration certifications are to be included.

4) A narrative of any project specific and/or non-standard TAB procedures to be used, and the equipment or systems they apply to.

3. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit two copies of the Contract Documents review report as specified in Part 3 of this Section.
4. Strategies and Procedures Plan: Submit two copies of the TAB strategies and step-by-step procedures as specified in Part 3 below. Include a complete set of report forms intended for use on this Project.
5. Specify reports required because of editing procedures in Part 3 of this Section.
6. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by the TAB Agent.
7. Sample Report Forms: Submit two sets of sample TAB report forms.
8. Test Instrument Calibration: Submit proof of calibration within the last 6 months.
9. Final Report.
10. Provide additional submittals to commissioning authority as dictated in commissioning specifications.

1.05 QUALITY ASSURANCE

A. Quality Assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Acceptable Balance Firm:
   a. General:
      1) Procure services of independent TAB agency to balance, adjust and test water circulating and air moving equipment and air distribution or exhaust systems. Minimum experience: 5 years.
   b. Industry Standards: Testing and Balancing will conform to NEBB, American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE), and American National Standards Institute (ANSI) as follows:
      1) NEBB: Comply with Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
      2) ASHRAE: Comply with recommendations pertaining to measurements, instruments, and TAB.
      3) ANSI:
         (a) S1.4 Specifications for sound level meters.
         (b) S1.11 Specifications for Octave-Band and Fractional-Octave-Band analog and digital filters.
         (c) ANSI S1.13 Methods for the Measurement of Sound Pressure Levels.
   c. Test Observation: If requested, conduct tests in the presence of the Architect or the Architect's representative.
2. Noise Criteria:
   a. Noise levels in all 8 octave bands due to equipment and duct systems are not to exceed the following NC levels:

TYPE OF ROOM	NC LEVEL
Bathrooms and Toilet Rooms	35-40
Conference Room	30-35

Corridors (Public)	35-40
Lobbies, Waiting Areas	35-40
Offices, Large Open (3 or more occupants)	35-40
Offices, Small Private (2 or fewer occupants)	30-35
Kitchens	40-45
Classrooms (Small, Medium, Large)	30-35
Cafeteria/Dining	35-40
All Others	35-40

b. For equipment which has no sound power ratings scheduled on the Drawings, select equipment that the foregoing noise criteria, local ordinance noise levels, and OSHA requirements are not exceeded. Selection procedure in accordance with ASHRAE Fundamentals Handbook, Chapter 7, Sound and Vibration.

c. An allowance, not to exceed 5db, may be added to the measured value to compensate for the variation of the room attenuating effect between room test condition prior to occupancy and design condition after occupancy which may include the addition of sound absorbing material, such as furniture. This allowance may not be taken after occupancy. The room attenuating effect is defined as the difference between sound power level emitted to room and sound pressure level in room.

d. In absence of specified measurement requirements, measure equipment noise levels three feet from equipment and at an elevation of maximum noise generation.

3. Allowable Vibration Tolerances for Rotating, Non-Reciprocating Equipment: Not to exceed a self-excited vibration maximum velocity of 5 mm per second (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. Measurements for internally isolated fans and motors may be made at the mounting feet.
4. Provide proof of testing agency having successfully completed at least five projects of similar size and scope.
5. Code Compliance: Perform tests in the presence of the Authority Having Jurisdiction (AHJ) where required by the Authority Having Jurisdiction (AHJ).
6. Owner Witness: Perform tests in the presence of the Owners representative.
7. Engineer Witness: The engineer or engineer's representative reserves the right to observe tests or selected tests to assure compliance with the specifications.
8. Simultaneous Testing: Test observations by the AHJ, the Owner's Authorized Representative and the engineer's representative need not occur simultaneously.
9. Do not perform TAB work until heating, ventilating, and air conditioning equipment has been completely installed and is operating continuously as required.
10. Conduct air testing and balancing with clean filters in place. Clean strainers prior to performing hydronic testing and balancing.
11. Agent Qualifications: Engage a TAB agent certified by AABC or NEBB.
12. TAB Conference: Meet with the Owner's and the Architect's representatives on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days advance notice of scheduled meeting time and location.

a. Agenda Items: Include at least the following:
   1) Submittal distribution requirements.
   2) Contract Documents examination report.
   3) TAB plan.
   4) Work schedule and Project site access requirements.
   5) Coordination and cooperation of trades and subcontractors.
   6) Coordination of documentation and communication flow.

13. Certification of TAB Reports: This certification includes the following:
   a. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   b. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
14. TAB Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing" and NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
15. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards and NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
16. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. TAB Agency provides warranty for a period of 90 days following submission of completed report, during which time, Owner may request a recheck of up to 10 percent of total number of terminals, or resetting of any outlet, coil, or device listed in the final TAB report.
   2. Guarantee: Meet the requirements of the following programs:
      a. Provide a guarantee on AABC or NEBB forms stating that the agency will assist in completing the requirements of the Contract Documents if the TAB Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
         1) The certified Agent has tested, adjusted, and balanced systems according to the Contract Documents.
         2) Systems are balanced to optimum performance capabilities within design and installation limits.

1.07 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.

C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a persons skin than is normally dissipated.

D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

E. Report Forms: Test data sheets for recording test data in logical order.

F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

J. TAB: Testing, Adjusting, and Balancing.

K. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

L. Test: A procedure to determine quantitative performance of a system or equipment.

M. Testing, Adjusting, and Balancing (TAB) Agent: The entity responsible for performing and reporting the TAB procedures.

N. AABC: Associated Air Balance Council.

O. AMCA: Air Movement and Control Association.

P. CTI: Cooling Tower Institute.

Q. NEBB: National Environmental Balancing Bureau.

R. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.08 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide 7 days advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS AND PROCEDURES

A. Project Conditions:

1. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire TAB period. Cooperate with the Owner during TAB operations to minimize conflicts with the Owner's operations.
2. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during TAB operations to minimize conflicts with the Owner's operations.
3. Non-Owner Occupancy: Complete balancing of building systems prior to Substantial Completion and owner occupancy.

B. General Requirements:

1. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and controls, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
2. Perform TAB work with doors, closed windows, and ceilings installed etc., to obtain simulated or project operating conditions. Do not proceed until systems scheduled for TAB are clean and free from debris, dirt and discarded building materials.

3. Where Owner occupies building during the testing period, cooperate with Owner to minimize conflicts with Owner's operations.

C. Examination:

1. Examine Contract Documents to become familiar with project requirements and existing building record documents (if available) to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
   a. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
   b. Verify that balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
2. Examine approved submittal data of HVAC systems and equipment.
3. Examine project record documents described in Division 01, General Requirements.
4. Examine Architect's and Engineer's design data, including Basis of Design, 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.
5. Examine equipment performance data, including fan and pump curves. 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. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
6. Coordinate requirements in system and equipment with this Section.
7. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
8. Examine system and equipment test reports.
9. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
10. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
11. Examine equipment for installation and for properly operating safety interlocks and controls.
12. Report deficiencies discovered before and during performance of TAB procedures.
13. Beginning of work means acceptance of existing conditions.

D. Preparation:

1. Prepare a TAB plan that includes strategies and step-by-step procedures.

2. Complete system readiness checks and prepare system readiness reports. Verify the following:
    a. Permanent electrical power wiring is complete.
    b. Hydronic systems are filled, clean, and free of air.
    c. Automatic temperature-control systems are operational.
    d. Equipment and duct access doors are securely closed.
    e. Balance, smoke, and fire dampers are open.
    f. Isolating and balancing valves are open and control valves are operational.
    g. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
    h. Windows, doors and other portions of the building envelope can be closed so design conditions for system operations can be met.
3. Hold a pre-balancing meeting at least one week prior to starting TAB work.
    a. Attendance is required by installers whose work will be tested, adjusted, or balanced.
4. Provide instruments required for TAB operations. Make instruments available to Architect to facilitate spot checks during testing.

E. General TAB Procedures:
1. Perform TAB procedures on each system according to the procedures contained in AABC national standards or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
2. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
3. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

F. Adjustment Tolerances:
1. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.
2. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
3. Hydronic Systems: Adjust to within plus or minus 10 percent of design at coils and plus or minus 5 percent at system pumps and equipment.
4. Adjust supply, return, and exhaust air quantities to maintain pressurization in spaces indicated on Drawings. Note and document room-to-room pressurization and maintain these relationships. Adjust pressure controlled spaces to within plus or minus 0.01 in WC.

G. Recording and Adjusting:
1. Field Logs: Maintain written logs including:
    a. Running log of events and issues.
    b. Discrepancies, deficient or uncompleted work by others.
    c. Contract interpretation requests.
    d. Lists of completed tests.

2. Ensure recorded data represents actual measured or observed conditions.
3. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
4. Mark on drawings locations where traverse and other critical measurements were taken and cross reference location in final report.
5. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
6. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
7. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner's Authorized Representative, or Commissioning Agent.

3.02 FUNDAMENTAL AIR SYSTEMS BALANCING PROCEDURES

A. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

B. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.

C. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

D. Prepare test reports for both fans and inlets and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross check the summation of required outlet volumes with required fan volumes.

E. Prepare schematic diagrams of systems' "as-built" duct layouts.

F. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

G. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

H. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

I. Verify that motor starters are equipped with thermal protection, sized for the connected load.

J. Check dampers for proper position to achieve desired airflow path.

K. Check for airflow blockages.

L. Check that condensate drains are installed, trapped and primed and routed to drain.

M. Check for readily observable leaks in air-handling unit components and ductwork.

N. Use sheaves and pulleys to adjust the speed of belt drive fans to achieve design flow with motors running at 60 Hertz unless noted otherwise.

3.03 TEMPERATURE CONTROL VERIFICATION

A. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices operate by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, equipment, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.

7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to design values.

B. Verify that controllers are calibrated and commissioned.

C. Check transmitter and controller locations and note conditions that would adversely affect control functions.

D. Record controller settings and note variances between set points and actual measurements.

E. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).

F. Verify free travel and proper operation of control devices such as damper and valve operators.

G. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.

H. Confirm interaction of electrically operated switch transducers.

I. Confirm interaction of interlock and lockout systems.

J. Verify main control supply-air pressure and observe compressor and dryer operations.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.04 CONSTANT VOLUME AIR SYSTEMS BALANCING PROCEDURES

A. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer. Adjust fans to deliver design airflow at the lowest possible speed.

1. Measure fan static pressures to determine actual static pressure as follows:
   a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
   b. Measure static pressure directly at the fan outlet or through the flexible connection.
   c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
   d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
2. Measure static pressure across each air-handling unit component under final balanced condition.
3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Recommend corrective action to align design and actual conditions.
4. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
5. Do not make fan-speed adjustments that result in motor loading greater than full load amps. Do not increase fan speed beyond fan class rating. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
6. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.

7. Calibrate airflow measuring stations.

3.05 PRE-BALANCE REPORTING

A. Pre-Construction Phase Report:

1. Provide a pre-construction phase TAB Plan at least 2 weeks prior to the commencement of TAB work. This report is to include:

a. A complete set of report forms intended for use on the project, with all data filled in except for the field readings. Forms to be project specific.

b. Marked up shop drawings identifying all HVAC equipment to be balanced, and associated outlets and terminal devices.

c. Identification of the type, manufacturer, and model of actual instruments to be used, and clear indication of which instrument will be used to take each type of reading. Calibration certifications are to be included.

d. A narrative of any project specific and/or non-standard TAB procedures to be used, and the equipment or systems they apply to.

B. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

C. Status Reports: As Work progresses, prepare 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.

3.06 FINAL REPORTS

A. Report Requirements:

1. General:

a. Computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.

b. Include a certification sheet in front of binder signed and sealed by the certified TAB engineer.

1) Include a list of the instruments used for procedures, along with proof of calibration.

c. Final Report Contents: In addition to the 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, but do not include approved Shop Drawings and Product Data.

B. General Report Data:

1. In addition to the form titles and entries, include the following data in the final report, as applicable:

a. Title Page

b. Name and Address of TAB Agent

c. Project Name

d. Project Location

e. Architect's Name and Address

f. Engineer's Name and Address
g. Contractor's Name and Address
h. Report Date
i. Signature of TAB Agent who Certifies the Report
j. Summary of Contents, Including the Following:
1) Design versus Final Performance
2) Notable Characteristics of Systems
3) Description of System Operation Sequence if it varies from the Contract Documents
k. Nomenclature Sheets for Each Item of Equipment
l. Data for Terminal Units, including Manufacturer, Type Size, and Fittings
m. Notes to explain why certain final data in the body of reports vary from design values.
n. Test Conditions for Fans and Pump Performance Forms, Including the Following:
1) Settings for Outside-, Return-, and Exhaust-air Dampers
2) Conditions of Filters
3) Cooling Coil, Wet- and Dry-bulb Conditions
4) Face and Bypass Damper Settings at Coils
5) Fan Drive Settings, including Settings and Percentage of Maximum Pitch Diameter
6) Inlet Vane Settings for Variable-Air-Volume Systems
7) Settings for Supply-air, Static-pressure Controller
8) Other System Operating Conditions that affect Performance

C. System Diagrams:
1. Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
a. Quantities of Outside, Supply, Return, and Exhaust Airflows
b. Water and Steam Flow Rates
c. Duct, Outlet, and Inlet Sizes
d. Pipe and Valve Sizes and Locations
e. Terminal Units
f. Balancing Stations

D. Air Handling Units:
1. For air-handling units, split systems, fan coils, pumps, and evaporator units with coils, include the following:
a. Unit Data: Include the following:
1) Unit Identification
2) Location
3) Make and Type
4) Model Number and Unit Size
5) Manufacturer's Serial Number
6) Unit Arrangement and Class
7) Discharge Arrangement
8) Sheave Make, Size in inches, and Bore

9) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
10) Number of Belts, Make, and Size
11) Number of Filters, Type, and Size

b. Motor Data: Include the following:
1) Make and Frame Type and Size
2) Horsepower and rpm
3) Volts, Phase, and Hertz
4) Full-load Amperage and Service Factor
5) Sheave Make, Size in Inches, and Bore
6) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches

c. Test Data: Include design and actual values for the following:
1) Total Airflow Rate in cfm (L/s)
2) Total System Static Pressure in Inches wg (Pa)
3) Fan rpm
4) Discharge Static Pressure in Inches wg (Pa)
5) Filter Static-pressure Differential in Inches wg (Pa)
6) Preheat Coil Static-pressure Differential in Inches wg (Pa)
7) Cooling Coil Static-pressure Differential in Inches wg (Pa)
8) Heating Coil Static-pressure Differential in Inches wg (Pa)
9) Outside Airflow in cfm (L/s)
10) Return Airflow in cfm (L/s)
11) Outside-air Damper Position
12) Return-air Damper Position
13) Vortex Damper Position

E. Fans:

1. Fan Test Reports: For supply, return, and exhaust fans, include the following:

a. Fan Data: Include the following:
1) System Identification
2) Location
3) Make and Type
4) Model Number and Size
5) Manufacturer's Serial Number
6) Arrangement and Class
7) Sheave Make, Size in Inches, and Bore
8) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches.

b. Motor Data: Include the following:
1) Make and Frame Type and Size
2) Horsepower and rpm
3) Volts, Phase, and Hertz
4) Full-load Amperage and Service Factor
5) Sheave Make, Size in Inches, and Bore
6) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches

7) Number of Belts, Make, and Size

c. Test Data: Include design and actual values for the following:

1) Total Airflow Rate in cfm
2) Total System Static Pressure in Inches wg
3) Fan rpm
4) Discharge Static Pressure in Inches wg
5) Suction Static Pressure in Inches wg

F. Duct Traverses:

1. Include a diagram with a grid representing the duct cross-section and record the following:

a. Report Data: Include the following:

1) System and Air-handling Unit Number
2) Location and Zone
3) Traverse Air Temperature in Degrees F
4) Duct Static Pressure in Inches wg
5) Duct Size in Inches
6) Duct Area in SF
7) Design Airflow Rate in cfm
8) Design Velocity in fpm
9) Actual Airflow Rate in cfm
10) Actual Average Velocity in fpm
11) Barometric Pressure in PSIG

G. Diffusers/Registers/Grilles:

1. For diffusers, registers and grilles, include the following:

a. Unit Data: Include the following:

1) System and Air-handling Unit Identification
2) Location and Zone
3) Test Apparatus Used
4) Area Served
5) Air-terminal-device Make
6) Air-terminal-device Number from System Diagram
7) Air-terminal-device Type and Model Number
8) Air-terminal-device Size
9) Air-terminal-device Effective Area in SF

b. Test Data: Include design and actual values for the following:

1) Airflow Rate in cfm
2) Air Velocity in fpm
3) Preliminary Airflow Rate as Needed in cfm
4) Preliminary Velocity as Needed in fpm
5) Final Airflow Rate in cfm
6) Final Velocity in fpm
7) Space Temperature in Degrees F

H. Instrument Calibration:

1. For instrument calibration, include the following:

a. Report Data: Include the following:

1) Instrument Type and Make
2) Serial Number
3) Application.
4) Dates of Use

b. Dates of Calibration.

3.07 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing 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 inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 00
HVAC INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. Type A, Flexible Glass Wool Blanket
2. Type B, Duct Liner
3. Type 1, Glass Wool Pipe Insulation
4. Type 2, Flexible Elastomeric Pipe Insulation
5. Jacketing
6. Accessories
7. Duct Insulation Accessories
8. Duct Insulation Compounds
9. Outdoor Ducting Cover

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Piping and duct insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Installer qualifications.
2. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any) for each type of product indicated.
3. 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.
4. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.
5. Submit manufacturer's installation instructions.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Formaldehyde Free: Should be third-party certified with UL Environment Validation.
2. Recycled Content: A minimum of 40 percent post-consumer recycled glass content certified and UL validated.

3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.
4. Installer to have minimum 5 years' experience in the business of installing insulation.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 FIRE HAZARD CLASSIFICATION

A. Maximum fire hazard classification of the composite insulation construction as installed to be not more than a Flame Spread Index (FSI) of 25 and Smoke Developed Index (SDI) of 50 as tested by current edition of ASTM E84 (NFPA 255) method.

B. Test pipe insulation in accordance with the requirements of current edition of UL "Pipe and Equipment Coverings R5583 400 8.15".

C. Test duct insulation in accordance with current edition of ASTM E84, UL 723, NFPA 255, NFPA 90A and NFPA 90B.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Type A, Flexible Glass Wool Blanket:
1. Certainteed
2. Johns Manville
3. Knauf
4. Owens-Corning
5. Or approved equivalent.

B. Type B, Duct Liner:
1. Certainteed
2. Johns Manville
3. Knauf
4. Owens-Corning
5. Or approved equivalent.

C. Type 1, Glass Wool Pipe Insulation:
1. Certainteed
2. Johns Manville
3. Knauf
4. Owens-Corning
5. Or approved equivalent.

D. Type 2, Flexible Elastomeric Pipe Insulation:
1. Insulation:
   a. Armacell LLC Armaflex
   b. K-Flex
   c. Or approved equivalent.
2. Glue:
   a. Armacell LLC Armaflex Low VOC Adhesive
   b. K-Flex
   c. Or approved equivalent.
3. Paint:

a. Armacell LLC Armaflex
b. K-Flex
c. Or approved equivalent.

E. Jacketing:
1. ITW Insulation Systems
2. Or approved equivalent.

F. Accessories:
1. ITW Insulation Systems
2. Or approved equivalent.

G. Duct Insulation Accessories:
1. Certainteed
2. Johns Manville
3. Owens-Corning
4. Or approved equivalent.

H. Duct Insulation Compounds:
1. Certainteed
2. Johns Manville
3. Owens-Corning
4. Or approved equivalent.

I. Outdoor Ducting Cover:
1. Certainteed
2. Johns Manville
3. Owens-Corning
4. Or approved equivalent.

2.02 TYPE A, FLEXIBLE GLASS WOOL BLANKET

A. ASTM C553, Type 1, Class B-2; flexible blanket.

B. 'K' Value: 0.27 BTU*in/(hr*sf*F) at 75 degrees F installed, maximum service temperature: 250 degrees F.

C. Density: 0.75 pounds per cubic foot.

D. DBDE-free. UL/E validated to be formaldehyde-free.

E. Vapor Barrier Jacket: FSK aluminum foil reinforced with glass wool yarn and laminated to fire resistant Kraft, secured with UL listed pressure sensitive tape or outward clinched expanded staples and vapor barrier mastic as needed.

2.03 TYPE B, DUCT LINER

A. ASTM C1071; flexible blanket.

B. 'K' Value: ASTM C518, 0.25 BTU*in/(hr*sf*F) at 75 degrees F, maximum service temperature: 250 degrees F.

C. Noise Reduction Coefficient: 0.65 or higher based on ASTM C 423 "Type A mounting."

D. Maximum Velocity on Mat or Coated Air Side: 5,000 FPM.

E. Adhesive: UL listed waterproof type.

F. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.

G. Erosion-Resistant Surfaces: UL 181.

H. ASTM G21 and ASTM G22 Microbial Growth Resistance.

I. UL GREENGUARD Certified does not support the growth of mold, fungi, or bacteria per ASTM C 1338 and meets UL Environment GREENGUARD Microbial Resistance Listing

per UL 2824-“GREENGUARD Certification Program Method for Measuring Microbial Resistance”. DBDE-free. UL/E validated to be formaldehyde-free.

2.04 TYPE 1, GLASS WOOL PIPE INSULATION

A. Glass Wool: ASTM C547 Type I and IV; rigid molded, noncombustible.
   1. Thermal Conductivity Value: As indicated in the insulation tables below.
   2. Maximum Service Temperature: 850 degrees F to 1000 degrees F.

B. Vapor Retarder Jacket: White Kraft paper reinforced with glass wool and bonded to aluminum foil, secure with self-sealing longitudinal laps and butt strips or vapor barrier mastic.

2.05 TYPE 2, FLEXIBLE ELASTOMERIC PIPE INSULATION

A. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet.
   1. Thermal Conductivity Value: As indicated in the insulation tables below.
   2. Maximum Service Temperature of 220 degrees F.
   3. Maximum Flame Spread: 25.
   4. Maximum Smoke Developed: 50 (1-inch thick and below).
   5. Connection: Waterproof vapor retarder adhesive as needed.
   6. UV Protection: UV outdoor protective coating per manufacturer's requirements.

B. Glue: Contact adhesive specifically manufactured for cementing flexible elastomeric foam.

C. Paint: Nonhardening high elasticity type, specifically manufactured as protective covering of flexible elastomeric foam insulation for prevention of degradation due to exposure to sunlight and weather.

2.06 JACKETING

A. Canvas Jacket: UL listed fabric, 6 ounce/sq.yd., plain weave cotton treated with dilute fire retardant lagging adhesive.

B. PVC preformed molded insulation covers. Zeston or approved equivalent.

C. Aluminum Jacket: 0.016-inch-thick sheet, (smooth/embossed) finish, with longitudinal slip joints and 2-inch laps, die-shaped fitting covers with factory attached protective liner.

D. Stainless Steel Jacket: Type 304 stainless steel, 0.010-inch, smooth finish.

2.07 ACCESSORIES

A. Equipment Insulation Jacketing: Presized glass cloth, not less than 7.8 ounces/sq.yd., except as otherwise indicated. Coat with gypsum based cement.

B. Equipment Insulation Compounds: Provide adhesives, cement, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

C. General: Provide staples, bands, wire, wire netting, tape corner angles, anchors, stud pins and metal covers as recommended by insulation manufacturer for applications indicated. Accessories, i.e., adhesives, mastics, cements and tape to have the same flame and smoke component ratings as the insulation materials with which they are used. Shipping cartons to bear a label indicating that flame and smoke ratings do not exceed those listed above. Provide permanent treatment of jackets or facings to impart flame and smoke safety. Provide nonwater soluble treatments. Provide UV protection recommended by manufacturer for outdoor installation.

2.08 DUCT INSULATION ACCESSORIES

A. Staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

2.09 DUCT INSULATION COMPOUNDS

A. Cements, adhesives, coatings, sealers, protective finishes and similar accessories as recommended by insulation manufacturer for applications indicated.

2.10 OUTDOOR DUCTING COVER

A. Aluminum Jacket: 0.016-inch-thick sheet, smooth/embossed finish, with longitudinal slip joints and 2-inch laps.

B. Nonwater vapor retarder, nonburning, weatherproof coating for use over insulation where "breathing" is required.

C. UV resistant polyvinyl chloride covering with joints secured and sealed.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Verification of Conditions:

1. Do not apply insulation until pressure testing and inspection of ducts and piping has been completed.
2. Examine areas and conditions under which duct and pipe insulation will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Preparation: Clean and dry surfaces to be insulated.

C. Installation:

1. Insulation: Continuous through walls, floors and partitions except where noted otherwise.
2. Piping and Equipment:
   a. Install insulation over clean, dry surfaces with adjoining sections firmly butted together and covering surfaces. Fill voids and holes. Seal raw edges. Install insulation in a manner such that insulation may be split, removed, and reinstalled with vapor barrier tape on strainer caps and unions. Do not install insulation until piping has been leak tested and has passed such tests. Do not insulate manholes, equipment manufacturer's nameplates, handholes, and ASME stamps. Provide beveled edge at such insulation interruptions. Repair voids or tears.
   b. Cover insulation on pipes above ground, outside of building, with aluminum jacketing. Position seam on bottom of pipe.

D. Provide accessories as required. See Part 2 Article "Accessories" above.

E. Protection and Replacement: Installed insulation during construction. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

F. Labeling and Marking: Provide labels, arrows and color on piping and ductwork. Attach labels and flow direction arrows to the jacketing per Section 23 05 53, Identification for HVAC Piping, Ductwork and Equipment.

G. Ductwork:

1. Install insulation in conformance with manufacturer's recommendations to completely cover duct.
2. Butt insulation joints firmly together and install jackets and tapes smoothly and securely.
3. Apply duct insulation continuously through sleeves and prepared openings, except as otherwise specified. Apply vapor barrier materials to form complete unbroken vapor seal over insulation.
4. Coat staples and seals with vapor barrier coating.
5. Cover breaks in jacket materials with patches of same material as vapor barrier. Extend patches not less than 2-inches beyond break or penetration on all directions and secure with adhesive and staples. Seal staples and joints with vapor barrier coating.

6. Fill jacket penetrations. i.e., hangers, thermometers and damper operating rods, and other voids in insulation with vapor barrier coating. Seal penetration with vapor barrier coating. Insulate hangers and supports for cold duct in un-conditioned spaces to extent to prevent condensation on surfaces.
7. Seal and flash insulation terminations and pin punctures with reinforced vapor barrier coating.
8. Continue insulation at fire dampers and fire/smoke dampers up to and including those portions of damper frame visible at outside of the rated fire barrier. Insulating terminations at fire dampers in accordance with this Section.
9. Do not conceal duct access doors with insulation. Install insulation terminations at access door in accordance with this Section.

H. Insulated Pipe Exposed to Weather: Where piping is exposed to weather, cover insulation with aluminum jacket. Seal watertight jacket per manufacturer's recommendations. Install metal jacket with 2-inch overlap at longitudinal and butt joints with exposed lap pointing down. Secure jacket with stainless-steel draw bands 12-inches on center and at butt joints.

I. Insulation Shields: Provide hangers and shields (18 gauge minimum) outside of insulation for cold piping (<60 degrees F). Hot water piping hangers may penetrate insulation to contact pipe directly. Provide 18-inch long, noncompressible insulation section at insulation shields for lines 2-inches and larger (hot and cold) piping.

J. Ductwork Surfaces to be Insulated:

Item to be Insulated	System Insulation Type	Duct Size	Insulation Thickness
Supply ductwork where duct is not specified to be lined.	A	All	1.5-inch
Return ductwork where duct is not specified to be lined.	--	All	None
Supply ductwork (exposed to weather, in crawl space and in unheated attics)	A	All	3-inch
Return ductwork (exposed to weather, in crawl space and in unheated attics)	A	All	3-inch
Duct Silencers	C	All	1.5-inch
Outside Air Ducts	A	All	3-inch
HVAC plenums and unit housings not preinsulated	B	All	1.5-inch
Grease Exhaust	E	All	Per rating level
Exhaust ducts within 10-feet of exterior	A	All	3-inch
Exposed insulation in mechanical rooms or areas subject to damage	C, D	All	1.5-inch

1. Note: Insulation thickness shown is a minimum. If state codes require additional thickness, then provide insulation thickness per code requirements.

K. Piping Surfaces to be Insulated:

Item to be Insulated	System Insulation Type	Conductivity Range (Btu-inch per hour per SF per degrees F)	Pipe Size (Inches)	Insulation Thickness (Inches)
Heating, Steam, and Steam Condensate (above 350F)	1, 4	0.32-0.34 at a mean rating temperature of 250 degrees F	<1 1 to <1.5 1.5 to <4 4 to <8 >= 8	4.5 5.0 5.0 5.0 5.0
Heating, Steam, and Steam Condensate (251F to 350F)	1, 4	0.29-0.32 at a mean rating temperature of 200 degrees F	<1 1 to <1.5 1.5 to <4 4 to <8 >= 8	3.0 4.0 4.5 4.5 4.5
Heating, Steam, and Condensate (201F to 250F)	1, 4	0.27-0.30 at a mean rating temperature of 150 degrees F	<1 1 to <1.5 1.5 to <4 4 to <8 >= 8	2.5 2.5 2.5 3.0 3.0
Heating, Steam, and Steam Condensate (141F to 200F)	1, 4	0.25-0.29 at a mean rating temperature of 125 degrees F	<1 1 to <1.5 1.5 to <4 4 to <8 >= 8	1.5 1.5 2.0 2.0 2.0
Heating, Steam, and Steam Condensate (105F to 140F)	1, 4	0.21-0.28 at a mean rating temperature of 100 degrees F	<1 1 to <1.5 1.5 to <4 4 to <8 >= 8	1.0 1.0 1.5 1.5 1.5

Chilled Water (40F to 60F)	1, 4	0.21-0.27 at a mean rating temperature of 75 degrees F	<1 1 to <1.5 1.5 to <4 4 to <8 >= 8	0.5 0.5 1.0 1.0 1.0
Chilled Water (<40F)	1, 4	0.20-0.26 at a mean rating temperature of 50 degrees F	<1 1 to <1.5 1.5 to <4 4 to <8 >= 8	0.5 1.0 1.0 1.0 1.5
Refrigerant Suction Piping (40F to 60F)	2	0.21-0.27 at a mean rating temperature of 75 degrees F	<1 1 to <1.5 1.5 to <4 4 to <8 >= 8	0.5 0.5 1.0 1.0 1.0
Refrigerant Suction Piping (<=40F)	2	0.20-0.26 at a mean rating temperature of 50 degrees F	<1 1 to <1.5 1.5 to <4 4 to <8 >= 8	0.5 1.0 1.0 1.0 1.5
Breeching, Generator Exhaust	3	0.52-0.58 at a mean rating temperature of 500 degrees F	All	4.0
Heating Water Storage and Air Separation Tanks	2, 5	0.24-0.28 at a mean rating temperature of 75 degrees F	N/A	2.0
Chilled Water Storage and Air Separation Tanks	2, 5	0.24-0.28 at a mean rating temperature of 75 degrees F	N/A	1.0
Heat Exchangers (Steam)	2, 5	0.24-0.28 at a mean rating temperature of 75 degrees F	N/A	4.0

Heat Exchangers (Hydronic)	2, 5	0.24-0.28 at a mean rating temperature of 75 degrees F	N/A	2.0
Condenser Water (Exterior)	1, 2, aluminum jacketing	0.21-0.27 at a mean rating temperature of 75 degrees F	1 to 6 >=8	1.0 1.5

1. Note: Insulation thickness shown is a minimum. If state code requires additional thickness, then provide insulation thickness per code requirements.

3.02 TYPE A, FLEXIBLE GLASS WOOL BLANKET

A. Install insulation in conformance with manufacturer's recommendations and requirements.

B. Duct Wrap: Cover air ducts per insulation table except ducts internally lined where internal duct lining is adequate to achieve adequate insulating values to meet local Energy Codes (indicate on shop drawings, locations where duct wrap is planned to be omitted and indicate internal duct lining insulating values to confirm they will meet the Energy Code.) Wrap tightly with circumferential joints butted and longitudinal joints overlapped minimum of 2-inches. On ducts over 24-inches wide, additionally secure insulation with suitable mechanical fasteners at 18-inches on center. Circumferential and longitudinal joints stapled with flare staples 6-inches on center and covered with 3-inch wide, foil reinforced tape.

3.03 TYPE B, DUCT LINER

A. Install insulation in conformance with manufacturer's recommendations and requirements.

B. Duct Liners: Mat finish surface on air stream side. Secure insulation to cleaned sheet metal duct with continuous (minimum 90) percent coat of adhesive. Secure liner with mechanical fasteners 15-inches on center or per manufacturer requirements. Accurately cut liner and thoroughly coat ends with adhesive. Butt joints tightly. Top and bottom Sections of insulation overlap sides. Factory/field coat exposed edges. Metal nosing for exposed leading or transverse edges and when velocity exceeds 3500 FPM or manufacturer rating on exposed edges. Keep duct liner clean and free from dust. At completion of project, vacuum duct liner if it is dirty or dusty. Do not use small pieces. If insulation is installed without horizontal, longitudinal, and end joints butted together, installation will be rejected and work removed and replaced with work that conforms to this Specification.

3.04 TYPE 1, GLASS WOOL PIPE INSULATION

A. See General Installation Requirements above.

B. Install insulation in conformance with manufacturer's recommendations and requirements.

C. Lap seal insulation with waterproof adhesive. Do not use staples or other methods of attachment which would penetrate vapor barrier. Apply fitting covers with seated tacks and vapor barrier tape.

D. Apply insulation to pipe and seal with self-sealing lap. Use self-sealing butt strips to seal butt joints. Insulate fittings, valves and unions with single or multiple layers of insulation and cover to match pipe or use preformed PVC molded insulation covers.

3.05 TYPE 2, FLEXIBLE ELASTOMERIC PIPE INSULATION

A. Flexible Elastomeric Insulation:

1. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover insulation exposed to

weather and below grade with two coats of finish as recommended by manufacturer.

B. Flexible Elastomeric Tubing:

1. Flexible Elastomeric Tubing: Slip insulation over piping or, if piping is already installed, slit insulation and snap over piping. Joints and butt ends must be adhered with 520 adhesive.

C. See General Installation Requirements above.

D. Install insulation in conformance with manufacturer's recommendations and requirements.

E. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and undergrade with two coats of finish as recommended by manufacturer.

F. Install in accordance with manufacturer's instructions for below grade installation.

3.06 JACKETING

A. See General Installation Requirements above.

B. Install in accordance with manufacturer's instructions.

3.07 ACCESSORIES

A. Install insulation in conformance with manufacturer's instructions, recommendations and requirements.

B. See General Installation Requirements above.

C. Provide and install accessories for all insulation types listed in this Section.

3.08 DUCT INSULATION ACCESSORIES

A. Install insulation in conformance with manufacturer's recommendations and requirements.

3.09 DUCT INSULATION COMPOUNDS

A. Install insulation in conformance with manufacturer's recommendations and requirements.

3.10 OUTDOOR DUCTING COVER

A. Install insulation in conformance with manufacturer's recommendations and requirements.

B. Outdoor Duct Exposed to Weather:

1. Install jacket with brakes/slope to prevent standing water on duct. Use weatherable components.

2. Weatherproof seal at joints and seams. Minimum 2-inch overlap.

3. Label jacket every 6-feet and within 2-feet of building penetrations and equipment connections: "Do not stand or place equipment on duct."

END OF SECTION

SECTION 23 21 13
HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Heating Water Piping, Buried
   2. Heating Water Piping, Above Ground
   3. Unions
   4. Refrigerant Piping

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Welding Certificates: Copies of certificates for welding procedures and personnel.
   2. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
      a. Test procedures used.
      b. Test results that comply with requirements.
      c. Failed test results and corrective action taken to achieve requirements.
   3. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at project site.
   4. Buried piping manufacturer to submit thrust block (chilled water) and anchor plate (heating hot water) layout and details including anchorage and seismic calculations.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Installer Qualifications: Company specializing in performing work of the type specified in this Section, with documented experience.
   2. Welder Qualifications: Certify in accordance with ASME (BPV IX).
   3. ASME Compliance: Comply with ASME B31.9 "Building Services Piping" for materials, products, and installation. Provide safety valves and pressure vessels with the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 01.
   4. Refrigerant Piping:
      a. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX "Welding and Brazing Qualifications."

b. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

c. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."

d. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical" or UL 429 "Electrically Operated Valves."

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements, General Requirements.

PART 2 - PRODUCTS

2.01 HEATING WATER PIPING, BURIED

A. Acceptable Manufacturers:

1. Underground Heating Water Piping Systems:

a. Ricwil

b. Uponor

c. Thermacor

d. Rovanco

e. Perma-Pipe

f. Rehau

B. Steel Pipe: ASTM A 53/A 53M, Schedule 40, black, Grade B, ERW (Type E) or seamless (Type S).

1. Fittings: ASTM A 234/A 234M, wrought steel welding type.

a. Make changes in direction with weld fittings.

b. Where tee branches are smaller than the mains they join, weld-o-lets may be used.

c. Provide weld fittings that are long radius and the same wall thickness as adjacent piping.

2. Joints: Welded in accordance with AWS D1.1.

3. Insulation: Polyurethane foam either spray applied or high pressure injected with one shot into the annular space between carrier pipe and jacket. Provide insulation rigid, 90-95 percent closed cell polyurethane with a 2.0 to 3.0 pounds per cubic foot density and coefficient of thermal conductivity (K-Factor) of 0.14 and conforming to ASTM C-591. Maximum operating temperature not-to-exceed 250 Degrees F.

4. Jacketing Material: Provide either extruded white polyvinyl chloride, consisting of clean, virgin NSF approved Class 12454-B PVC compound, conforming to ASTM D-1784, Type 1, Grade 1 or high density polyethylene (HDPE). Provide PVC jacket with a wall thickness in mils equal to ten times the nominal jacket diameter and not less than 60 mils. HDPE to have a minimum wall thickness of 125 mils for jacket sizes equal to or less than 12-inches or 150 mils for jacket sizes greater than 12-inch to 24-inch and be used for all jacketing larger than 16-inch. No FRP, HDUP, or tape jacket allowed.

5. Provide jacketing for fittings, valves, etc. of the same material as for piping.

6. Expansion Loop and Ells:

a. Expansion loops or expansion elbows furnished and enclosed in the same type of casing as those furnished for the standard section of the piping system.

b. Size to permit the inner pipe or pipes to move without damage to the insulation material.

c. Provide expansion loops or expansion elbows prefabricated and shipped to the job site in as few pieces as possible (manufacturer's recommendations to govern).

d. Provide inner pipe loops and expansion bends cold sprung in the field as required.

e. Provide calculations as part of submittals.

7. Moisture Barrier End Seals: Factory applied, sealed to the jacket and carrier pipe. Provide end seals certified as having passed a 20-foot head pressure test. Provide end seals with high temperature mastic completely sealing the exposed end of the insulation. Field applied end seals installed at any field cut to the piping before continuing with the installation.

C. Steel Pipe Sizes 12-inch and Over: ASTM A 53/A 53M, 0.375-inch wall, black, Grade B, ERW (Type E) or seamless (Type S).

1. Fittings: ASTM A 234/A 234M, wrought steel welding type.

a. Changes in direction made with weld fittings.

b. Where tee branches are smaller than the mains they join, weld-o-lets may be used.

c. Provide weld fittings long radius and the same wall thickness as adjacent piping.

2. Joints: Welded in accordance with AWS D1.1.

3. Insulation: Polyurethane foam either spray applied or high pressure injected with one shot into the annular space between carrier pipe and jacket. Insulation rigid, 90-95 percent closed cell polyurethane with a 2.0 to 3.0 pounds per cubic foot density and coefficient of thermal conductivity (K-Factor) of 0.14 and conforming to ASTM C-591. Maximum operating temperature not-to-exceed 250 Degrees F.

4. Jacketing Material: Provide either extruded white polyvinyl chloride, consisting of clean, virgin NSF approved Class 12454-B PVC compound, conforming to ASTM D-1784, Type 1, Grade 1 or high density polyethylene (HDPE). Provide PVC jacket with a wall thickness in mils equal to ten times the nominal jacket diameter and not less than 60 mils. HDPE to have a minimum wall thickness of 125 mils for jacket sizes equal to or less than 12-inch or 150 mils for jacket sizes greater than 12-inch to 24-inch and used for all jacketing larger than 16-inch. No FRP, HDUP, or tape jacket allowed.

5. Provide jacketing for fittings, valves, etc. of the same material as for piping.

6. Expansion Loop and Ells:

a. Expansion loops or expansion elbows furnished and enclosed in the same type of casing as those furnished for the standard section of the piping system.

b. Size to permit the inner pipe or pipes to move without damage to the insulation material.

c. Provide expansion loops or expansion elbows prefabricated and shipped to the job site in as few pieces as possible (manufacturer's recommendations to govern).

d. Provide inner pipe loops and expansion bends cold sprung in the field as required.

e. Provide calculations as part of submittals.

7. Moisture Barrier End Seals: Factory applied, sealed to the jacket and carrier pipe. End seals certified as having passed a 20-foot head pressure test. Provide end seals with high temperature mastic completely sealing the exposed end of the insulation. Field applied end seals installed at any field cut to the piping before continuing with the installation.

D. Copper Tube: ASTM B 88 (ASTM B 88M), Type K. Copper piping to have ends cut square for socket brazing. Provide straight sections of factory insulated pipe 20-feet in length and having 6-inch of exposed pipe at each end for field joint fabrication. Field joining of piping to utilize approved methods of silver soldering or brazing with alloys melting at or above 1100 degrees F; 50-50 tin-lead solder is not acceptable.

1. Fittings: ASME B16.22, wrought copper.
2. Joints: Solder, lead free, ASTM B 32, HB alloy (95-5 tin-antimony), or tin and silver.
3. Insulation: Polyurethane foam either spray applied or injected with one shot into the annular space between carrier pipe and jacket, and bonded to both. Provide insulation rigid, 90-95 percent closed cell polyurethane with a 2.0 to 3.0 pounds per cubic foot density and coefficient of thermal conductivity (K-Factor) of 0.14 and conforming to ASTM C-591. Maximum operating temperature of urethane not-to-exceed 250 degrees F.
4. Jacketing Material: Provide either extruded white polyvinyl chloride, consisting of clean, virgin NSF approved Class 12454-B PVC compound, conforming to ASTM D-1784, Type 1, Grade 1 or high density polyethylene (HDPE). Provide PVC jacket with a wall thickness in mils equal to ten times the nominal jacket diameter and not less than 60 mils. HDPE to have a minimum wall thickness of 125 mils for jacket sizes equal to or less than 12-inch or 150 mils for jacket sizes greater than 12-inch to 24-inch and used for all jacketing larger than 16-inch. No FRP, HDUP or tape jacket allowed.
    a. Provide jacketing for fittings, valves, etc. of same material as for piping.
5. Expansion Loops and Ells:
    a. Expansion loops or expansion elbows furnished and enclosed in the same type of casing as those furnished for the standard section of the piping system.
    b. Size to permit the inner pipe or pipes to move without damage to the insulation material.
    c. Provide expansion loops or expansion elbows prefabricated and shipped to the job site in as few pieces as possible (manufacturer's recommendations govern).
    d. Inner pipe loops and expansion bends cold sprung in the field as required.
6. Moisture Barrier End Seals: Factory applied, sealed to the jacket and carrier pipe. End seals certified as having passed a 20-foot head pressure test. Provide end seals with high temperature mastic completely sealing the exposed end of the insulation. Field applied end seals installed at any field cut to the piping before continuing with the installation.

E. Preinsulated Underground PEX Pipe

1. Factory preinsulated piping system, consisting of an inner media carrier pipe, insulation around the carrier pipe, and a water/vapor seal jacket over the insulation. Rated for minimum 180F heating water at 85 PSI.
2. Carrier Pipe Material: PEX piping. Combined supply and return.
3. Insulation: Rigid closed cell polyurethane.
4. Outer Casing: Flexible HPDE.
5. Each factory prefabricated section provides complete sealing of insulation at each end of conduit/casing. Provide permanent water and vapor seal.
6. Carry over outer casing and extend to carrier pipe or use prefabricated caps specifically designed for end seal of prefabricated insulation systems. Fabricate caps of the same material as the outer casing.

7. Manufacturers: Uponor Ecoflex or approved equivalent.

2.02 HEATING WATER PIPING, ABOVE GROUND

A. Steel Pipe: ASTM A53/A 53M, Schedule 40, black, Type E (electric resistance welded), Grade B.
   1. Fittings: ASME B16.3, malleable iron or ASTM A 234/A 234M, wrought steel welding type.
   2. Wrought Cast and Forged Steel Flanges and Flanged Fittings: ASME B16.5 including bolts, nuts, and gaskets of the following material group, end connections, and facings:
      a. Material Group: 1.1.
      b. End Connections: Butt welding.
      c. Facings: Raised face.
   3. Joints: Threaded or AWS D1.1 welded.

B. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), drawn.
   1. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
   2. Joints: Solder, lead free ASTM B32, HB alloy (95-5 tin antimony), or tin and silver.
   3. Joints: Brazed, AWS A5.8, Classification BAg-1 (silver). Pipes 2-1/2-inches or larger or piping routed over food preparation centers, food serving facilities, food storage areas, computer rooms, telecommunications rooms, and electrical rooms.

2.03 UNIONS

A. Unions for Pipe 2-inches and Under:
   1. Ferrous Piping: 150, 250, and 300 PSIG malleable iron, threaded, ASME B16.39.
   2. Copper Pipe: Bronze, soldered joints, ASME B16.22.

B. Dielectric Connections: Provide dielectric waterway or brass nipple fitting with threaded ends. Dielectric unions are not allowed.

2.04 REFRIGERANT PIPING

A. Piping:
   1. Copper Tube: ASTM B 280, Type ACR, drawn-temper tube, clean, dry and capped.
      a. Fittings: ASME B16.22 wrought copper.
      b. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy (15 percent Silver).
   2. Copper Tube to 5/8-inch OD: ASTM B280. Tube ACR, annealed-temper copper tube, clean, dry and capped.
      a. Fittings: ASME B16.26 cast copper.
      b. Joints: Flared.

B. Moisture and Liquid Indicators:
   1. Manufacturers:
      a. Henry Technologies.
      b. Parker Hannifin/Refrigeration and Air Conditioning.
      c. Sporlan Valve Company.
      d. Substitutions: See Section 23 00 00, HVAC Basic Requirements, Division 00, Procurement and Contracting Requirements and Division 01, General Requirements requirements.
   2. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator and plastic cap; for

maximum temperature of 200 degrees F and maximum working pressure of 300 PSI.

C. Valves:

1. Manufacturers:

a. Hansen Technologies Corporation.

b. Henry Technologies.

c. Danfoss Flomatic.

d. Substitutions: See Section 23 00 00, HVAC Basic Requirements, Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.

2. Packaged Ball Valves:

a. Two piece bolted forged brass body with Teflon ball seals and copper tube extensions, brass seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of and maximum temperature of 300 degrees F.

D. Filter-Driers:

1. Manufacturers:

a. Flow Controls Division of Emerson Electric.

b. Parker Hannifin/Refrigeration and Air Conditioning.

c. Sporlan Valve Company.

d. Substitutions: See Section 23 00 00, HVAC Basic Requirements, Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.

2. Performance:

a. Flow Capacity - Liquid Line: As required by equipment manufacturer, rated in accordance with ANSI/AHRI 710 I-P.

b. Flow Capacity - Suction Line: As required by equipment manufacturer, rated in accordance with ANSI/AHRI 730 I-P.

c. Water Capacity: As recommended by equipment manufacturer, rated in accordance with AHRI 710 I-P.

d. Pressure Drop: No greater than maximum recommended by equipment manufacturer, when operating at full connected evaporator capacity.

e. Design Working Pressure: 350 PSI, maximum.

3. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, and filtration to 40 microns; of construction that will not pass into refrigerant lines.

4. Construction: UL listed.

a. Replaceable Core Type: Steel shell with removable cap.

b. Sealed Type: Copper shell.

c. Connections: As specified for applicable pipe type.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Install per manufacturer's written instructions and requirements.

B. Preparation:

1. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

2. Remove scale and dirt on inside and outside before assembly.

3. Prepare piping connections to equipment with flanges or unions.

4. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

C. Buried Piping Installation:

1. Install in accordance with Drawings, specifications, and manufacturer's installation instructions. Provide a field service instructor on site to train the Contractor in all phases of installation.
2. Underground Systems: Buried in a trench of not less than 2-feet deeper than the top of the pipe and not less than 18-inches wider than the combined outside diameter of all piping systems. A minimum thickness of 24-inches of compacted backfill over the top of the pipe is required. System installation must meet H-20 highway loading.
3. Trench bottom to have a minimum of 6-inch of sand, pea gravel, or specified backfill material, as approved by the engineer, as a cushion for the piping. Field cutting of the pipe performed in accordance with the manufacturer's installation instructions.
4. Provide thrust blocking, anchor plates, and concrete.
5. Cast a concrete block over anchor plates as recommended by manufacturer. Block to sit on undisturbed trench sidewalls and/or the bottom of the trench. Concrete block to be at least the length as recommended by manufacturer and extend a minimum distance as recommended by manufacturer beyond the top and bottom of anchor plate.
6. Pressure test buried piping.
7. Field Service: Provided by a certified manufacturer's representative or company field service technician. The technician will be available at the job to check unloading, storing, and handling of pipe, joint installation, pressure testing and backfilling techniques.
8. Provide identification and tracer wire, per Section 23 05 53, Identification for HVAC Piping, Ductwork and Equipment.
9. Clean piping systems thoroughly. Purge pipe of construction debris and contamination before placing the piping systems in service. Provide temporary connections for cleaning, purging, and circulating fluids through the piping system.
10. Use temporary strainers and temporary pumps that can create fluid velocities up to 10 feet per second to flush and clean the piping systems. Do not use Owner's permanent strainers to trap debris during pipe flushing operations. Fit the temporary construction strainers with a line size blowoff valve.
11. When constructing minor piping modifications or additions, verify with Owner if the Owner's pumps and strainers can be used for flushing and chemical cleaning operations. When the flushing and cleaning operations are complete, ensure the strainer baskets and screens installed in the piping systems permanent strainers are replaced with clean elements. Keep temporary strainers in service until the equipment has been tested, then replace straining element with a new strainer and clean and deliver the old straining elements to Owner. Fit the Owner's strainers with a line size blowoff valve.
12. Install bypass piping or hoses at the supply and return piping connections at heat exchangers, chillers, cooling towers, pumps, and cooling coils, etc., to prevent debris from being caught or causing damage to equipment which will be connected to the piping system.
13. Circulate a chemical cleaner in chilled and heating water piping systems to remove mill scale, grease, oil, and silt. Cleaner to be selected by chemical treatment vendor on project. Circulate for 48 hours, flush system and replace with clean water. Dispose of chemical solution in accordance with local codes. The chilled and heating water system should then be treated with chemicals and

inhibitors to be selected by chemical treatment vendor on project. When the chemical cleaning is complete, remove, clean, and reinstall all permanent screens. Notify Owner so that the reinstallation of clean strainer screens may be witnessed.

14. Do not install underground piping when bedding is wet or frozen.

D. Above Ground Piping Installation:

1. Install per manufacturer's written instructions and requirements.
2. Install heating water, glycol, condenser water, piping to ASME B31.9 requirements. Install chilled water piping to ASME B31.5 requirements.
3. PVC Pipe: Make solvent-welded joints in accordance with ASTM D 2855.
4. Route piping in orderly manner, parallel to building structure, and maintain gradient.
5. Install piping to conserve building space and to avoid interference with use of space.
6. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
7. Sleeve pipe passing through partitions, walls and floors allowing adequate space for pipe insulation.
8. Slope piping at 0.2 percent upward in direction of flow and arrange to drain at low points.
9. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
10. 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.
11. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.
12. Anchor piping for proper direction of expansion and contraction.
13. Inserts:
    a. Provide inserts for placement in concrete formwork.
    b. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
    c. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4-inches.
    d. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
    e. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.
14. Pipe Hangers and Supports:
    a. Install in accordance with Division 23, HVAC, Hangers and Supports.
    b. Install hangers to provide minimum1/2-inch space between finished covering and adjacent work.
    c. Place hangers within 12-inches of each horizontal elbow.
    d. Use hangers with 1-1/2-inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
    e. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

f. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

g. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.

h. Provide copper plated hangers and supports for copper piping.

i. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

15. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

16. Provide access where valves and fittings are not exposed.

17. Use eccentric reducers to maintain top of pipe level.

18. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

19. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.

E. Field Quality Control:

1. Leave joints, including welds, uninsulated and exposed for examination during test.

2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

3. Flush system with clean water. Clean strainers.

4. Isolate equipment from piping. If a valve is used to isolate equipment, provide closure 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.

6. Perform the following tests on hydronic piping:

a. 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.

b. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.

c. Check expansion tanks to determine that they are not air bound and that system is full of water.

d. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure not-to-exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."

e. After hydrostatic test pressure has been applied for at least four hours, examine piping, joints and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

f. Prepare written report of testing.

F. Flushing and Cleaning of Piping Systems:

1. Clean piping systems thoroughly. Purge pipe of construction debris and contamination before placing the piping systems in service. Provide temporary connections for cleaning, purging, and circulating fluids through the piping system.
2. Use temporary strainers and temporary pumps that can create fluid velocities up to 10 feet per second to flush and clean the piping systems. Do not use Owner's permanent strainers to trap debris during pipe flushing operations. Fit the temporary construction strainers with a line size blowoff valve.
3. When constructing minor piping modifications or additions, verify with Owner if the Owner's pumps and strainers can be used for flushing and chemical cleaning operations. When the flushing and cleaning operations are complete, ensure the strainer baskets and screens installed in the piping systems permanent strainers are replaced with clean elements. Keep temporary strainers in service until the equipment has been tested, then replace straining element with a new strainer and clean and deliver the old straining elements to Owner. Fit the Owner's strainers with a line size blowoff valve.
4. Install bypass piping or hoses at the supply and return piping connections at heat exchangers, chillers, cooling towers, pumps, and cooling coils, etc., to prevent debris from being caught or causing damage to equipment which will be connected to the piping system.
5. Circulate a chemical cleaner in chilled and heating water piping systems to remove mill scale, grease, oil, and silt. Cleaner to be selected by chemical treatment vendor on project. Circulate for 48 hours, flush system and replace with clean water. Dispose of chemical solution in accordance with local codes. The chilled and heating water system should then be treated with chemicals and inhibitors to be selected by chemical treatment vendor on project. When the chemical cleaning is complete, remove, clean, and reinstall all permanent screens. Notify Owner so that the reinstallation of clean strainer screens may be witnessed.

G. Pipe Painting Requirements:

1. Paint all ferrous metal pipe including flanges. Do not paint flange bolts, washers and nuts. At flexible coupling the only the flanges are to be painted. All rubber portions are to remain unpainted.
2. Paint exterior uninsulated steel piping with exterior latex, semi-gloss (AE), Master Painters Institute MPI 11, suitable for metallic surfaces B, Haze Gray color.
3. Use ready-mixed (including colors) paint. Prime paint with pigment and vehicle, compatible with substrate and finish coats specified. Volatile Organic Compounds (VOC) content of paint materials shall not exceed 50g/l for exterior latex paints and primers. Lead-based paint is not permitted.
4. Do not apply coating when air or substrate conditions are:
   a. Less than 5 degrees F above dew point.
   b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the product manufacturer.
5. Do no exterior painting when it is windy and dusty. Do not paint in direct sunlight or on surfaces that the sun will soon warm.
6. Apply only on clean, dry and frost-free surface. Remove all materials the will affect the ability of the paint to adhere to the pipe including painted pipe identification labels.
7. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign. Remove loose mill scale, rust, and paint, by hand or power tool cleaning. All surfaces are to be dry at the time paint is applied.

8. Apply paint in two coats; prime, and finish. Apply each coat evenly and cover substrate completely. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions.
9. Finish surfaces to show solid even color, free from runs, lumps, brushmarks, laps, holidays, or other defects. Apply by brush, roller or spray.

3.02 REFRIGERANT PIPING INSTALLATION

A. Install systems in accordance with ASHRAE Standard 15.

B. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

C. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

D. Flood piping system with nitrogen when brazing.

E. Follow ASHRAE Standard 15 procedures for charging and purging of systems and for disposal of refrigerant.

F. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.

G. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

H. Fully charge completed system with refrigerant after testing.

I. Field Quality Control:

1. Test refrigeration system in accordance with ASME B31.5.
2. Pressure test system with dry nitrogen to 200 PSI. Perform final tests at 27-inches vacuum and 200 PSI using electronic leak detector. Test to no leakage.

END OF SECTION

SECTION 23 22 00
STEAM AND CONDENSATE PIPING AND PUMPS

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Low Pressure Steam Piping (15 PSIG Maximum)
   2. Low Pressure Steam Condensate Piping
   3. Unions, Flanges, and Couplings
   4. Gate Valves
   5. Ball Valves
   6. Swing Check Valves
   7. Steam Traps
   8. Steam Air Vents
   9. Safety Relief Valves

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:
   1. AWS A5.8/A5.8M Specification for Filler Metals for Brazing and Braze Welding, American Welding Society, current edition.
   2. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture; Manufacturers Standardization Society of the Valve and Fittings Industry Inc., current edition.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Product Data:
      a. Provide for manufactured products and assemblies required for this project.
      b. Include product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
      c. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each specialty.
      d. Include electrical characteristics and connection requirements.
   2. Manufacturer's Installation Instructions: Indicate application, selection, and hookup configuration. Include pipe and accessory elevations.
   3. Operation and Maintenance Data: Include installation instructions, servicing requirements, and recommended spare parts lists.
   4. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

5. Welders Certificate: Include welders certification of compliance with ASME (BPV IX) or AWS D1.1.
6. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
7. Project Record Documents: Record actual locations of valves.
8. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
9. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    a. See Division 01, General Requirements for additional provisions.
    b. Valve Repacking Kits: One for each type and size of valve.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Perform Work in accordance with State of _____ standard for installation of boilers and pressure vessels.
    a. Maintain one copy of each document(s) on site.
2. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose indicated.
3. Installer Qualifications: Company specializing in performing the work of this Section, with minimum _____ years of documented experience.
4. Welder Qualifications: Certified in accordance with ASME (BPV IX) or AWS D1.1 current edition.

1.06 WARRANTY

A. Warranty of materials and workmanship as outlined in Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 SYSTEM DESCRIPTION

A. When more than one piping system material is selected, ensure systems components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.

B. Use unions and flanges downstream of valves and at equipment or apparatus connections. Use dielectric unions where joining dissimilar materials. Do not use direct welded or threaded connections.

C. Provide pipe hangers and supports in accordance with current edition of ASME B31.9 or MSS SP-58 unless indicated otherwise.

D. Use gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Use gate valves for throttling, bypass, or manual flow control services.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing Sections of the work, and isolating parts of completed system.

1.09 EXTRA MATERIALS

A. See Division 01, General Requirements, Product Requirements, for additional provisions.

B. Provide two service kits for each size and type of steam trap.

C. Provide one set of mechanical seals for each pump.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Low Pressure Steam Piping (15 PSIG Maximum):
   1. Taylor Forge and Pipe Works
   2. Or approved equivalent.

B. Low Pressure Steam Condensate Piping:
   1. Taylor Forge and Pipe Works
   2. Or approved equivalent.

C. Unions, Flanges and Couplings:
   1. Same manufacturer as pipe
   2. Or approved equivalent.

D. Gate Valves:
   1. Conbraco Industries
   2. Nibco Inc.
   3. Milwaukee Valve company
   4. Or approved equivalent.

E. Ball Valves:
   1. Conbraco Industries
   2. Nibco Inc.
   3. Milwaukee Valve Company
   4. Or approved equivalent.

F. Swing Check Valves:
   1. Hammond Valve
   2. Nibco Inc.
   3. Milwaukee Valve Company
   4. Or approved equivalent.

G. Steam Traps:
   1. Armstrong International, Inc.
   2. ITT Hoffman Specialty
   3. Barnes and Jones, Inc.
   4. Marshall Engineered Products Company
   5. Spirax-Sarco
   6. Or approved equivalent.

H. Steam Air Vents:
   1. Armstrong
   2. ITT Hoffman Specialty
   3. Spriax-Sarco
   4. Barnes and Jones, Inc.
   5. Or approved equivalent.

I. Safety Relief Valves:
   1. Armstrong International, Inc.
   2. ITT McDonald & Miller
   3. Spriax-Sarco

4. Or approved equivalent.

2.02 LOW PRESSURE STEAM PIPING (15 PSIG MAXIMUM)

A. Steel Pipe: ASTM A 53/A 53M, Schedule 40, black.
   1. Fittings: ASME B16.3 malleable iron Class 150, ASME B16.5 flanged or ASTM A 234/A 234M wrought steel.
   2. Joints: Threaded, or AWS D1.1 welded.

B. Steel Pipe Sizes 12-inch and Over: ASTM A 53/A 53M, 0.375-inch wall, black.
   1. Fittings: ASTM A 234/A 234M wrought steel.
   2. Joints: Welded in accordance with AWS D1.1.

2.03 LOW PRESSURE STEAM CONDENSATE PIPING

A. Steel Pipe: ASTM A 53/A 53M, Schedule 80, black.
   1. Fittings: ASME B16.3 malleable iron Class 150, or ASTM A 234/A 234M wrought steel.
   2. Joints: Threaded, or AWS D1.1 welded.

B. Steel Pipe Sizes 12-inch and Over: ASTM A 53/A 53M, 0.375-inch wall, black.
   1. Fittings: ASTM A 234/A 234M wrought steel.
   2. Joints: Welded in accordance with AWS D1.1.

2.04 UNIONS, FLANGES, AND COUPLINGS

A. Unions for Pipe 2-inches and Under:
   1. Ferrous Piping: 150 PSIG galvanized malleable iron, threaded.

B. Flanges for Pipe Over 2-inches:
   1. Ferrous Piping: 150 PSIG forged steel, slip-on.
   2. Gaskets: 1/16-inch thick preformed non-asbestos graphite fiber.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, water impervious isolation barrier.

2.05 GATE VALVES

A. Up To and Including 2-inches:
   1. Bronze body, bronze trim, screwed or union bonnet, non-rising or rising stem, lockshield stem or handwheel, inside screw with backseating stem, solid or split wedge disc, alloy seat rings, threaded ends.

B. Over 2-inches:
   1. Iron body, bronze trim, bolted bonnet, rising or non-rising, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends.

2.06 BALL VALVES

A. Up To and Including 2-inches:
   1. Bronze or Stainless steel, one or two piece body, chrome plated brass or stainless steel ball, Teflon seats and stuffing box ring, lever handle with balancing stops or threaded ends with union.

B. Over 2-inches:
   1. Cast steel body, chrome plated steel ball, Teflon seat and stuffing box seals, lever handle, or gear drive handwheel for sizes 10 inches and over flanged.

2.07 SWING CHECK VALVES

A. Up To and Including 2-inches:
   1. Bronze or iron body, bronze trim, bronze rotating swing disc with composition seat, threaded ends.

B. Over 2-inches:

1. Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

2.08 STEAM TRAPS

A. Steam Trap Applications:
   1. Use Thermostatic Steam Traps for:
      a. Steam Radiation Units
      b. Convectors
      c. Unit Ventilators
      d. Other similar terminal heating units.
   2. Use Float and Thermostatic Traps for:
      a. Unit Heaters
      b. Converters
      c. Heating Coils
      d. Steam Separators
      e. Flash Tanks
      f. Steam Jacketed Equipment
      g. Direct Steam Injected Equipment
      h. Deaerators
      i. Absorption Chillers
      j. Process Equipment
      k. Main Headers
      l. Branch Lines
   3. Use Inverted Bucket Steam Traps for: _____
   4. Use Thermodynamic Steam Traps for: _____

B. Steam Trap Performance:
   1. Select to handle minimum of two times maximum condensate load of apparatus served.
   2. Pressure Differentials:
      a. Low Pressure Systems (5 PSI and less): 1/4 PSI
      b. Low Pressure Systems (5 PSI and less): 1/2 PSI
      c. Low Pressure Systems (15 PSI maximum): 2 PSI
      d. Medium Pressure Steam (25 PSI maximum): 5 PSI
      e. Medium Pressure Steam (40 PSI maximum): 10 PSI
      f. Medium Pressure Steam (60 PSI maximum): 15 PSI
      g. High Pressure Steam (100 PSI maximum): 30 PSI
      h. High Pressure Steam (150 PSI maximum): 40 PSI

C. Inverted Bucket Traps: ASTM A 126, cast iron or semi-steel body with bolted cover, brass bucket, stainless steel seats and plungers, and stainless steel lever mechanism with knife edge operating surfaces.
   1. Rating: 60 PSI WSP.
   2. Features: Access to internal parts without disturbing piping, top test plug, bottom drain plugs.
   3. Accessories:
      a. Integral inlet strainer of brass.
      b. Integral inlet check valve.
      c. Integral bimetal air vent.

D. Float and Thermostatic Traps: ASTM A 126 cast iron or semi-steel body and bolted cover, stainless steel or bronze bellows type air vent, stainless steel or copper float, stainless steel lever and valve assembly
   1. Rating: 15 PSI WSP.
   2. Features: Access to internal parts without disturbing piping, bottom drain plug.
   3. Accessories: Gauge glass with shut-off cocks.

E. Thermodynamic Traps: Stainless steel body, disc, and cap.
   1. Rating: 300 PSI WSP.
   2. Features:
      a. Stainless steel insulating cap.
      b. 1/4-inch steel blow down valve.
      c. Integral strainer.

F. Pressure Balanced Thermostatic Traps: ASTM A 395/A 395M cast iron body and bolted or screwed cover and integral ball joint union for 125 PSI WSP; phosphor bronze bellows, stainless steel valve and seat, integral stainless steel strainer.

G. Freeze Proof Thermostatic Traps: Cast iron body for 300 PSI WSP, bronze bellows, stainless steel valve and seat, external adjustment.

H. Bi-metallic Thermostatic Traps: ASTM A 105/A 105M forged steel body and cover, for 300 PSI WSP, bi-metal element with stainless steel components, integral Type 304 stainless steel strainer screen.

I. Bi-metallic Thermostatic Traps: ASTM A 105/A 105M forged steel body and cover, for 300 PSI WSP, bi-metal element with stainless steel components, integral Type 304 stainless steel strainer screen, 1/4-inch blow down valve.

2.09 STEAM AIR VENTS

A. 125 psi (860 kPa) WSP: Balanced pressure type; cast brass body and cover; access to internal parts without disturbing piping; stainless steel bellows, stainless steel valve and seat.

B. 225 psi (1550 kPa) WSP: Balanced pressure type; ASTM A 126 cast iron body and cover; access to internal parts without disturbing piping; phosphor bronze bellows, stainless steel valve and seat.

2.10 SAFETY RELIEF VALVES

A. Valve: Bronze body, stainless steel valve spring, stem, and trim, direct pressure actuated, capacities ASME certified and labelled.

B. Accessories: Drip pan elbow.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Whenever work is suspended during construction protect open ends with temporary plugs or caps.

E. Install in accordance with manufacturer's instructions.

F. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.

G. Install piping to conserve building space and avoid interference with use of space.

H. Sleeve pipe passing through partitions, walls, and floors.

I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

J. Pipe expansion, in general, is to be absorbed in bends, swing joints, expansion loops, and offsets. Provide piping mains, branches and runouts installed to allow for free expansion and contraction without developing leaks or undue stressing of pipe. Provide stresses within allowable limits of ANSI B31.1 for pressure piping. Provide vertical piping for steam and steam condensate with expansion joints as indicated. Packing not required for expansion joints. Installer to select materials and pressure/temperature ratings to suit intended service. Select packless expansion joints to provide 150 percent absorption capacity of calculated maximum piping expansion between anchors. Connections to have ends to match piping system application. Expansion Joints for Steam Piping with pre-fabricated stainless steel bellows with integral guide rods.

K. Inserts:

1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement Section for inserts carrying pipe over 4-inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

L. Pipe Hangers and Supports:

1. Install in accordance with MSS SP-58
2. Support horizontal piping as scheduled.
3. Place hangers within 12-inches of each horizontal elbow.
4. Use hangers with 1-1/2-inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
7. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

M. Provide clearance for installation of insulation and access to valves and fittings.

N. Provide access where valves and fittings are not exposed.

O. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

P. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting. Reference Section 09 90 00.

3.02 LOW PRESSURE STEAM PIPING (15 PSIG MAXIMUM) INSTALLATION

A. Slope steam piping 1/2-inch in 10-feet in direction of flow. Use eccentric reducers to maintain bottom of pipe level.

B. Install steam and steam condensate piping and specialties in accordance with ASME B31.9.

3.03 LOW PRESSURE STEAM CONDENSATE PIPING INSTALLATION

A. Slope condensate piping 1/2-inch in 10 feet.

B. Install steam and steam condensate piping and specialties in accordance with ASME B31.9.

3.04 UNIONS, FLANGES, AND COUPLINGS INSTALLATION

A. Install steam and steam condensate piping and specialties in accordance with ASME B31.9.

3.05 GATE VALVES INSTALLATION

A. Valves to be line size unless noted otherwise.

B. Install valves with stems upright or horizontal, not inverted.

3.06 BALL VALVES INSTALLATION

A. Valves to be line size unless noted otherwise.

B. Install valves with stems upright or horizontal, not inverted.

3.07 SWING CHECK VALVES INSTALLATION

A. Valves to be line size unless noted otherwise

3.08 STEAM TRAPS INSTALLATION

A. Provide steam traps at all system low points, the bottom of steam pipe rises, and before all control valves.

B. Steam Traps:

1. Provide minimum 3/4-inch size on steam mains and branches.
2. Install with union or flanged connections at both ends.
3. Provide gate valve and strainer at inlet, and gate valve and check valve at discharge.
4. Provide minimum 10-inch long, line size dirt pocket between apparatus and trap.

C. Remove thermostatic elements from steam traps during temporary and trial usage, and until system has been operated and dirt pockets cleaned of sediment and scale.

3.09 STEAM AIR VENTS INSTALLATION

A. See General Installation Requirements above.

3.10 SAFETY RELIEF VALVES INSTALLATION

A. Rate relief valves for pressure upstream of pressure reducing station, for full operating capacity. Set relief at maximum 20 percent above reduced pressure.

B. Terminate relief valves to outdoors. Provide drip pan elbow with drain connection to nearest floor drain. Discharge lines sized per ASME.

C. Terminate relief valves to outdoors 2-feet minimum above roof. Provide drip pan elbow with drain connection to nearest floor drain.

D. When several relief valve vents are connected to a common header, header cross Section area to equal sum of individual vent outlet areas.

END OF SECTION

SECTION 23 31 00
HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Ductwork, Joints and Fittings
   2. Insulated Flexible Duct
   3. Drain Pans
   4. Ductwork Joint Sealers and Sealants

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:
   1. Section 23 05 29, Hangers and Supports for HVAC Piping, Ductwork and Equipment.
   2. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Welding Certificates
   2. Field Quality Control Reports

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. NFPA Compliance:
      a. NFPA 90A Installation of Air Conditioning and Ventilating Systems.
      b. NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
   2. Comply with NFPA 96, Ventilation Control and Fire Protection of Commercial Cooking Operations, Ch. 3, Duct System for range hood ducts, unless otherwise indicated.
   3. Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Provide sheet metal materials free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
   4. If required, provide ductwork pressure testing per Section 23 05 93, Testing, Adjusting and Balancing for HVAC.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Duct design is generally diagrammatic and is not meant to be scaled. Major changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Ductwork, Joints, and Fittings:
   1. Ductmate
   2. Lindab Inc
   3. Nexus Inc
   4. SEMCO
   5. United McGill Corporation
   6. Ward Industries
   7. Or approved equivalent

B. Insulated Flexible Duct:
   1. ATCO
   2. Flexmaster
   3. J.P. Lamborn Co.
   4. Hart and Cooley
   5. Or approved equivalent

C. Ductwork Joint Sealers and Sealants
   1. Ductmate
   2. Durodyne
   3. Hardcast
   4. United McGill Corporation
   5. Vulkem
   6. Foster
   7. Childer
   8. Or approved equivalent

2.02 DUCTWORK, JOINTS AND FITTINGS

A. Materials:
   1. Galvanized Steel Ducts: Hot-dipped galvanized steel sheet, lock-forming quality, ASTM A 653/A 653M FS Type B, with G90/Z275 coating. Ducts to have mill phosphatized finish for surfaces exposed to view.
   2. Aluminum Ducts: ASTM B 209 (ASTM B 209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
   3. Stainless Steel: Fabricated in accordance with ASTM A167 and A480.

B. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
   1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.

2. Deflection: Duct systems not-to-exceed deflection limits according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible.
3. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

C. Formed-On Flanges: construct according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Figure 1-4, using corner, bolt, cleat, and gasket details.
1. Duct Size: Maximum 30-inches wide and up to 2-inch wg pressure class.
2. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
3. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19-inches and larger and 0.0359-inch thick or less, with more than 10 SF of nonbraced panel area unless ducts are lined.

D. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of material specified in this Section according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible.
1. Ducts up to 20-inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
2. Ducts 21- to 72-inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
3. Ducts Larger than 72-inches in Diameter: Companion angle flanged joints per SMACNA HVAC Duct Construction Standards-Metal and Flexible, Figure 3-2.
4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.

E. 90-Degree Tees and laterals and Conical Tees: Fabricate to comply with SMACNA's HVAC Duct Construction Standards-Metal and Flexible, with metal thicknesses specified for longitudinal-seam straight ducts.

F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows to be 1.5 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's HVAC Duct Construction Standards-Metal and flexible, unless otherwise indicated.
2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg (minus 500 to plus 500 Pa):
    a. Ducts 3- to 36-inches in Diameter: 0.034-inch .
    b. Ducts 37- to 50-inches in Diameter: 0.040-inch.
    c. Ducts 52- to 60-inches in Diameter5: 0.052-inch.
    d. Ducts 62- to 84-inches in diameter: 0.064-inch.
3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
    a. Ducts 3- to 26-inches in Diameter: 0.034-inch.
    b. Ducts 27- to 50-inches in Diameter: 0.040-inch.
    c. Ducts 52- to 60-inches in Diameter: 0.052-inch.
    d. Ducts 62- to 84-inches in Diameter: 0.064-inch.
4. 90-Degree, Two-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space

restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.

5. Round Elbows
   a. 8-inches and Less in Diameter: Fabricate die-formed elbows for 45 and 90-degree elbows and pleated elbows for 30, 45, 60 and 90 degrees only. Fabricate nonstandard bend-angle configurations or non-standard diameter elbows with gored construction.
   b. 9 through 14-inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60 and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
   c. Larger than 14-inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
6. Die-Formed Elbows for Sizes through 8-inches in Diameter and Pressures 0.040-inch thick with two-piece welded construction.
7. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
8. Pleated Elbows for Sizes through 14-inches in Diameter and Pressures through 10-inch wg (2500 Pa): 0.022-inch.
9. Not acceptable:
   a. Corrugated or flexible metal duct.
   b. Adjustable elbows.

H. Flat Oval Duct
1. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with circumference equal to the perimeter of a given size of flat-oval duct.
2. Flat Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's HVAC Duct Construction Standards-Metal and Flexible. Fabricate ducts larger than 72-inches in diameter with butt-welded longitudinal seams.
3. Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.
4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
5. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.

2.03 INSULATED FLEXIBLE DUCT

A. Construction: Standard factory fabricated product. Inner wall: Impervious vinyl or chlorinated polyethylene, permanently bonded to a vinyl or zinc-coated spring steel helix.

B. Insulation: Fiberglass blanket insulation covered by an outer wall of vinyl or fiberglass-reinforced metalized vapor barrier.

C. Listing: UL 181 listed Class 1 flexible air duct material. Overall thermal transmission: No more than 0.25 BTU/in or hr/sq. degrees F at 75 degrees F differential, per ASTM C335.

D. Vapor transmission value no more than 0.10 perm, per ASTM E96

E. Pressure Rating: 4-inch wg positive pressure and 1-inch wg negative pressure.

F. Performance Air Friction Correction Factor: 1.3 maximum at 95 percent extension. Working air velocity: Minimum 2000 FPM.

G. Flame Spread Rating: No more than 25.

H. Smoke Development Rating: No more than 50 as tested per ASTM E84.

I. Insertion Loss: Minimum attenuation of 29 DB for 10-foot straight length at 8-inch diameter at 500 Hz.

2.04 DRAIN PANS

A. Primary Drain Pans: Stainless Steel, Fabricated in accordance with ASTM A167 and A480.

B. Secondary Drain Pans: Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A 653/A 653M FS Type B, with G90/Z275 coating.

2.05 DUCTWORK JOINT SEALERS AND SEALANTS

A. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.

B. Low Emitting Materials Requirement: Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.

C. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure and leakage class of ducts.

D. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E 84.

E. Water Based Sealant for Brush-On Application: Flexible, adhesive sealant, resistant to UV light, UL-181A, and UL-181-B listed, complying with NFPA requirements for Class 1 ducts. Min. 69 percent solids, nonflammable. Hardcast Versa-Grip 181; Childers CP-146; Foster 32-19 for SMACNA 1/2, 1, 2, 3, 4, 6, and 10-inch WG duct classes, and SMACNA Seal Class A, B, or C.

F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use O.

G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

H. Polyurethane Sealant: General-purpose, exterior use, non-brittle sealant for gunned application. Vulkem 616 or equal.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. General: Use the following pressure seal, and leakage class(es) in design of ductwork specified in this section unless otherwise noted on Drawings.

SYSTEM	PRESSURE CLASS (Inches of Water)	SEAL CLASS	LEAKAGE CLASS ROUND DUCTS	LEAKAGE CLASS RECTANGULAR DUCTS
Medium pressure supply (fan to terminal unit)	0.5-inch higher than air handlers discharge pressure (min 4-inch pressure class).	A	3	6
Low pressure (downstream of terminal unit)	+ 1-inch	A	3	6
Return main (>24-inch)	0.5-inch more negative than return/exhaust fan pressure or -2-inch pressure class, whichever is more negative.	A	3	6
Return branch (<24-inch)	0.5-inch more negative than return/exhaust fan pressure or -2-inch pressure class, whichever is more negative.	A	3	6

General exhaust	0.5-inch more negative than return/exhaust fan pressure or -2-inch pressure class, whichever is more negative.	A	3	6
Kitchen grease exhaust	-6-inch	N/A	N/A	N/A
Lab medium pressure exhaust (lab valve/terminal unit to fan)	-6-inch	A	3	6
Lab low pressure exhaust (upstream of lab valve/terminal unit)	-1-inch	A	3	6
Hazardous exhaust	-6-inch	A	3	6
Cryogen relief vent	+10-inch	N/A	N/A	N/A

B. Ductwork Installation:

1. General: Install entire duct system in accordance with drawings, Specifications, and latest issues of local Mechanical Code, NFPA 90A, and SMACNA Duct Construction Manual. At Contractor's option, rectangular ductwork may be resized to maintain an equivalent air velocity and friction rate, while maintaining a maximum aspect ratio of 3. Remove markings and tagging from ductwork exterior surface in mechanical rooms and other locations where ductwork is exposed.
2. The duct layout shown on the Contract Drawings is diagrammatic in nature. Coordinate the ductwork routing and layout, and make alterations to the ductwork routing and layout to eliminate physical interferences. Where deviations in the ductwork routing as shown in the Contract Drawings are required, alterations may be made so as not to compromise the air flow, pressure drop, and sound characteristics of the duct fitting or duct run as shown on the Contract Drawings. In the event Architect determines that the installed ductwork is inconsistent with the above mentioned criteria, remove and replace at no additional cost to the Owner.
3. Install ducts with fewest possible joints.
4. Install fabricated fittings for changes in directions, size, shape, and for connections.
5. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12-inches, with a minimum of 3 screws in each coupling.
6. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
7. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
8. Install ducts with a clearance of 1-inch, plus allowance for insulation thickness. Allow for easy removal of ceiling tile.
9. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

10. Coordinate layout with suspended ceiling, air duct accessories, lighting layouts, and similar finish work.
11. Electrical and IT Equipment Spaces: route ducts to avoid passing through transformer vaults, electrical equipment spaces, IDF/MPOE rooms, and enclosures.
12. Boiler Rooms and Refrigeration Machinery Rooms: Only route ducts serving these rooms through these rooms.
13. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2-inches.
14. Fire- and Smoke-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire, smoke or combination fire and smoke dampers as governed by Building Code and AHJ, including sleeves, and firestopping sealant.
15. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by applicable building codes. Reference SMACNA's Seismic Restraint Manual: Guidelines for Mechanical Systems, Mason Seismic Restraint and Support Systems.
16. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's Duct Cleanliness for New Construction Advanced Level.
17. Paint interiors of metal ducts, that do not have duct liner, for 24-inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible duct material.
18. Install ductwork in the location and manner shown and detailed. Review deviations required by job conditions with Architect prior to any fabrication. Provide fittings for construction per SMACNA.
19. Humidifier Duct:
    a. Supply duct section 15-feet downstream from humidifier.
        1) Seams water tight.
        2) Pitch down to low point. See Drain Pans article in this Section.

C. Flanged Take-Offs:
1. Install at branch takeoffs to outlets using round or flex duct.
2. Flanged take-offs secured with minimum 8-inch screw spacing (three screws minimum).
3. Provide ductwork taps and branches off of main ducts at 45 degrees whether shown on Drawings or not (drawings are diagrammatic).

D. Cleaning:
1. Clean duct systems with high power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.
2. Grille and Exposed Duct Cleaning:
    a. After completion of ductwork installation, operate each fan system (excluding exhaust fans) for a minimum of 30 minutes prior to installation of ceiling grilles and diffusers. After grilles and diffusers are installed, clean out accumulation of particles from grilles and diffusers prior to acceptance.
    b. Clean exterior surface of ducts exposed to public view of chalk, pencil and pen marks, labels, sizing tags, dirt, dust, etc., so that upon

completion of installation, ducts are left in clean and unblemished manufactured conditions.

c. Exposed duct and grilles to remain free of dust entrained streaks due to leakage at joints and grille connections during warranty period. Clean leaks, seal and refinish to match existing if visible streaks develop.

3.02 DUCTWORK, JOINTS AND FITTINGS INSTALLATION

A. Duct Materials - Applied Locations:

1. General: Use the following materials in design of ductwork specified in this Section unless otherwise noted on the Drawings.

Location or Application	Material
Supply, Return, Transfer, and Exhaust - Low Pressure (downstream of terminal units)	Single Wall, Galvanized Steel
Supply, Return, and Exhaust - Medium Pressure (upstream of terminal units)	Single Wall, Galvanized Steel
General Exhaust Branch Serving Air Inlet in Shower Room or Toilet Room with Shower	Single Wall, Aluminum or Type 304 Stainless Steel
Supply, Return, Exhaust serving Natatorium, Pool, or Spa Area	Single Wall, Aluminum or Type 304 Stainless Steel
Fume Hood Exhaust	Single Wall, Type 316 Stainless Steel
Ductwork for the First 15-feet Downstream of Humidifier	Single Wall, Type 316 Stainless Steel

B. Ductwork Installation:

1. Fabricate radius elbows with centerline radius not less than 1-1/2 duct diameters.
2. Do not install duct size transition pitch angles which exceed 30 degrees for reductions in duct size in the direction of airflow, and 15 degrees for expansions in duct size in the direction of airflow.
3. Install fixed turning vanes in square throat rectangular elbows and in tees.
4. Fabricate duct turns with the inside (smallest) radius at least equal to the duct width (supply ducts) and 1.5 times radius (return and exhaust ducts). Where necessary, square elbows may be used, with maximum available inside radius and with fixed turning vanes. In healthcare settings such as hospitals and medical office buildings, square elbows and turning vanes allowed on supply ductwork only.

3.03 INSULATED FLEXIBLE DUCT INSTALLATION

A. Provide sheet metal plenum or rigid elbow and connect to diffusers and grilles with ductwork connections. Refer to Drawings for more information. Provide straight section of flexible duct with minimum length of 2-feet and maximum length of 5-feet and connect to sheet metal plenums and rigid elbows connected to diffusers and grilles, unless noted otherwise.

1. Provide round neck grilles/diffusers or square-to-round transitions. Flexible duct connections directly to diffuser and grilles is not allowed.
2. Flexible duct allowed in concealed spaces above lay-in ceilings only.

3.04 DRAIN PANS INSTALLATION

A. Install where shown on Drawings. Drain provided by Division 22, Plumbing. Provide drain (sized per code) connection from each drain pan and pipe to nearest floor drain through trap and 10-inch air gap. Drain pans over 6-feet in length require drain connections from both ends. Pitch drain pans in direction of air flow and to drain. Support secondary drain pan independently from equipment.

3.05 DUCTWORK JOINT SEALERS AND SEALANTS INSTALLATION

A. Joints and Seam Joint Sealing:

1. Seal duct seams and joints according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, for duct pressure class indicated.
2. Seal transverse joints, longitudinal seams and duct wall penetrations including screw, fastener, pipe, rod, and wire.
3. Seal ducts before external insulation is applied.
4. Tape joints of PVC coated metal ductwork with PVC tape.
5. Fasteners such as sheet-metal screws, machine screws or rivets to be cadmium plated.
6. Rectangular Ductwork: Where intermediate joint reinforcement is required for duct of negative pressure class, pre-drill stiffening flange and provide fastener maximum 8-inches on center. Where retaining flanges are welded to duct wall, paint welds with zinc coating.
7. Single Wall Round Ductwork: Joint to incorporate beaded slip collar with minimum #8 sheet metal screws 8-inches on center. Seal ductwork as specified in this Section.
8. Seal joints and seams. Apply sealant to make end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
9. Double Wall Round Ductwork: Joint to incorporate beaded slip collar or flanged connection, with minimum #8 sheet metal screws 8-inches on center. Seal ductwork as specified in this Section.
10. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
11. Provide openings in ductwork where required to accommodate thermometers and control devices. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
12. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities as well as Code required clearances.

END OF SECTION

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Sheet Metal Materials
   2. Backdraft Dampers
   3. Dampers
   4. Duct Test Holes
   5. Flexible Connectors

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Manufacturer's catalog data and fabrication/installation drawings for each factory fabricated duct accessory. Include leakage, pressure drop and maximum back pressure data.
   2. Shop Drawings: Indicate air duct accessories.
   3. Manufacturer's installation instructions: Provide instructions for each factory fabricated duct accessory.
   4. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
      a. See Division 01, General Requirements, Product Requirements for additional provisions.
      b. Extra Fusible Links: One of each type and size.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this Section, with minimum five years of documented experience.
   2. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
   3. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
   4. AMCA 511 - Certified Ratings Program for Air Control Devices.
   5. AMCA 611, latest edition - Certified Ratings Program - Product Rating Manual for Airflow Measurement Stations.
   6. AMCA 610, latest edition - Laboratory Methods of Testing Airflow Measurement Stations for Performance Rating.

7. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
8. NFPA 92A - Smoke-Control Systems.
9. NFPA 92B - Smoke Control Systems in Atria, Covered Malls and Large Areas.
10. NFPA 101 - Life Safety Code.
11. UL 555 - Standard for Safety; Fire Dampers.
12. UL 555S - Standard for Safety; Leakage Rated Dampers for Use in Smoke Control Systems.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Backdraft Dampers:
   1. Greenheck
   2. Nailor
   3. Ruskin

B. Dampers:
   1. Greenheck
   2. Nailor
   3. Ruskin

C. Duct Test Holes:
   1. Ventlok
   2. Or approved equivalent.

D. Flexible Connectors:
   1. Duro Dyne Corp.
   2. Ventfabrics Inc.
   3. Ward Industries

2.02 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M. Galvanizing: 1-1/4 ounces per square foot total both sides; ducts to have mill-phosphatized finish for surfaces exposed to view.

C. Stainless Steel: ASTM A 480/A 480M.

D. Aluminum Sheets: ASTM B 209 (ASTM B 209M), alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy 6063, temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36-inches or less; 3/8-inch minimum diameter for lengths longer than 36-inches.

2.03 BACKDRAFT DAMPERS

A. Basis-of-Design: Ruskin CB D6.

B. Description: Multiple-blade gravity balanced with center pivoted blades with sealed edges, assembled in rattle free manner with 90-degree stop, adjustment device to permit setting for varying differential static pressure.

C. Frame: 0.125-inch thick 6063-T5 extruded aluminum channel with galvanized steel braces at mitered corners. Provide mounting flange.

D. Blades: Single piece, overlap frame, parallel action, horizontal orientation, minimum 0.07-inch 6063-T5 extruded aluminum material, maximum 6-inch width.

E. Bearings: Corrosion-resistant synthetic, formed as single piece with axles.

F. Blade Seals: Extruded vinyl, mechanically attached to blade edge.

G. Blade Axles: Corrosion-resistant, synthetic formed as single piece with bearings, locked to blade.

H. Tie Bars and Brackets: Galvanized steel.

I. Return Spring: Adjustable tension.

J. Damper Capacity:

1. Closed Position: Maximum back pressure of 16-inches water gauge.
2. Open Position: Maximum air velocity of 2,500-feet per minute.

K. Counterbalances: Adjustable zinc plated steel weights mechanically attached to blade. Must be capable of operating over wide range of pressures.

L. Finish: Mill aluminum.

M. Temperature Rating: -40 degrees F to 200 degrees F.

N. Operation of Blade:

1. Start to Open: 0.01-inch wg
2. Fully Open: 0.05-inch.

O. Pressure Drop: Maximum 0.15-inch wg at 1,500-feet per minute through 24-inch by 24-inch damper.

P. Factory Sleeve: Minimum 20 gauge thickness, 12-inches in length.

Q. Screen: At outdoor intake or discharge. 1/4-inch aluminum.

2.04 DAMPERS

A. Basis-of-Design: Ruskin MD 35.

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Pressure Classes of 3-Inch wg (750 Pa) or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

C. Rectangular Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design with linkage concealed in frame and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum 16 gauge thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
   a. Roll-Formed Steel Blades: 16 gauge thick, galvanized sheet steel.
   b. Aluminum Frames: Hat-shaped, 10 gauge thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
   c. Roll-Formed Aluminum Blades: 10 gauge thick aluminum sheet.
   d. Extruded-Aluminum Blades: 16 gauge thick extruded aluminum.

e. Blade Axles: Minimum 1/2-inch diameter, plated steel, hex shaped, mechanically attached to blade.

f. Bearings: Molded synthetic sleeve, turning in extruded hole in frame.

g. Tie Bars and Brackets: Galvanized steel.

h. Mill galvanized.

i. Capacity:

1) Closed Position: Maximum pressure of 3-inches wg.

2) Open Position: Maximum air velocity of 1,500-feet per minute across 24-inch by 24-inch damper.

D. Round Volume Dampers: Single-blade suitable for horizontal or vertical applications.

1. Steel Frames: Galvanized, roll formed, minimum of 20 gauge thick with beads at each end.

2. Blades: Minimum 20 gauge thick, galvanized sheet steel, round, single-piece.

3. Aluminum Frames: Minimum 10 gauge thick aluminum sheet.

4. Aluminum Blades: Minimum 10 gauge thick aluminum sheet.

5. Extruded-Aluminum Blades: Minimum 16 gauge thick extruded aluminum.

6. Blade Axles: Minimum 3/8-inch square, plated steel, mechanically attached to blade.

7. Bearings: Molded synthetic sleeve, turning in hole in frame.

8. Finish: Mill galvanized.

9. Capacity:

a. Closed Position: Maximum pressure of 3-inches wg

b. Open Position: Maximum air velocity of 1,500-feet per minute.

10. Leakage: Maximum 40 cfm at 1-inch wg for 20-inches diameter damper.

11. Pressure Drop: Maximum 0.02-inch wg at 1,500-feet per minute through 20-inch diameter dampers.

E. Jackshaft: 1-inch diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

2. Damper Hardware: 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. Include center hole to suit damper operating-rod size. Include 2-inch elevated platform for insulated duct mounting.

2.05 DUCT TEST HOLES

A. Temporary Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.06 FLEXIBLE CONNECTORS

A. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

B. Metal-Edged Connectors: Factory fabricated with a fabric strip 4-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. Select metal compatible with ducts.

C. Provide a spring and bracket assembly to reinforce the fabric with sufficient tension to prevent connector collapse under negative or positive pressure. Number and positioning

of spring-link fixture to be determined by the manufacturer to maintain straight axis and without kinks between two sections of duct, or between duct and the moving element. Hardcast Spring-Link SL-200, or equal.

D. Indoor System, Flexible Connector Fabric (FC-I): Glass fabric double coated with neoprene.
   1. Minimum Weight: 26 ounces per square yard.
   2. Tensile Strength: 480 pounds of force per in the warp and 360 pounds of force per inch in the filling.
   3. Service Temperature: -40 degrees F to 200 degrees F.

E. Outdoor System, Flexible Connector Fabric (FC-O): Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
   1. Minimum Weight: 24 ounces per square yard.
   2. Tensile Strength: 530 pounds of force per inch in the warp and 440 pounds of force per inch in the filling.
   3. Service Temperature: -50 degrees F to 250 degrees F.

F. High-Temperature System, Flexible Connectors (FC-HT): Glass fabric coated with silicone rubber.
   1. Minimum Weight: 16 ounces per square yard.
   2. Tensile Strength: 285 pounds of force per inch in the warp and 185 pounds of force per inch in the filling.
   3. Service Temperature: -67 degrees F to 500 degrees F.

G. High-Corrosive-Environment System, Flexible Connectors (FC-HC): Glass fabric with chemical-resistant coating.
   1. Minimum Weight: 14 ounces per square yard.
   2. Tensile Strength: 450 pounds of force per inch in the warp and 340 pounds of force per inch in the filling.
   3. Service Temperature: -67 degrees F to 500 degrees F.

PART 3 - EXECUTION

3.01 DUCT ACCESSORIES GENERAL INSTALLATION

A. Inspect areas to receive air duct accessories. Notify Engineer of conditions that would adversely affect the installation of the dampers. Do not proceed until conditions are corrected.

B. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.

C. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

D. Do not compress or stretch damper frames into duct or opening.

E. Handle dampers using sleeve or frame. Do not lift dampers using blades, actuators, or jack shafts.

F. Adjust duct accessories for proper settings.

3.02 SHEET METAL MATERIALS INSTALLATION

A. Install bracing for multiple sections to support assembly weights and hold against system pressure. Install bracing as needed.

3.03 BACKDRAFT DAMPERS INSTALLATION

A. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated. Provide at outside air intakes where motorized dampers are not shown on drawings.

3.04 DAMPERS INSTALLATION

A. Where installing volume dampers in ducts with liner, avoid damage to and erosion of duct liner.

B. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts for air balancing. Install at a minimum of two duct widths from each branch takeoff. Provide balancing dampers for all air inlets and outlets.

C. Install dampers square and free from racking with blade running horizontally.

3.05 DUCT TEST HOLES INSTALLATION

A. Provide test holes at fan inlets and outlets where indicated and where required for air testing and balancing.

3.06 FLEXIBLE CONNECTORS INSTALLATION

A. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators. Provide sheet metal weather cover over flexible connections located outdoors. Attach sheet metal to either equipment side or ductwork side, but not both.

B. Per NFPA, do not use flexible connectors on grease exhaust fans.

C. Securely attach spring-lock brackets to the metal strips of the connector collar using No. 8 sheet metal screws.

D. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

E. Adjust the following types in the following locations:

1. FC-I: Indoors.
2. FC-O: Outdoors.
3. FC-HT: High temperature exhaust systems and smoke removal systems.
4. FC-HC: High corrosive systems inclusive of all laboratory exhaust systems.

END OF SECTION

SECTION 23 82 00
TERMINAL HEAT TRANSFER EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. Electric Wall Heaters

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

A. Warranty of materials and workmanship as outlined in Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Electric Wall Heaters:

1. Trane
2. Markel
3. Qmark
4. Chromalox
5. Or approved equivalent.

2.02 ELECTRIC WALL HEATERS

A. Description: Wall mounted forced air unit heater, including enclosure for surface mounting, fan and motor, heating elements and wall box. UL listed and wired per NEC.

B. Cabinet: 20 gauge zinc coated steel, 16 gauge painted exterior grille.

C. Fan and Motor: Propeller type fan, totally enclosed motor with permanently lubricated bearings and thermal overload protection, vandal proof.

D. Heating Element: Sealed tubular type with finned heating elements, manual reset thermal limit safety switch, fan purge limit to dissipate residual heat on heater shutdown.

E. Control:

1. Control specified in Section 23 09 00, Instrumentation and Control Performance Specifications.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Avoid interference with structure and with work of other trades, preserving adequate headroom and clearing doors and passageways. Check each piece of equipment for defects, verifying that items function properly and that adjustments have been made.

B. Prior to acceptance, thoroughly clean exposed portions of terminal heat transfer equipment, remove shipping labels and traces of foreign substance. Touch up scratched surfaces of radiant panels with factory matching paint.

3.02 ELECTRIC WALL HEATERS INSTALLATION

A. Damaged Coils: Make every effort to prevent damage to both built-up coils and coils of packaged equipment. Comb damaged coil fins to be straight.

B. Install per manufacturer's instructions. Comply with NEC and UL listings.

C. Install heaters in place with box trim flush with finished wall.

D. Install thermostat as shown on drawings. Provide control wiring from thermostat to unit.

END OF SECTION

SECTION 26 00 00
ELECTRICAL BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Work included in 26 00 00, Electrical Basic Requirements applies to Division 26, Electrical work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of electrical systems for proposed project.

B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.

C. Definitions:

1. Provide: To furnish and install, complete and ready for intended use.
2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.02 RELATED SECTIONS

A. Contents of Section applies to Division 26, Electrical Contract Documents.

B. Related Work:

1. Additional conditions apply to this Division including, but not limited to:
   a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
   b. Drawings
   c. Addenda
   d. Owner/Architect Agreement
   e. Owner/Contractor Agreement
   f. Codes, Standards, Public Ordinances and Permits

1.03 REFERENCES AND STANDARDS

A. References and Standards per Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) , Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, individual Division 26, Electrical Sections and those listed in this Section.

B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:

1. State of Oregon:
   a. OAR - Oregon Administrative Rules

b. OESC - Oregon Electrical Specialty Code
c. OFC - Oregon Fire Code
d. OMSC - Oregon Mechanical Specialty Code
e. OPSC - Oregon Plumbing Specialty Code
f. OSSC - Oregon Structural Specialty Code
g. OEESC - Oregon Energy Efficiency Specialty Code

C. Reference standards and guidelines include but are not limited to the latest adopted editions from:

1. ABA - Architectural Barriers Act
2. ADA - Americans with Disabilities Act
3. ANSI - American National Standards Institute
4. APWA - American Public Works Association
5. ASCE - American Society of Civil Engineers
6. ASHRAE Guideline 0, the Commissioning Process
7. ASTM - ASTM International
8. CFR - Code of Federal Regulations
9. EPA - Environmental Protection Agency
10. ETL - Electrical Testing Laboratories
11. FCC - Federal Communications Commission
12. FM - FM Global
13. IBC - International Building Code
14. IEC - International Electrotechnical Commission
15. IEEE - Institute of Electrical and Electronics Engineers
16. IES - Illuminating Engineering Society
17. ISO - International Organization for Standardization
18. MSS - Manufacturers Standardization Society
19. NEC - National Electric Code
20. NECA - National Electrical Contractors Association
21. NEMA - National Electrical Manufacturers Association
22. NETA - National Electrical Testing Association
23. NFPA - National Fire Protection Association
24. OSHA - Occupational Safety and Health Administration
25. UL - Underwriters Laboratories Inc.

D. See Division 26, Electrical individual Sections for additional references.

1.04 SUBMITTALS

A. See Division 01, General Requirements for Submittal Procedures as well as individual Division 26, Electrical Sections.

B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.

C. In addition:

1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.

2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail or posted to ftp site. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. Provide separate submittals for power system study (per Specification Section 26 05 73) and electrical equipment (for example, switchboards and panelboards). Provide separate submittals for lighting control cutsheets, and for lighting control shop drawings. Deviations will be returned without review.
3. Product Data: Provide manufacturer's descriptive literature for products specified in Division 26, Electrical Sections.
4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the specifications and drawings.
    a. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
    b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference individual Division 26, Electrical specification Sections for specific items required in product data submittal outside of these requirements.
    c. See Division 26, Electrical individual Sections for additional submittal requirements outside of these requirements.
5. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of these additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer’s comments. Identify Engineer’s comments and provide an individual response to each of the Engineer’s comments. Cloud changes in the submittals and further identify changes which are in response to Engineer’s comments.
7. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-10 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
8. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 26, Electrical Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals. Electric motors are supplied and installed by Division 23 unless otherwise specified. During shop drawing stage of the project, verify correct disconnect sizes, conductor sizes, etc., and bring any discrepancies to the attention of the Mechanical trade. Be responsible for any modifications to

electrical equipment or installations as a result of equipment incompatibility discovered after shop drawing review.

9. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.

10. Substitutions and Variation from Basis of Design:

    a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.

    b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.

11. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, device layout plans, and control wiring diagrams. Reference individual Division 26, Electrical specification Sections for additional requirements for shop drawings outside of these requirements.

    a. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.

12. Samples: Provide samples when requested by individual Sections.

13. Resubmission Requirements:

    a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.

    b. Resubmit for review until review indicates no exception taken or "make corrections as noted".

14. Operation and Maintenance Manuals, Owner's Instructions:

    a. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.

        1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.

        2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include

manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment.

3) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

4) Include product certificates of warranties and guarantees.

5) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.

6) Include commissioning reports.

7) Include copy of startup and test reports specific to each piece of equipment.

8) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.

b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 26 00 00, Electrical Basic Requirements, Demonstration.

c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.

15. Record Drawings:

a. Maintain at site at least one set of drawings for recording “As-constructed” conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements, location of conduit, and location of concealed electrical items. Include items changed by field orders, supplemental instructions, and constructed conditions.

b. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.

c. At completion of project, input changes to original project on Revit Model and make one set of black-line drawings created from Revit Model in version/release equal to contract drawings. Submit Revit disk and drawings upon substantial completion.

d. See Division 26, Electrical individual Sections for additional items to include in record drawings.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.

B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.

C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e. distribution equipment, duct banks, light fixtures, etc.) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.

D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.

E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.

F. Provide products that are UL listed.

1.06 WARRANTY

A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.07 COORDINATION DOCUMENTS

A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, plumbing equipment/fixtures, fire sprinklers, plumbing, lights, cable tray and electrical services with architectural and structural requirements, and other trades (including ceiling suspension and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.

B. Advise Architect in event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.

C. Verify in field exact size, location, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.

D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer.

2.02 STANDARDS OF MATERIALS AND WORKMANSHIP

A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or ETL approved or have adequate approval or be acceptable by state, county, and city authorities. Equipment/fixture supplier is responsible for obtaining State, County, and City acceptance on equipment/fixtures that are not UL or ETL approved or are not listed for installation.

B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.

C. Hazardous Materials:

1. Comply with local, State of Oregon, and Federal regulations relating to hazardous materials.
2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.01 ACCESSIBILITY AND INSTALLATION

A. Confirm Accessibility and Installation requirements in Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

B. Install equipment requiring access (i.e., junction boxes, light fixtures, power supplies, motors, etc.) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in passageways, doorways, scuttles or crawlspaces which would impede or block the intended usage.

C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.

D. Earthwork:

1. Confirm Earthwork requirements in Contract Documents. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
   a. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.

E. Firestopping:

1. Confirm requirements in Division 07, Thermal and Moisture Protection. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
   a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

F. Plenums:

1. In plenums, provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

G. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

H. Provide miscellaneous supports/metals required for installation of equipment and conduit.

3.02 SEISMIC CONTROL

A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 26 Electrical Sections.

B. General:

1. Earthquake resistant designs for Electrical (Division 26) equipment and distribution, i.e. power distribution equipment, generators, UPS, etc. to conform to regulations of jurisdiction having authority.
2. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.
3. Provide stamped shop drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for conduit and equipment. Submit shop drawings along with equipment submittals.
4. Provide stamped shop drawings from licensed Structural Engineer of seismic flexible joints for conduit crossing building expansion or seismic joints. Submit shop drawings along with seismic bracing details.
5. Provide means to prohibit excessive motion of electrical equipment during earthquake.

3.03 REVIEW AND OBSERVATION

A. Confirm Review and Observation requirements in Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:

1. Prior to covering walls.
2. Prior to ceiling cover/installation.
3. When main systems, or portions of, are being tested and ready for inspection by AHJ.

C. Final Punch:

1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Electrical Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the electrical systems are ready for final punch.
2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.04 CONTINUITY OF SERVICE

A. Confirm requirements in Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) , Division 00, Procurement and Contracting Requirements and Division 01, General

Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:

1. During remodeling or addition to existing structure, while existing structure is occupied, present services to remain intact until new construction, facilities or equipment is installed.
2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new wiring, and wiring to point of connection.
3. Coordinate transfer time to new service with Owner. If required, perform transfer during off-peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
    a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
4. No interruption of services to any part of existing facilities will be permitted without express permission in each instance from Owner. Requests for outages must state specific dates, hours and maximum durations, with outages kept to these specific dates, hours and maximum durations. Obtain written permission from Owner for any interruption of power, lighting or signal circuits and systems.
    a. Organize work to minimize duration of power interruption.
    b. Coordinate utility service outages with utility company.
    c. Coordinate all electrical service outages with the District Project Manager a minimum of seven calendar days in advance.
    d. Confirm outage times with District Project Manager, in advance, a minimum of 48 hours.

3.05 CUTTING AND PATCHING

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:

1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and/or walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.06 EQUIPMENT SELECTION AND SERVICEABILITY

A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

3.07 DELIVERY, STORAGE AND HANDLING

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:

1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Products and/or materials that become damaged due to water, dirt, and/or dust as a result of improper storage and handling to be replaced before installation.
2. Protect equipment to avoid damage. Close conduit openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
3. Protect bus duct and similar items until in service.

3.08 DEMONSTRATION

A. Confirm Demonstration requirements in Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) ,Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, and individual Division 26, Electrical Sections.

B. Upon completion of work and adjustment of equipment, test systems and demonstrate to Owner's Authorized Representative, Architect, and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

D. Provide training for appropriate District personnel. Training will review complete Operations and Maintenance (O&M) Manual, including but not limited to, programming and setup of any control systems, required maintenance, and troubleshooting, including contact names and phone numbers for factory support.

3.09 CLEANING

A. Confirm Cleaning requirements in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

B. Upon completion of installation, thoroughly clean electrical equipment, removing dirt, debris, dust, temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.10 INSTALLATION

A. Confirm Installation requirements in Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) , Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.

C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

D. Provide miscellaneous supports/metals required for installation of equipment.

3.11 PAINTING

A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:

1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces (i.e., hangers, hanger rods, equipment stands, etc.) with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
2. In Electrical Room, on roof or other exposed areas, equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
3. See individual equipment Specifications for other painting.
4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
5. Conduit: Clean, primer coat and paint interior/exterior conduit exposed in public areas with two coats paint suitable for metallic surfaces. Color selected by Architect.
6. Covers: Covers such as manholes, vaults and the like will be furnished with finishes which resist corrosion and rust.

3.12 DEMOLITION

A. Confirm requirements in Division 01, General Requirements and Division 02, Existing Conditions. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:

1. It is the intent of these documents to provide necessary information and adjustments to electrical system required to meet code, and accommodate installation of new work.
2. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas. Owner will cooperate to best of their ability to assist in coordinated schedule, but will remain final authority as to time of work permitted.
3. Examination:
    a. Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to locate and preserve utilities. Replace damaged items with new material to match existing.
    b. Verify that abandoned wiring and equipment serve only abandoned facilities.
    c. Demolition drawings are based on casual field observation and existing record documents.
        1) Verify accuracy of information shown prior to bidding and provide such labor and material as is necessary to accomplish work.
        2) Verify location and number of electrical outlets, luminaires, panels, etc. in field.
    d. Report discrepancies to Architect before disturbing existing installation.
        1) Promptly notify Owner if utilities are found which are not shown on Drawings.

4. Execution:
   a. Remove existing luminaires, switches, receptacles, and other electrical equipment and devices and associated wiring from walls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or demolition unless shown as retained or relocated on Drawings.
   b. Provide temporary wiring and connections to maintain electrical continuity of existing systems during construction. Remove or relocate electrical boxes, conduit, wiring, equipment, and luminaires, as encountered in removed or remodeled areas in existing construction affected by this work.
   c. Remove and restore wiring which serves usable existing outlets clear of construction or demolition.
   d. If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing electrical equipment which is being retained, provide new conduit and wire to bypass inaccessible junction boxes and abandoned outlets.
   e. If existing conduits pass through partitions or ceiling which are being removed or remodeled, provide new conduit and wire to reroute clear of construction or demolition and maintain service to existing load.
   f. Extend circuiting and devices in existing walls to be furred out.
   g. Remove abandoned wiring to source of supply.
   h. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
   i. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
   j. Disconnect and remove abandoned panelboards and distribution equipment.
   k. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
   l. Existing lighting which is to remain, leave luminaires in proper working order.
   m. Repair adjacent construction and finishes damaged during demolition work.
   n. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

3.13 ACCEPTANCE

A. Confirm requirements in Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) , Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:

1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
   a. Cleaning
   b. Operation and Maintenance Manuals
   c. Training of Operating Personnel
   d. Record Drawings

e. Warranty and Guaranty Certificates

f. Start-up/Test Document and Commissioning Reports

3.14 FIELD QUALITY CONTROL

A. Confirm Field Quality Control requirements in Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

B. Tests:

1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in operation and maintenance manuals.
2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.15 LETTER OF CONFORMANCE

A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that Electrical items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

3.16 SALVAGED EQUIPMENT AND RECYCLED MATERIAL

A. Salvage the following equipment not being reused and return to Owner:

1. Luminaires
2. Panelboards
3. Breakers
4. Transformers

B. Electrical equipment that cannot be salvaged for reuse, sell/give to recycling company. Recycle following excess, removed, or demolished electrical material:

1. Copper or aluminum conductors, buses, and motor/transformer windings.
2. Steel and aluminum from raceways, boxes, enclosures, and housings.
3. Acrylic and glass from luminaire lenses/refractors.

C. Provide separate on-site storage space for recycled and salvaged material. Clearly label space.

D. Confirm additional salvaged equipment and recycled materials in the Contract Documents.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Lugs and Pads
   2. Wires and Cables
   3. Connectors

1.02 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) , Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Cable insulation test reports in project closeout documentation.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Lugs and Pads:
   1. Anderson
   2. Ilsco
   3. Panduit
   4. Thomas & Betts
   5. 3M
   6. Or approved equivalent.

B. Wires and Cables:
   1. General:
      a. General Cable
      b. Okonite
      c. Southwire
      d. Or approved equivalent.

C. Splices:
   1. Branch Circuit Splices:
      a. Ideal
      b. 3M Scotchlok

c. Uraseal, Inc.
d. Or approved equivalent.

D. Connectors:
1. Anderson Power Products
2. Burndy
3. Ilsco
4. 3M
5. Thomas & Betts
6. Or approved equivalent.

2.02 LUGS AND PADS

A. Ampacity: Cross-sectional area of pad for multiple conductor terminations to match ampere rating of panelboard bus or equipment line terminals.

B. Copper Pads: Drilled and tapped for multiple conductor terminals.

C. Lugs: Compression type for use with stranded branch circuit or control conductors; mechanical lugs for use with solid branch and feeder circuit conductors.

2.03 WIRES AND CABLES

A. Building Wires:
1. Copper: Soft-drawn with conductivity of not less than 98 percent IACS at 20 degrees C (68 degrees F). 600 volt rated throughout. Conductors 12 AWG and 10 AWG, solid. Conductors 8 AWG and larger, stranded. 12 AWG minimum conductor size. Minimum insulation rating of 90 degrees C. Insulation Type: THHN/THWN-2.
2. Aluminum conductors are not permitted unless written approval is received from the Engineer.

B. Phase color to be consistent at feeder terminations; A-B-C, top to bottom, left to right, front to back.

C. Color Code Conductors as Follows:

PHASE	208 VOLT WYE	480 VOLT
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Neutral	White	Gray or White w/colored strip
Ground	Green	Green

D. MC Cable: Not allowed.

E. AC Cable (Armored Cable): Not allowed.

F. NMB Cable: Not allowed.

2.04 SPLICES

A. Branch Circuits: Twist on, high temperature, grounding type wing nuts.
1. Ideal Industries Wing-Nut Twist-On Connectors.
2. 3M Scotchlok Twist-On Wire Connectors.

2.05 CONNECTORS

A. Split bolt connectors not allowed.

B. Conductor Branch Circuits: Wire nuts with integral spring connectors for conductors 12 AWG through 8 AWG. Push-in type connectors where conductors are not required to be twisted together are not acceptable.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Install per manufacturer instructions and OSSC.

B. Field Quality Control:

1. Test conductor insulation on feeders of 100 amp and greater for conformity with 1000 volt megohmmeter. Use Insulated Cable Engineers Association testing procedures. Minimum insulation resistance acceptable is 1 megohm for systems 600 volts and below. Notify Architect if insulation resistance is less than 1 megohm.
2. Test Report: Prepare a typed tabular report indicating the testing instrument, the feeder tested, amperage rating of the feeder, insulation type, voltage, the approximate length of the feeder, conduit type, and the measured resistance of the megohmmeter test. Submit test reports with project closeout documents.
3. Inspect and test in accordance with NETA Standard ATS, except Section 4.
4. Perform inspections and tests listed in NETA Standard ATS, Section 7.3.2.

3.02 LUGS AND PADS

A. Thoroughly clean surfaces to remove all dirt, oil, great or paint.

B. Use torque wrench to tighten per manufacturer's directions.

3.03 WIRES AND CABLES

A. General:

1. Do not install or handle thermoplastic insulated wire and cable in temperatures below -10 degrees C (14 degrees F). Do not handle thermoset insulated wire and cable in temperatures below -40 degrees C (-40 degrees F).
2. Install conductors in raceways having adequate, code size cross-sectional area for wires indicated.
3. Install conductors with care to avoid damage to insulation.
4. Do not apply greater tension on conductors than recommended by manufacturer during installation.
5. Use of pulling compounds is permitted. Clean residue from exposed conductors and raceway entrances after conductor installation. Do not use pulling compounds for installation of conductors connected to GFCI circuit breakers or GFCI receptacles.
6. Conductor Size and Quantity:
    a. Install no conductors smaller than 12 AWG unless otherwise shown.
    b. Provide required conductors for a fully operable system.
    c. Power Circuits: No. 12 AWG minimum, except as follows:
        1) No. 10 AWG for 15A, 120V circuits longer than 100 ft.
        2) No. 8 AWG for 15A, 120V circuits longer than 150 ft.
        3) No. 10 AWG for 20A, 120V circuits longer than 70 ft.
        4) No. 8 AWG for 20A, 120V circuits longer than 100 ft.
    d. When exact run lengths are determined for all branch circuits, and prior to installation of the conductors, ensure that the maximum voltage drop, based on 80 percent of the circuit protective device, does not exceed 3 percent. Increase wire size from #12AWG, if necessary, to ensure that the 3 percent voltage drop is not exceeded.
7. Provide dedicated neutrals (one neutral conductor for each phase conductor) in all 120V circuits and all 277V circuits.

B. Conductors in Cabinets:

1. Cable and tree wires in panels and cabinets for power and control. Use plastic ties in panels and cabinets.
2. Tie and bundle feeder conductors in wireways of panelboards.
3. Hold conductors away from sharp metal edges.

C. Homeruns:

1. Do not change intent of branch circuit homeruns without approval. Homeruns for 20A branch circuits may be combined to a maximum of six current carrying conductors including neutral conductors in homeruns. Apply derating factors as required per NEC. Increase conductor size as needed.

D. Identify wire and cable under the provisions of Section 26 05 53, Identification for Electrical Systems. Identify each conductor with its panel and circuit number as indicated.

E. Exposed cable is not allowed.

F. All cable must be run parallel or perpendicular to building lines and hidden from view when possible. Where installed in tray each power cable is to be identified with Lamacoid nametag engraved with identification of equipment being fed. Tag to be fastened to cable using tie-wraps. Provide nametag at each floor level.

G. Do not install PVC jacketed cables in return air plenums, unless they are specially rated plenum cables.

3.04 SPLICES

A. Make splices complete and promptly after wire installation. Provide single wire pigtails for luminaire and device connections. Wire nuts may be used for luminaire wire connections to single wire circuit conductor pigtails.

B. Make splices for No. 8 and larger wires with mechanically applied pressure type connectors. Make all taped joints with Scotch 33+ or equal, applied in half-lap layers without stretching to deform. Uraseal splice kits are also acceptable through 250 KCMIL.

C. Remove insulation with a stripping tool designed specifically for that purpose. A pocket knife is not an acceptable tool. Leave all conductors nick-free.

3.05 CONNECTORS

A. Install to assure a solid and safe connection.

B. Select hand twist connectors for wire size and install tightly on conductors.

C. Install compression connectors using methods and tools recommended by the manufacturer.

D. Do not install stranded conductors under screw terminals unless compression lugs are installed.

E. Do not connect wiring without UL listed connectors that are listed for the purposes.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Connectors and Accessories
   2. Grounding Conductor

1.02 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) , Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Comply with the requirements of ANSI/NFPA 70.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Connectors and Accessories:
   1. Burndy Hyground Compression System
   2. Erico/Cadweld
   3. Amp Ampact Grounding System
   4. Pipe Grounding Clamp:
      a. Burndy GAR Series
      b. O Z Gedney
      c. Thomas & Betts
      d. Or approved equivalent.

B. Grounding Conductor
   1. General Cable
   2. Okonite
   3. Southwire
   4. Or approved equivalent

2.02 CONNECTORS AND ACCESSORIES

A. Grounding Connectors: Hydraulic compression tool applied connectors or exothermic welding process connectors or powder actuated compression tool applied connectors.

B. Pipe Grounding Clamp: Mechanical ground connector with cable parallel or perpendicular to pipe.

2.03 GROUNDING CONDUCTOR

A. Grounding Electrode Conductor: Soft-draw bare stranded copper for wire sizes larger than #10 AWG Bare. Solid copper for wire sizes #10 AWG and smaller.

B. Equipment Grounding Conductor: Green insulated, insulation type to match that of associated feeder or branch circuit wiring, size as indicated on drawings.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Verify site conditions prior to beginning work.

B. Bond Sections of service equipment enclosure to service ground bus.

C. Separately Derived Systems: Ground each separately derived system per NEC Article 250.

D. Corrosion inhibitors: Apply a corrosion inhibitor to contact surfaces when making grounding and bonding connections. Use corrosion inhibitor appropriate for protecting a connection between metals used.

E. Grounding system resistance to ground not to exceed 25 ohms. Make necessary modifications or additions to grounding electrode system for compliance. Submit final tests to assure that this requirement is met.

F. Resistance of grounding electrode system: measure using a four-terminal fall-of-potential method as defined in IEEE 81. Take ground resistance measurements before electrical distribution system is energized and in normally dry conditions, not less than 48 hours after last rainfall. Take resistance measurements of separate grounding electrode systems before systems are bonded together below grade. Combined resistance of separate systems may be used to meet required resistance, but specified number of electrodes must still be provided.

G. Inspect and test in accordance with NETA Standard ATS, Except Section 4.

H. Perform inspections and tests listed in NETA Standard AB, Section 7.13.

3.02 BONDING INSTALLATION

A. Metal Underground Water Service: Bond water service pipe to service equipment ground bus or to the grounding electrode system. Connect to water pipe on utility side of isolating fittings or meters, bond across water meters.

B. Other Metal Piping Systems: Bond gas piping system, fire sprinkler piping system and other metal piping systems to service equipment ground bus or to the grounding electrode system.

C. Bond together metal siding not attached to grounded structure; bond to grounding electrode system.

3.03 CONNECTORS AND ACCESSORIES INSTALLATION

A. Install per manufacturer's instructions.

3.04 GROUNDING CONDUCTOR INSTALLATION

A. Raceways:

1. Ground metallic raceway systems. Bond to ground terminal with code size jumper except where code size or larger equipment grounding conductor is included with circuit, use grounding bushing with lay-in lug.
2. Connect metal raceways, which terminate within an enclosure but without mechanical connection to enclosure, by grounding bushings and ground conductor to grounding bus.
3. Where equipment supply conductors are in flexible metallic conduit, install stranded copper equipment grounding conductor from outlet box to equipment frame.
4. Install equipment grounding conductor, code size minimum unless noted on drawings, in metallic and nonmetallic raceway systems.

B. Feeders and Branch Circuits:

1. Provide continuous green insulated copper equipment grounding conductors for feeders and branch circuits.
2. Where installed in a continuous solid metallic raceway system and larger sizes are not detailed, provide insulated equipment grounding conductors for feeders and branch circuits sized in accordance with the latest adopted edition of NEC Article 250, Table 250-122.

C. Bond boxes, cabinets, enclosures and panelboard equipment grounding conductors to enclosure with specified conductors and lugs. Install lugs only on thoroughly cleaned contact surfaces.

D. Motors, Equipment and Appliances: Install code size equipment grounding conductor to (motor) equipment frame or manufacturer's designated ground terminal.

E. Receptacles: Connect ground terminal of receptacle and associated outlet box to equipment grounding conductor. Self grounding nature of receptacle devices does not eliminate equipment grounding conductor bolted to outlet box.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Anchors, Threaded Rod and Fasteners
   2. Support Channel, Hangers and Supports
   3. Rooftop Conduit Supports

1.02 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) , Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals not required for this Section.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Manufacturers regularly engaged in the manufacture of bolted metal framing support systems, whose products have been in satisfactory use in similar service for not less than 10 years.
   2. Support systems to be supplied by a single manufacturer.
   3. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, equipment hangers/supports, and seismic restraint by a qualified Structural Professional Engineer.
      a. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.07 PERFORMANCE REQUIREMENTS

A. General: Provide conduit and equipment hangers and supports in accordance with the following:
   1. When supports, anchorages, and seismic restraints for equipment and supports, anchorages and seismic restraints for conduit, cable tray and equipment are not shown on the Drawings, the Contractor is responsible for their design.
   2. Connections to structural framing shall not introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.

B. Engineered Support Systems: The following support systems to be designed, detailed, and bear the seal of a professional engineer registered in the State of Oregon.

1. Support frames such as conduit racks or stanchions for conduit and equipment which provide support from below.
2. Equipment and piping support frame anchorage to supporting slab or structure.

C. Provide channel support systems, for conduits to support multiple conduits capable of supporting combined weight of support systems and system contents.

D. Provide heavy-duty steel trapezes for piping to support multiple conduit capable of supporting combined weight of supported systems and system contents.

E. Provide seismic restraint hangers and supports for conduit and equipment.

F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Anchors, Threaded Rod and Fasteners:
1. Anchor It
2. Epcon System
3. Hilti-Hit System
4. Power Fast System
5. Or approved equivalent.

B. Support Channel, Hangers and Supports:
1. B-Line
2. Kindorf
3. Superstrut
4. Unistrut
5. Or approved equivalent.

C. Rooftop Conduit Supports:
1. Cooper B-Line Dura-Block Rooftop Support Base
2. Or approved equivalent.

2.02 ANCHORS, THREADED ROD AND FASTENERS

A. Anchors, Threaded Rod and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.

B. Concrete Inserts: Cast in concrete for support fasteners for loads up to 800 lbs.

C. Anchors and Fasteners:
1. Do not use powder-actuated anchors.
2. Concrete Structural Elements: Use precast inserts, expansion anchors, or powder-actuated anchors.
3. Steel Structural Elements: Use beam clamps, steel spring clips, steel ramset fasteners, or welded fasteners.
4. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
5. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.
6. Solid Masonry Walls: Use expansion anchors.
7. Sheet Metal: Use sheet metal screws.
8. Wood Elements: Use wood screws.

D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.

E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.

F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.

2.03 SUPPORT CHANNEL, HANGERS AND SUPPORTS

A. Hangers and Supports - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.

1. Channel Material: Carbon steel.
2. Coating: Hot dip galvanized.

B. Pipe Straps: Two-hole galvanized or malleable iron.

C. Luminaire Chain: 90 lb. test with steel hooks.

D. Miscellaneous Metal: Provide miscellaneous metal items specified hereunder, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on Drawings or otherwise not shown on drawings that are necessary for completion of the project. The Contractor is responsible for their design.

1. Fabricate miscellaneous units to size shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.

E. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.

F. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.

G. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.

2.04 ROOFTOP CONDUIT SUPPORTS

A. Curb base made of 100 percent recycled rubber and polyurethane prepolymer with a uniform load

B. Capacity of 500 pounds per linear foot of support.

C. UV resistant.

D. Steel Frame: Steel, 14 gauge strut galvanized per ASTM A653 or 12 gauge strut galvanized per ASTM A653 for bridge series.

E. Continuous block channel supports with 1-inch gaps to allow water flow, bridge channel supports, extendable height channel supports and elevated single conduit supports.

F. Attaching Hardware: Zinc-plated threaded rod, nuts and attaching hardware per ASTM B633 fastened directly into rubber material with weather resistant Type 12 lag screws.

G. Provide load distribution plates when required for heavy loads.

H. Finish: Black with safety yellow striping.

I. Provide hot dipped galvanized components for items exposed to weather.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Fabrication - Miscellaneous Metals

1. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on Drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill,

countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates, and similar devices. Hot dipped galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.

2. Finishes:

a. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with one coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas in primer with same material, before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.

b. Metal in contact with Concrete, Masonry and Other Dissimilar Materials: Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.

c. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

3.02 ANCHORS, THREADED ROD AND FASTENERS INSTALLATION

A. Safety factor of 4 required for every fastening device or support for equipment installed. Supports to withstand four times the weight of equipment it supports.

B. Do not use other trade's fastening devices as supporting means for luminaires, equipment or materials.

C. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

D. Do not use supports or fastening devices to support other than one particular item.

E. Securely suspend junction boxes, pull boxes or other conduit terminating housings located above suspended ceiling from floor above or roof structure to prevent sagging and swaying.

F. Provide seismic bracing per OSSC requirements.

G. Install surface-mounted cabinets and panelboards with minimum of four anchors.

H. Use spring lock washers under fastener nuts for strut.

I. Cutting and Drilling

1. Do not drill or cut structural members without prior permission from Architect.

3.03 SUPPORT CHANNEL, HANGERS AND SUPPORTS INSTALLATION

A. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.

B. Safety factor of 4 required for every fastening device or support for equipment installed. Supports to withstand four times the weight of equipment it supports.

C. Verify mounting height of luminaires prior to installation when heights are not detailed.

D. Install vertical support members for equipment and luminaires, straight and parallel to building walls.

E. Install horizontal support members straight and parallel to ceilings or finished floor unless otherwise noted.

F. Provide independent supports to structural member for luminaires, materials, or equipment installed in or on ceiling, walls or in void spaces or over suspended ceilings.

G. Do not use other trade's fastening devices as supporting means for luminaires, equipment or materials.

H. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

I. Do not use supports or fastening devices to support other than one particular item.

J. Support conduits within 18-inches of outlets, boxes, panels, cabinets and deflections unless more stringently required by OESC.

K. Maximum distance between supports not to exceed 5 foot spacing unless otherwise required by Beaverton School District Technical Standards .

L. Support flexible conduits within 12-inches of outlets, boxes, panels, cabinets and deflections unless otherwise required by OESC.

M. Maximum distance between supports for flexible conduits not to exceed 48-inches spacing unless otherwise required by OESC.

N. Maximum distance between supports for auxiliary gutters and wireways unless otherwise required by OESC is as follows:

1. Sheet metal auxiliary gutters and wireways - 4-feet apart horizontally and 10-feet vertically.
2. Non-metallic auxiliary gutters and wireways - 30-inches apart horizontally and 3-feet vertically.

O. Install strut hangers as instructed by strut manufacturer. Suspend strut hangers as instructed by strut manufacturer for the load, with a maximum spacing of 8-feet on center and within 2-feet of outlet box, cabinet, junction box or other channel raceway termination unless otherwise required by OESC.

P. Coordinate routing of conduit racks with materials and equipment installed by other trades. Where conduit racks are exposed to view, coordinate location and installation with Architect for optimal appearance.

Q. Securely suspend junction boxes, pull boxes or other conduit terminating housings located above suspended ceiling from floor above or roof structure to prevent sagging and swaying.

R. Provide seismic bracing per OSSC requirements.

S. Where service disconnects are mounted on building exterior, physically attach service disconnect to the building or structure served.

T. Install surface-mounted cabinets and panelboards with minimum of four anchors.

U. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

V. Wet and Damp Locations:

1. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1-inch off wall.

3.04 ROOFTOP CONDUIT SUPPORTS INSTALLATION

A. Consult roofing manufacturer for roof membrane compression capacities. If necessary, provide a compatible sheet of roofing material (rubber pad) under rooftop support to disperse concentrated loads and add further membrane protection.

B. Do not use supports that will void roof warranty.

C. Install supports per manufacturer's instructions and recommendations.

D. Use properly sized clamps to suit conduit sizes.

E. Install supports for rooftop raceways to raise raceways a minimum of 7/8-inches above the roof structure unless otherwise noted.

END OF SECTION

SECTION 26 05 33
RACEWAYS

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Rigid Metal Conduit (RMC)
   2. Electrical Metallic Tubing (EMT)
   3. Flexible Metal Conduit (FMC)
   4. Liquidtight Flexible Metal Conduit (LFMC)
   5. Conduit Fittings

B. Provide a complete system of conduit and fittings, with associated couplings, connectors, and fittings, as shown on drawings and described in these specifications.

1.02 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:
   1. Section 26 05 29, Hangers and Supports for Electrical Systems and Equipment
   2. Section 26 05 34, Boxes

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) , Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.07 DEFINITIONS

A. Raceway system is defined as consisting of conduit, tubing, duct, and fittings including but not limited to connectors, couplings, offsets, elbows, bushings, expansion/deflection fittings, and other components and accessories. Complete electrical raceway installation before starting the installation of conductors and cables.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Rigid Metal Conduit (RMC):
   1. Allied Tube & Conduit
   2. Beck Manufacturing Inc.
   3. Picoma
   4. Wheatland Tube Company
   5. Or approved equivalent.

B. Electrical Metallic Tubing (EMT):
   1. Allied Tube & Conduit

2. Beck Manufacturing WL
3. Picoma
4. Wheatland Tube Company
5. Or approved equivalent.

C. Flexible Metal Conduit (FMC):
1. AFC Cable Systems Inc.
2. Electri-Flex Company
3. International Metal Hose
4. Or approved equivalent.

D. Liquidtight Flexible Metal Conduit (LFMC):
1. AFC Cable Systems Inc.
2. Electri-Flex Company
3. International Metal Hose
4. Or approved equivalent.

E. Conduit Fittings:
1. Bushings:
a. Insulated Type for Threaded Raceway Without Factory Installed Plastic Throat Conductor Protection:
1) Thomas & Betts 1222 Series
2) O-Z Gedney B Series
3) Or approved Equivalent.
2. Raceway Connectors and Couplings:
a. Thomas & Betts Series
b. O-Z Gedney Series
c. Or approved Equivalent.
3. Expansion/Deflection Fittings:
a. EMT: O-Z Gedney Type TX
b. RMC: O-Z Gedney Type AX, DX and AXDX, Crouse & Hinds XD
c. PVC: O-Z Gedney Type DX with PVC adapters, Carlon E945 Series, Kraloy OPEJ Series
d. Or approved equivalent.

2.02 RIGID METAL CONDUIT (RMC)

A. UL 6, ANSI C80.1. Hot dipped galvanized steel conduit after thread cutting.
1. Fittings: NEMA FB2.10.

2.03 ELECTRICAL METALLIC TUBING (EMT)

A. Description: UL 797, ANSI C80.3; steel galvanized tubing.
B. Fittings: NEMA FB 1; steel, compression or set screw type.

2.04 FLEXIBLE METAL CONDUIT (FMC)

A. Description: UL 1, Interlocked steel construction.
B. Fittings: NEMA FB 2.20.

2.05 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Description: UL 360, inner core made from spiral wound strip of heavy gauge, hot dipped galvanized low carbon steel. 3/4-inch through 1-1/4-inch trade sizes to have a square lock core and contain an integral bonding strip of copper. 1-1/2-inch and larger to have fully interlocked core. Jacket material to be moisture, oil and sunlight resistant flexible PVC.
B. Fittings: NEMA FB 2.20.

2.06 CONDUIT FITTINGS

A. Bushings:
   1. Insulated type for threaded raceway connectors without factory-installed plastic throat conductor protection.
   2. Insulated grounding type for threaded raceway connectors.

B. Raceway Connectors and Couplings:
   1. Steel connectors, couplings, and conduit bodies, hot-dip galvanized.
   2. Connector locknuts to be steel, with threads meeting ASTM tolerances. Locknuts to be hot-dip galvanized.
   3. Connector throats (EMT, flexible conduit, metal clad cable and cordset connectors) to have factory installed plastic inserts permanently installed. For normal cable or conductor exiting angles from raceway, the cable jacket or conductor insulation to bear only on plastic throat insert.
   4. Steel gland, Tomic or Breagle connectors and couplings are recognized for this Contract as having acceptable raceway to fitting electrical conductance.
   5. Set screw connectors and couplings, without integral compression glands, are recognized for this Contract as not having acceptable raceway to fitting electrical conductance. A ground conductor sized per this Specification must be included and bonded within raceway assembly utilizing this type connector or coupling.

C. Provide expansion/deflection fittings for EMT or RMC.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Finished Surfaces: Schedule raceway installation to avoid conflict with installed wall and ceiling surfaces. If unavoidable, coordinate work and repairs with Architect.

B. Conduit Size:
   1. Minimum Size: 3/4-inch for power and control, unless otherwise noted. 3/4-inch for communication/data, unless otherwise noted. 3/4-inch for signal systems, unless otherwise noted.

C. Provide two pull strings/tapes in empty conduits. Types:
   1. Feeders: Polyester measure/pulling tape, Greenlee 4436 or approved.
   2. Branch Circuits and Low Voltage: Greenlee Poly Line 431 or approved.
   3. If fish tape is used for pulling line or low voltage wiring, fiberglass type to be used. Metal fish tapes will not be allowed.
   4. Secure pull string/tape at each end.
   5. Provide caps on ends of empty conduit to be used in future.
   6. Label both ends of empty conduits with location of opposite end.

D. Elbow for Low Energy Signal Systems: Use long radius factory ells where linking sections of raceway for installation of signal cable.

E. Verify that field measurements are as shown on drawings.

F. Plan locations of conduit runs in advance of the installation and coordinate with ductwork, plumbing, ceiling and wall construction in the same areas.

G. Locate penetrations and holes in advance where they are proposed in the structural sections such as footings, beams, and walls. Penetrations are acceptable only when the following occurs:
   1. Where shown on the structural drawings.
   2. As approved by the Structural Engineer prior to construction, and after submittal of drawing showing location, size, and position of each penetration.

H. Verify routing and termination locations of conduit prior to rough-in.

I. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

J. Install raceways securely, in neat and workmanlike manner, as specified in NECA 1, Standard Practices for Good Workmanship in Electrical Construction.

K. Install steel conduit as specified in NECA 101, Standard for Installing Steel Conduits.

L. Install nonmetallic conduit in accordance with manufacturer's instructions.

M. Inserts, anchors and sleeves.

1. Coordinate location of inserts and anchor bolts for electrical systems prior to concrete pour.
2. Coordinate location of sleeves with consideration for other building systems prior to concrete pour.

N. Conduit Supports:

1. Arrange supports to prevent misalignment during wiring installation.
2. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
3. Group related conduits; support using conduit rack. Construct rack using steel channel. Provide space on each for conduits.
4. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
5. Do not attach conduit to ceiling support wires.

O. Flexible steel conduit length not-to-exceed 6-feet, 3-feet in concealed walls. Provide sufficient slack to reduce the effect of vibration.

P. Install conduit seals at boundaries where ambient temperatures differ by 10 degrees F or more as shown on the drawings. Install seals on warm side of partition.

Q. Seal raceways stubbing up into electrical equipment. Plug raceways with conductors with duct-seal. Cap spare raceways and plug PVC raceway products with plastic plugs as made by Underground Products, or equal, shaped to fit snugly into the stubup.

R. Seal raceways penetrating an exterior building wall to prevent moisture and vermin from entering into the electrical equipment.

S. Use suitable caps on spare and empty conduits to protect installed conduit against entrance of dirt and moisture.

T. Keep 277/480 volt wiring independent of 120/208 volt wiring. Keep power wiring independent of communication system wiring.

U. Keep emergency system wiring independent of other wiring systems per NEC 700.

V. Arrange conduit to maintain headroom and present neat appearance.

W. Do not install conduits on surface of building exterior, along vapor barrier, across roof, on top of parapet walls, or across floors, unless otherwise noted on drawings.

X. Exposed conduits are permitted only in following areas:

1. Mechanical rooms, electrical rooms or spaces where walls, ceilings and floors will not be covered with finished material.
2. Existing walls that are concrete or block construction.
3. Where specifically noted on Drawings.
4. Route exposed conduit parallel and perpendicular to walls, tight to finished surfaces and neatly offset into boxes.

Y. Do not install conduits or other electrical equipment in obvious passages, doorways, scuttles or crawl spaces which would impede or block area passage's intended usage.

Z. Install continuous conduit and raceways for electrical power wiring and signal systems wiring.

AA. Route conduit installed above accessible ceilings parallel and perpendicular to walls.

AB. Maintain adequate clearance between conduit and piping.

AC. Keep conduits a minimum of 12-inches away from steam or hot water radiant heating lines (at or above 104 degrees F) or 3-inches away from waste or water lines.

AD. Cut conduit square using saw or pipecutter; deburr cut ends.

AE. Bring conduit to shoulder of fittings; fasten securely.

AF. Use conduit hubs or sealing locknuts to fasten conduit to cast boxes in damp and wet locations.

AG. Install no more than the equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams.

AH. Use hydraulic one shot bender to fabricate elbows for bends in metal conduit larger than 2-inch size.

AI. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

AJ. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control, and expansion joints.

AK. Conduit Terminations for Signal Systems: Provide a plastic bushing on the end of conduit used for signal system wiring.

AL. Feeders: Do not combine or change feeder runs.

AM. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07, Thermal and Moisture Protection.

AN. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation and installer.

3.02 RIGID METAL CONDUIT (RMC) INSTALLATION

A. Outdoor Locations Above Grade: RMC.

B. Damp Locations: RMC.

C. In areas exposed to mechanical damage: RMC.

D. For security conduits installed exposed and subject to tampering: RMC.

3.03 ELECTRICAL METALLIC TUBING (EMT) INSTALLATION

A. Dry Locations:

1. Concealed: EMT.
2. Exposed: EMT.

B. Dry, Protected: EMT.

3.04 FLEXIBLE METAL CONDUIT (FMC) INSTALLATION

A. Dry Locations: Motors, recessed luminaires and equipment connections subject to movement or vibration, use flexible metallic conduit.

B. Install 12-inch minimum slack loop on flexible metallic conduit.

3.05 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC) INSTALLATION

A. Use PVC coated liquidtight flexible metallic conduit for motors and equipment connections subject to movement or vibration and subjected to any of following conditions: Exterior location, moist or humid atmosphere, corrosive environments, water spray, oil, or grease.

B. Install 12-inch minimum slack loop on liquidtight flexible metallic conduit.

3.06 CONDUIT FITTINGS INSTALLATION

A. Conduit Joints: Assemble conduits continuous and secure to boxes, panels, luminaires and equipment with fittings to maintain continuity. Provide watertight joints where embedded in concrete, below grade or in damp locations. Seal metal conduit with metal thread primer. Rigid conduit connections to be threaded, clean and tight (metal to metal).

Threadless connections are not permitted for RMC. Seal conduits where penetrating below raised floor area.

B. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

C. Use set screw type fittings only in dry locations. When set screw fittings are utilized provide insulated continuous equipment ground conductor in conduit, from overcurrent protection device to outlet.

D. Use compression fittings in dry locations, damp and rain-exposed locations. Maximum size permitted in damp locations and locations exposed to rain is 2-inches in diameter.

E. Use threaded type fittings in wet locations, and damp or rain-exposed locations where conduit size is greater than 2-inches.

F. Use PVC coated, threaded type fittings in corrosive environments.

G. Use insulated type bushings with ground provision at switchboards, panelboards, safety disconnect switches, junction boxes that have feeders 60 amperes and greater.

H. Condulets and Conduit Bodies:

1. Do not use condulets and conduit bodies in conduits for signal wiring, in feeders 100 amp and larger, or for conductor splicing.

I. Sleeves and Chases - Floor, Ceiling and Wall Penetrations: Provide necessary rigid conduit sleeves, openings and chases where conduits or cables are required to pass through floors, ceilings or walls.

J. Expansion Joints:

1. Provide conduits crossing expansion joints where cast in concrete with expansion-deflection fittings, installed per manufacturer's recommendations.
2. Secure conduits 3-inches and larger to building structure on opposite sides of a building expansion joint with an expansion-deflection fitting across joint installed per manufacturer's recommendations.
3. Provide conduits less than 3-inches where not cast in concrete with junction boxes securely fastened on both sides of expansion joint, connected together with 15-inches of slack (minimum of 15-inches longer than straight line length) flexible conduit and copper green ground bonding jumper. In lieu of this flexible conduit, an expansion-deflection fitting, as indicated for conduits 3-inch and larger may be installed.
4. Verify expansion/deflection requirements with Structural Engineer prior to installation.

K. Seismic Joints:

1. No conduits cast in concrete allowed to cross seismic joint.
2. Provide conduits with junction boxes securely fastened on both sides of seismic joint, connected together with 15-inches of slack (minimum of 15-inches longer than straight line length) flexible conduit and copper green ground bonding jumper. Prior to installation, verify with Architect that 15-inches is adequate for designed movement, and if not, increase this length as required.
3. Provide conduits less than 3-inches where not cast in concrete with junction boxes securely fastened on both sides of expansion joint, connected together with 15-inches of slack (minimum of 15-inches longer than straight line length) flexible conduit and copper green ground bonding jumper. In lieu of this flexible conduit, an expansion-deflection fitting, as indicated for conduits 3-inch and larger may be installed.

L. Provide rigid conduit coupling flush with surface of slab or wall for conduit stubbed in concrete slab or wall to serve electrical equipment or an outlet under table or to supply shop tool, etc. Provide plug where conduit is to be used in future.

END OF SECTION

SECTION 26 05 34
BOXES

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Outlet Boxes
   2. Pull and Junction Boxes
   3. Box Extension Adapter
   4. Weatherproof Outlet Boxes

B. Provide electrical boxes and fittings for a complete installation. Include but not limited to outlet boxes, junction boxes, pull boxes, bushings, locknuts and other necessary components.

1.02 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:
   1. Section 26 05 33, Raceways
   2. Section 26 05 53, Identification for Electrical Systems

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) , Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Outlet Boxes:
   1. Hubbell
   2. Thomas & Betts
   3. Eaton/Crouse-Hinds
   4. Or approved equivalent.

B. Pull and Junction Boxes:
   1. Eaton/Crouse-Hinds
   2. Hoffman
   3. Or approved equivalent.

C. Box Extension Adapter:
   1. Hubbell
   2. Thomas & Betts
   3. Eaton/Crouse-Hinds

4. Or approved equivalent.

D. Weatherproof Outlet Boxes:
   1. Legrand (Pass & Seymour)
   2. Hubbell
   3. Thomas & Betts
   4. Eaton/Crouse-Hinds
   5. Intermatic
   6. Or approved equivalent.

2.02 OUTLET BOXES

A. Luminaire Outlet: 4-inch octagonal box, 1-1/2-inches deep with 3/8-inch luminaire stud if required. Provide raised covers on bracket outlets and on ceiling outlets.

B. Device Outlet: Installation of one or two devices at common location, minimum 4-inches square, minimum 1-1/2-inches deep for non-USB type devices. Installation of one or two devices at common locations, minimum 4-inches square, minimum 2-inches deep for USB type devices. Single- or two-gang flush device raised covers.

C. Telecom Outlet: Provide 4-inches square, minimum 2-1/8-inch deep box with two-gang plaster ring.

D. Multiple Devices: Three or more devices at common location. Install one-piece gang boxes with one-piece device cover. Install one device per gang.

E. Masonry Boxes: Outlets in concrete.

F. Construction: For interior locations, provide galvanized steel outlet wiring boxes, of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices. All surface mounted outlet boxes are to be drawn. Welded boxes are not acceptable.

G. Accessories: Provide outlet box accessories for each installation, including mounting brackets, wallboard hangers, extension rings, luminaire studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual wiring situations.

2.03 PULL AND JUNCTION BOXES

A. Construction: Provide ANSI 49 gray enamel painted sheet steel junction and pull boxes, with screw-on covers; of type shape and size, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.

B. Location:
   1. Provide junction boxes above accessible ceilings for drops into walls for receptacle outlets from overhead.
   2. Provide junction boxes and pull boxes to facilitate installation of conductors and limiting accumulated angular sum of bends between boxes, cabinets and appliances to 270 degrees.

2.04 BOX EXTENSION ADAPTER

A. Construction: Diecast aluminum.

B. Location: Install over flush wall outlet boxes to permit flexible raceway extension from flush outlet to fixed or movable equipment.

2.05 WEATHERPROOF OUTLET BOXES

A. Construction: Provide corrosion-resistant cast metal weatherproof outlet wiring boxes, of the type, shape and size, including depth of box, with threaded conduit ends, cast metal faceplate with spring-hinged waterproof cap suitably configured for each application, including faceplate, gasket, blank plugs and corrosion proof fasteners. Weatherproof boxes to be constructed to have smooth sides, gray finish.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate locations of wall mounted wiring device boxes with architectural and structural floor plans prior to rough-in.

B. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1, Standard Practice of Good Workmanship in Electrical Construction.

C. Secure boxes rigidly to substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry.

D. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NEC. Locate boxes and conduit bodies so as to ensure accessibility of electrical wiring.

E. Set wall mounted boxes at elevations to accommodate mounting heights specified in this Section.

F. Electrical boxes are shown on drawings in approximate locations unless dimensioned.

G. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07, Thermal and Moisture Protection.

H. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

I. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

J. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12-inches of box.

K. Box Color Coding and Marking: Reference Section 26 05 53, Identification for Electrical Systems.

L. Adjust boxes to be parallel with building lines. Boxes not plumb to building lines are not acceptable.

M. Install knockout closures in unused box openings.

N. Clean interior of boxes to remove dust, debris, and other material.

O. Clean exposed surfaces and restore finish.

3.02 OUTLET BOXES INSTALLATION

A. Mount outlet boxes, unless otherwise required by ADA, or noted on drawings, following distances above finished floor:

1. Control Switches:
   a. 48-inches to the top of outlet box.
   b. 4-inches above top of backsplash at countertops/workstations, not-to-exceed 44-inches above finished floor to the top of outlet box per ADA requirements.
2. Receptacles: 15-inches to the bottom of outlet box.
3. Telecom Outlets: 15-inches to the bottom of outlet box.
4. Other Outlets: As indicated in other sections of specifications or as detailed on drawings.

B. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6-inches from ceiling access panel or from removable recessed luminaire.

C. Flush Outlets in Insulated Spaces: Maintain integrity of insulation and vapor barrier.

D. Coordinate electrical device locations and elevations (switches and receptacles) with architectural drawings to prevent mounting devices in mirrors, back splashes, and behind cabinets.

E. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

F. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices. Adjacent boxes not aligned vertically to be adjusted at no additional cost to Owner.

G. Use flush mounting outlet box in finished areas.

H. Do not install flush mounting box back-to-back in walls; provide minimum 6-inches separation. Provide minimum 24-inches or separated by stud wall partition in acoustic rated walls.

I. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

J. Use stamped steel bridges to fasten flush mounting outlet box between studs.

K. Use adjustable steel channel fasteners for hung ceiling outlet box.

L. Use gang box where more than one device is mounted together. Do not use sectional box.

M. Use gang box with plaster ring for single device outlets.

N. Adjust flush-mounting outlets to make front flush with finished wall material.

3.03 PULL AND JUNCTION BOXES INSTALLATION

A. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

B. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6-inches from ceiling access panel or from removable recessed luminaire.

C. Do not fasten boxes to ceiling support wires.

D. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.04 BOX EXTENSION ADAPTER INSTALLATION

A. Match material to box.

B. Install gaskets at exterior and wet locations.

3.05 WEATHERPROOF OUTLET BOXES INSTALLATION

A. Use cast outlet box in exterior locations exposed to weather and wet locations.

B. Install gaskets.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Device Labels
   2. Wire Markers

1.02 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) , Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals not required for this Section.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
   2. Manufacturer's standard products of categories and types required for each application as referenced in other Division 26, Electrical Sections. Where more than a single type is specified for application, provide single selection for each product category.
   3. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Device Labels:
   1. Kroy
   2. Brady
   3. Or approved equivalent.

B. Wire Markers:
   1. Brady
   2. Panduit
   3. Sumitomo
   4. Or approved equivalent.

2.02 DEVICE LABELS

A. Extra strength, laminated adhesive tape, with 3/16-inch black letters on clear background. Use only for identification of individual wall switches and receptacles. Indicate device name, source panel, and source circuits. Panel and circuit designation written in

permanent marker on the back of the plate and inside the back-box. Do not provide punch tape style labels.

B. Label all junction boxes to show system identification, source circuit, or raceway origin. In finished areas, utilize device label. In unfinished areas or above ceilings, use of permanent ink marker is acceptable.

2.03 WIRE MARKERS

A. Description: Vinyl-cloth self-adhesive or tubing type wire markers.

B. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, junction boxes, and each load connection.

C. Power and Lighting Circuits: Branch circuit or feeder number as indicated on drawings and source panel.

D. Control Circuits: control wire number indicated on schematic and interconnection diagrams on drawings.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate designations used on Drawings with equipment nameplates and device labels.

B. Install nameplates and labels parallel to equipment lines.

C. Identify empty conduit and boxes with intended use.

D. Provide typewritten branch panel schedules with protective clear transparent covers accounting for every breaker installed. Use actual room designations assigned by name or number near completion of the work, and not the designations shown on drawings.

E. Where changes are made in existing panels, distribution boards, etc., provide new labeling and typewritten schedules to accurately reflect the changes.

F. Provide color coded boxes as follows:

1. Fire Alarm: Red.

3.02 DEVICE LABELS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Degrease and clean surfaces to receive labels.

3.03 WIRE MARKERS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide wire markers on each conductor for power, control, signalling and communications circuits.

D. Where switches control remote lighting or power outlets, or where switches or outlets in same location serve different purposes, such as light, power, intercom, etc. or different areas, such as corridor and outside, provide plates with 1/8-inch black letters indicating function of each switch or outlet. Also label the function of light switches where two or more are mounted in same locations.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included: Provision of materials, installation and testing of:
   1. Wall Switches
   2. Receptacles
   3. Finish Plates
   4. Wall Dimmers
   5. Surface Covers

1.02 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) , Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. UL 498, Attachment Plugs and Receptacles.
   2. UL 943, Ground Fault Circuit Interrupters (Class A GFCI).
   3. UL 1472, Standard for Solid State Dimming Controls.

1.04 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Wall switches
   2. Receptacles
   3. Wall Plates
   4. Dimmers
   5. In-Use Cover

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Wall Switches:
   1. Toggle Type Characteristics:
      a. Hubbell HBL1221
      b. Leviton 1221
      c. Legrand P&S PS20AC1
      d. Or approved equivalent.

B. Receptacles:

1. Commercial Grade:
    a. 20 Amp:
        1) Cooper 5362
        2) Hubbell 5362
        3) Bryant CBRS20
        4) Leviton 5362S
        5) Legrand P&S 5362
        6) Or approved equivalent.
2. Ground Fault Circuit Interrupter (GFCI) Receptacle - 20 Amp:
    a. Cooper WRSGF20W
    b. Hubbell GFR5362SGW
    c. Legrand P&S 2097TRWR
    d. Or approved equivalent.
3. Specification Grade Tamper-Resistant Duplex - 20 Amp:
    a. Cooper TR5362
    b. Hubbell BR20TR
    c. Leviton TBR20
    d. Legrand P&S TR5362
    e. Or approved equivalent.

C. Finish Plates:
1. Hubbell
2. Leviton
3. Legrand P&S
4. Or approved equivalent.

D. Wall Dimmers:
1. Lutron Maestro Series
2. Or approved equivalent.

E. Surface Covers:
1. Aluminum with Gasket, Blanks, Single Gang:
    a. Bell 240-ALF
    b. Carlon
    c. Or approved equivalent.
2. 2-Gang:
    a. Bell 236-ALF
    b. Carlon
    c. Or approved equivalent.
3. While-in-Use Weatherproof Cover:
    a. Die Cast Cover:
        1) Intermatic
        2) Hubbell
        3) Cooper
        4) Or approved equivalent.

F. Provide lighting switches and receptacles of common manufacturer and appearance.

2.02 WALL SWITCHES

A. Characteristics: Toggle type, quiet acting, 20 amp, 120/277 volt, UL listed for motor loads up to 80 percent of rated amperage, extra heavy duty.

B. Finish: White or Match Building Standard.

2.03 RECEPTACLES

A. Duplex Receptacles Characteristics: Straight parallel blade, 125 volt, 2 pole, 3 wire grounding.

1. Commercial Grade: Riveted. Back and side wired. Brass ground contact on steel strap. Nylon face and nylon base. 20 amp.

B. Ground Fault Circuit Interrupter (GFCI) Receptacle: Feed through type, back-and-side wired, tamper-resistant, weather resistant self-testing, 20 amp, 125VAC.

C. Specification Grade Tamper-Resistant Receptacle: 20 amp, 125VAC, complies with OESC requirements.

D. Special Purpose Receptacles: Reference Drawings for NEMA Standard Specification.

E. Finish:

1. Same exposed finish as switches.

2.04 FINISH PLATES

A. Finish Plates: Type 302 stainless steel with smooth satin finish.

B. Provide telephone/signal device plates; activated outlets to have coverplates to match modular jack.

2.05 WALL DIMMERS

A. Provide wall dimmers compatible with type of load controlled (i.e. line voltage, low voltage, 2-wire, 3-wire, 0-10v). Finish to match wall switches. Size dimmers to accept connected load. Do not cut fins. Where dimmers are ganged together, provide a single multi gang coverplate.

B. LED indicator dots show by what percentage controlled lighting is dimmed. Programmable settings for maximum and minimum trim settings, and rate of change in lighting levels.

2.06 SURFACE COVERS

A. Material: Galvanized steel, drawn, 1/2-inch raised industrial type with openings appropriate for devices installed on surface receptacles.

B. Cast Box and Extension Adaptors: Aluminum with gasket, blanks single gang or 2-gang.

C. While-in-Use Weatherproof Cover: NEMA 3R when closed over energized plug. Vertical mount for duplex receptacle. Provide continuous use cover with cover capable of closing over energized cord cap with bottom aperture for cord exit.

1. Die cast cover with closed cell neoprene foam gasket: Capable of being locked closed to prevent tampering or unauthorized use.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. See Architectural elevations for location and mounting height of wiring devices. Review Architectural elevations prior to rough-in and contact Architect immediately if conflicts are found between Architectural and Electrical Drawings. Do not rough-in devices until conflicts are resolved.

B. Install wiring devices and finish plates plumb with building lines, equipment cabinets and adjacent devices. Devices not plumb will be fixed at no additional cost to Owner.

C. Orientation:

1. Install wiring devices with long dimension oriented vertically at centerline height shown on drawings or as specified.

2. Vertical Alignment: When more than one device is shown on drawings in close proximity to each other, but at different elevations, align devices on a common vertical center line for best appearance. Verify with Architect.
3. Horizontal Alignment: When more than one device is shown on drawings in close proximity to each other with same elevation, align devices on a common horizontal center line for best appearance. Verify with Architect.

D. Provide labeling per Section 26 05 53, Identification for Electrical Systems.

E. Test wiring devices to ensure electrical continuity of grounding connections, and after energizing circuitry, to demonstrate compliance with requirements. Test receptacles for line to neutral, line to ground and neutral to ground faults. Correct any defective wiring.

3.02 WALL SWITCHES INSTALLATION

A. At time of substantial completion, replace those items which have been damaged.

3.03 RECEPTACLES INSTALLATION

A. Upon installation, adhere to proper and cautious use of convenience receptacles. At time of substantial completion, replace those items which have been damaged, including those burned and scored by faulty receptacles or cord caps.

B. GFCI Receptacles: One GFCI receptacle may not be used to provide GFCI protection to downstream duplex receptacles on the same branch circuit.

3.04 FINISH PLATES INSTALLATION

A. Do not install items until finish painting is complete. Replace scratched and paint splattered finish plates and wiring devices.

3.05 WALL DIMMERS INSTALLATION

A. Install per manufacturer's recommendations and wiring diagrams.

3.06 SURFACE COVERS INSTALLATION

A. Do not install items until finish painting is complete. Replace scratched and paint splattered finish plates and wiring devices.

END OF SECTION

SECTION 26 28 00
OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Fuses
   2. Molded Case Circuit Breakers

1.02 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) , Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, provide:
   1. Product data and instantaneous let-through current curves and average melting time current curves for fuses supplied to project.
   2. Product data and time/current trip curves for circuit breakers supplied to project.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements apply to this Section.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Fuses:
   1. Bussmann
   2. Ferraz-Shawmut
   3. Littelfuse
   4. McGraw-Edison
   5. Or approved equivalent.

B. Molded Case Circuit Breakers:
   1. Eaton Electrical
   2. ABB/General Electric
   3. Siemens
   4. Schneider Electric/Square D
   5. Or approved equivalent.

2.02 FUSES

A. Characteristics:
   1. Dual element, time delay, current limiting, nonrenewable type, rejection feature. Blown-fuse indicator window.

2. Combination Loads: UL Class RK1, 1/10 to 600 amp. UL Class L, above 600 amps.
3. Motor Loads: UL Class RK5, 1/10 to 600 amp.
4. Fuse pullers for complete range of fuses.

2.03 MOLDED CASE CIRCUIT BREAKERS

A. 1-, 2- or 3-pole bolt-on, single handle common trip, 600VAC or 250VAC as indicated on Drawings.

B. Overcenter toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.

C. Calibrate for operation in 40 degrees C ambient temperature.

D. 15 to 150 Amp Breakers: Permanent trip unit containing individual thermal and magnetic trip elements in each pole.

E. 151 to 400 Amp Breakers: Adjustable magnetic trip elements. Provide push-to-trip button on cover of breaker for mechanical tripping.

F. Greater than 401 Amp: Electronic trip type with adjustments for long-time, instantaneous, and short-time functions.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Coordination:

1. Obtain and review the submitted product data for equipment furnished by the Owner, and furnished under other Divisions of this contract, particularly under Divisions 22 and 23.
2. Confirm the equipment nameplate maximum overcurrent protection (MOCP) and make accommodations and adjustments to overcurrent protective devices as necessary to coordinate with the nameplate rating.

B. Install all items in accordance with manufacturers written instructions.

3.02 FUSES

A. Fuses: For each class and ampere rating of fuse installed, provide the following quantities of spares for quantity of fuses installed:

1. 0 to 24: Provide 6 spare.
2. 25 to 48: Provide 9 spare.
3. 49 and Above: Provide 12 spare.

3.03 MOLDED CASE CIRCUIT BREAKERS

A. Provide testing of ground fault interrupting breakers.

B. Provide circuit breakers, as specified and on Drawings, for installation in panelboards, individual enclosures or combination motor starters.

C. Provide ground fault interrupter circuit breakers for equipment in damp or wet locations.

D. Provide device on handle to lock breaker in "ON" position for breakers feeding time switches, night lights and similar circuits required to be continuously energized.

E. Provide multi-pole branch circuit breakers for multiwire branch circuits for simultaneous disconnection of circuits.

END OF SECTION

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Toggle Type Disconnect Switches
   2. Manual Motor Starters
   3. Safety Switches
   4. Enclosed Circuit Breakers
   5. Molded Case Switches

1.02 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:
   1. Section 26 28 00, Overcurrent Protective Devices.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) , Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Toggle Type Disconnect Switches:
   1. Hubbell
   2. Leviton
   3. Legrand (Pass & Seymour)
   4. Or approved equivalent.

B. Manual Motor Starters:
   1. Eaton Electrical
   2. ABB/General Electric
   3. Siemens
   4. Schneider Electric/Square D
   5. Or approved equivalent.

C. Safety Switches:
   1. Eaton Electrical
   2. ABB/General Electric
   3. Siemens

4. Schneider Electric/Square D
5. Or approved equivalent.

D. Enclosed Circuit Breakers:
1. Eaton Electrical
2. ABB/General Electric
3. Siemens
4. Schneider Electric/Square D
5. Or approved equivalent.

E. Molded Case Switches:
1. Eaton Electrical
2. ABB/General Electric
3. Siemens
4. Schneider Electric/Square D
5. Or approved equivalent.

2.02 TOGGLE TYPE DISCONNECT SWITCHES

A. Rating: 120 or 277 volt, 1 or 2 pole, 20 amp, 1 hp maximum.

B. Enclosure:
1. NEMA 1: Dry locations/Indoors.
2. NEMA 3R: Damp or wet locations/Outdoors.

C. Handle lockable in 'off' position.

2.03 MANUAL MOTOR STARTERS

A. Quick-Make, Quick-Break. Thermal overload protection. Device labeled with maximum voltage, current, and horsepower.

B. Enclosure:
1. NEMA 1: Dry locations/Indoors.
2. NEMA 3R: Damp or wet locations/Outdoors.

2.04 SAFETY SWITCHES

A. Heavy duty fusible type and non-fusible type (as indicated on drawings), dual rated, quick-make, quick-break with fuse rejection feature for use with Class R fuses only, unless other fuse type is specifically noted.

B. Clearly marked for maximum voltage, current, and horsepower.

C. Operable handle interlocked to prevent opening front cover with switch in 'on' position.

D. Switches rated for maximum available fault current.

E. Handle lockable in 'off' position.

F. Enclosure:
1. NEMA 1: Dry locations/Indoors.
2. NEMA 3R: Damp or wet locations/Outdoors.

G. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Provide fuse rejection feature for Class R fuses up to 600 amp. Provide switches of 30 to 200 amp with plug-on line side connections.

H. Fusible Switch Assemblies, 800 Amperes and Larger: Bolted pressure contact switches. Fuse Clips: Designed to accommodate Class L fuses. Provide with shunt-trip and ground fault capabilities.

2.05 ENCLOSED CIRCUIT BREAKERS

A. Molded case circuit breakers:

1. 1-, 2-, or 3-pole bolt on, single-handle common trip, 600VAC or 250VAC as indicated on drawings.
2. Overcenter toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.
3. Calibrate for operation in 40C ambient temperature.
4. 15 to 150 Amp Breakers: Permanent trip unit containing individual thermal and magnetic trip elements in each pole.
5. 151 to 400 Amp Breakers: Variable magnetic trip elements. Provide push-to-trip button on cover of breaker for mechanical tripping.
6. Greater than 401 Amp: Electronic trip type with adjustments for long-time, instantaneous, and short-time functions. Provide ground fault function for breakers greater than 400 amps.
7. Provide handle mechanisms that are lockable in the open (off) position.
8. Circuit breakers to have minimum symmetrical interrupting capacity as indicated on Drawings.

B. Enclosure:
1. NEMA 1: Dry locations/Indoors.
2. NEMA 3R: Damp or wet locations/outdoors.

2.06 MOLDED CASE SWITCHES

A. Removable cover, galvanized steel enclosure, powder coat painted.

B. Provide cover padlock provision.

C. Provide trip unit with no overcurrent, overload, or low level fault protection. Trip unit to be high instantaneous magnetic fixed trip type with magnetic trip reset at factory to interrupt high fault currents at or above preset level.

D. Enclosure:
1. NEMA 1: Dry locations/Indoors.
2. NEMA 3R: Damp or wet locations/Outdoors.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Obtain and review the submitted product data for equipment furnished by the Owner, and furnished under other Divisions of this contract, particularly under Divisions 22 and 23.

B. Confirm the equipment nameplate maximum overcurrent protection (MOCP) and make accommodations and adjustments to switches, fuses and circuit breakers as necessary to coordinate with the nameplate rating

C. Install in accordance with manufacturer's instructions.

D. Provide engraved nameplates per Section 26 05 53, Identification for Electrical Systems.

E. Apply neatly typed adhesive tag on inside door of each fusible switch indicating NEMA fuse class and size installed.

3.02 TOGGLE TYPE DISCONNECT SWITCHES

A. Install fuses in fusible disconnect switches. Coordinate fuse ampere rating with installed equipment. Do not provide fuses of lower ampere rating than motor starter thermal units.

B. Install products, systems and equipments in accordance with manufacturers written instructions and requirements.

C. See General Installation Requirements above.

3.03 MANUAL MOTOR STARTERS

A. Provide disconnecting means within sight of each motor controller and of each motor. Motor controller disconnecting means equipped with lock-out/tag-out padlock provisions do not require a disconnect switch at the controlled motor location. Locate disconnect

means in view of and not inside of equipment, such that tools are not needed to remove covers to access the disconnecting means.

B. Install products, systems and equipments in accordance with manufacturers written instructions and requirements.

C. See General Installation Requirements above.

3.04 SAFETY SWITCHES

A. Install products, systems and equipments in accordance with manufacturers written instructions and requirements.

B. See General Installation Requirements above.

3.05 ENCLOSED CIRCUIT BREAKERS

A. Install products, systems and equipments in accordance with manufacturers written instructions and requirements.

B. See General Installation Requirements above.

3.06 MOLDED CASE SWITCHES

A. Install products, systems and equipments in accordance with manufacturers written instructions and requirements.

B. See General Installation Requirements above.

END OF SECTION

SECTION 28 00 01
ELECTRONIC SAFETY BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 DESIGN-BUILD SUMMARY

A. Work included in 28 00 01 applies to Division 28, Electronic Safety work to provide materials, labor, tools, permits and incidentals to make electronic safety systems ready for Owner's use for proposed project.

1.02 DESIGN-BUILD INSTRUCTIONS

A. This document is issued to give Bidders a basis for preparing a proposal to design and install a complete Electronic Safety system for this project.

B. Alternates to this Document may be offered as a separate proposal.

1.03 DESIGN-BUILD DESIGN APPROACH

A. Use this Specification as a guide for design/engineering requirements, workmanship and materials or construction. Utilize design-build concept throughout construction phase of project.

B. Investigate and be apprised of applicable codes, rules, and regulations as enforced by AHJ.

C. Visit the Site of the proposed construction. Verify and inspect the existing site to determine conditions that affect this work.

1.04 DESIGN-BUILD DESIGN CRITERIA/CALCULATIONS

A. Related Work Specified Elsewhere:

1. Contents of Section apply to Division 28, Electronic Safety Specifications.
2. Requirements of Section are a minimum for Division 28, Electronic Safety Sections, unless otherwise stated in each Section, in which case that Section's requirements take precedence.

B. Fire Alarm Design Criteria: Refer to Section 28 31 00, Fire Detection and Alarm, for fire alarm system design criteria.

C. Fire Alarm Equipment: Refer to Section 28 31 00, Fire Detection and Alarm, for fire alarm equipment requirements.

1.05 SECTION INCLUDES

A. Work included in 28 00 01, Electronic Safety Basic Requirements applies to Division 28, Electronic Safety work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of electronic safety systems for proposed project.

B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.

C. Definitions:

1. Provide: To furnish and install, complete and ready for intended use.
2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
3. Install: Includes unloading, unpacking, assembling, erecting, installing, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent," substitution requests must be submitted to Engineer for

consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.

5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities having jurisdiction, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.06 RELATED SECTIONS

A. Contents of Section apply to Division 28, Electronic Safety Contract Documents.

B. Related Work:

1. Additional conditions apply to this Division including, but not limited to:
   a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
   b. Drawings
   c. Addenda
   d. Owner/Architect Agreement
   e. Owner/Contractor Agreement
   f. Codes, Standards, Public Ordinances and Permits

C. Contents of Division 26, Electrical apply to this Section.

1.07 REFERENCES AND STANDARDS

A. References and Standards per Beaverton School District Technical Standards (https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards) , Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, individual Division 28, Electronic Safety Sections and those listed in this Section.

B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:

1. State of Oregon:
   a. OAR - Oregon Administrative Rules
   b. OESC - Oregon Electrical Specialty Code
   c. OFC - Oregon Fire Code
   d. OMSC - Oregon Mechanical Specialty Code
   e. OPSC - Oregon Plumbing Specialty Code
   f. OSSC - Oregon Structural Specialty Code
   g. OEESC - Oregon Energy Efficiency Specialty Code

C. Reference standards and guidelines include but are not limited to the latest adopted editions from:

1. ABA - Architectural Barriers Act
2. ADA - Americans with Disabilities Act
3. ANSI - American National Standards Institute
4. ASCE - American Society of Civil Engineers
5. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
6. ASHRAE Guideline 0, the Commissioning Process
7. ASME - American Society of Mechanical Engineers
8. ASTM - ASTM International
9. CFR - Code of Federal Regulations
10. EPA - Environmental Protection Agency

11. ETL - Electrical Testing Laboratories
12. FM - FM Global
13. ISO - International Organization for Standardization
14. NEC - National Electric Code
15. NEMA - National Electrical Manufacturers Association
16. NFPA - National Fire Protection Association
17. OSHA - Occupational Safety and Health Administration
18. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association
19. UL - Underwriters Laboratories Inc.

D. See Division 28, Electronic Safety individual Sections for additional references.

1.08 SUBMITTALS

A. See Division 01, General Requirements for Submittal Procedures.

B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.

C. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.

D. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. Copy Architect on all transmissions/submissions.

E. Product Data: Provide manufacturer's descriptive literature for products specified in Division 28, Electronic Safety Sections.

F. Identify/mark each submittal in detail. Note what difference, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the specifications and drawings.

1. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
2. Include technical data, installation instructions and dimensioned drawings for products, equipment and devices installed, furnished or provided. Reference individual Division 28, Electronic Safety specification Sections for specific items required in product data submittal outside of these requirements.
3. See Division 28, Electronic Safety individual Sections for additional submittal requirements outside of these requirements.

G. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.

H. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer’s comments. Identify Engineer’s comments and provide an

individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.

I. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-10 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.

J. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 28, Electronic Safety Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical and Division 28, Electronic Safety submittals.

K. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.

L. Substitutions and Variation from Basis of Design:

1. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
2. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor are required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals." For any product marked "or approved equivalent," a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
3. Where manufacturer equipment or model numbers are indicated with no exceptions, substitutions will be rejected.

M. Shop Drawings:

1. Provide coordinated shop drawings which include physical characteristics of all systems, device layout plans, and control wiring diagrams. Reference individual Division 28, Electronic Safety specification Sections for additional requirements for shop drawings outside of these requirements.
2. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.

N. Samples: Provide samples when requested by individual Sections.

O. Resubmission Requirements:

1. Make any corrections or change in submittals when required by Architect/Engineer review comments. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
2. Resubmit for review until review indicates no exception taken or "make corrections noted."
3. When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.

P. Operation and Maintenance Manuals, Owner's Instructions:

1. Reference individual Division 28, Electronic Safety Specification Sections for additional requirements for operations and maintenance manuals.
2. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
    a. Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
    b. Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes and quantities relevant to each piece of equipment.
    c. Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub-assemblies.
    d. Include Warranty per Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Sections.
    e. Include product certificates of warranties and guarantees.
    f. Include copy of start-up and test reports specific to each piece of equipment.
    g. Include commissioning reports.
    h. Engineer will return incomplete documentation without review.
    i. Engineer will provide one set of review comments in Submittal Review format. Arrange for additional reviews; Bear costs for additional reviews at Engineer's hourly rates.
3. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 28 00 01, Electronic Safety Basic Requirements Article titled "Demonstration."
4. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.

Q. Record Drawings:

1. Maintain at site at least one set of drawings for recording “as-constructed” conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements and location of concealed items. Include items changed by addenda, field orders, supplemental instructions, and constructed conditions.
2. Record Drawings are to include equipment locations, calculations, and schedules that accurately reflect "as constructed or installed" for project.
3. At completion of project, input changes to original project on CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD disk and drawings upon substantial completion.

4. See Division 28, Electronic Safety individual Sections for additional items to include in Record Drawings.

1.09 QUALITY ASSURANCE

A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.

B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.

C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (e.g. cable tray, panels, etc.) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.

D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.

E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.

F. Provide products that are UL listed.

1.10 WARRANTY

A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.

B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.11 COORDINATION DOCUMENTS

A. Prior to construction, prepare and submit coordinated layout drawings (composite drawings), to coordinate installation and location of ductwork, grilles, diffusers, piping, fire sprinklers, plumbing, lights, and electrical services. Composite Drawings show services on single sheet. Key Drawings to structural column identification system. Prior to completion of Drawings, coordinate proposed installation with architectural and structural requirements, and other trades (including plumbing, HVAC, fire protection, electrical, ceiling suspension, and ceiling tile systems, etc.), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence. Unless otherwise required by Division 00, Procurement and Contracting Requirements and/or Division 01, General Requirements, Division 28, Electronic Safety to combine information furnished by other trades onto master coordination documents.

B. Prepare Drawings as follows:

1. Drawings in CAD Format. CAD format release equal to design documents. Drawings to be same sheet size and scale as Contract Drawings and indicate

location, size and elevation above finished floor of equipment and distribution systems.

2. Review and revise, as necessary, section cuts in Contract Drawings after verification of field conditions.
3. Indicate fittings, hangers, access panels, and elevation of bottom of cable tray above finished floor.
4. Drawings to indicate proposed ceiling grid and lighting layout as shown on electrical drawings and architectural reflected ceiling drawings and HVAC equipment, ductwork.
5. Incorporate Addenda items and change orders.
6. Provide additional coordination as requested by other trades.

C. Advise Architect in event conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.

D. Verify in field exact size, location, and clearances of existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.

E. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Articles, fixtures, and equipment of a kind to be standard product of one manufacture, including but not limited to panels, devices and equipment unless otherwise specified in individual Division 28, Electronic Safety Sections.

2.02 STANDARDS OF MATERIALS AND WORKMANSHIP

A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or FM approved or have adequate approval or be acceptable by state, county, and city authorities.

B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.

C. Hazardous Materials:

1. Comply with local, State of Oregon, and Federal regulations relating to hazardous materials.
2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.01 ACCESSIBILITY AND INSTALLATION

A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.

B. Install equipment having components requiring access (i.e., devices, equipment, electrical boxes, panels, etc.) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in

obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.

C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing and coordination with other trades and disciplines.

D. Earthwork:

1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:

a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork divisions. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.

b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.

c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.

E. Firestopping:

1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection.

2. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around conduit, raceway and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

F. Plenums: In plenums, provide plenum rated materials that meet the requirements to be installed in plenums.

3.02 SEISMIC CONTROL

A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 28 Electronic Safety Sections.

B. Earthquake resistant designs for Electronic Safety (Division 28) systems and equipment to conform to regulations of jurisdiction having authority.

C. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.

D. Provide means to prohibit excessive motion of safety equipment during earthquake.

3.03 REVIEW AND OBSERVATION

A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.

B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:

1. Prior to covering walls when electronic safety systems installation is started.
2. Prior to ceiling cover/installation.
3. When main systems, or portions of, are being tested and ready for inspection by AHJ.

C. Final Punch: Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.04 CONTINUITY OF SERVICE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements in Division 01, General Requirements, comply with individual Division 28, Electronic Safety Sections and the following:

1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
2. Prior to changing over to new system, verify that every item is thoroughly prepared. Install new wiring to point of connection.
3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
4. Organize work to minimize duration of power interruption.

3.05 CUTTING AND PATCHING

A. Confirm Cutting and Patching Requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:

1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, repair, refinish and leave in condition matching existing prior to commencement of work.
5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.06 EQUIPMENT SELECTION AND SERVICEABILITY

A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

3.07 DELIVERY, STORAGE AND HANDLING

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with the individual Division 28, Electronic Safety Sections and the following:

1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust.
2. Protect equipment and pipe to avoid damage. Close conduit openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
3. Protect devices, panels and similar items until in service.
4. Products and/or materials that become damaged due to water, dirt and/or dust as a result of improper storage to be replaced before installation.

3.08 DEMONSTRATION

A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.

B. Upon completion of work and adjustment of equipment, test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Staff as specified in Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.

C. Manufacturer's Field Services: Furnish services of a qualified factory certified instructor at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.09 CLEANING

A. Confirm cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28 Sections.

B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.10 INSTALLATION

A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.

B. Install equipment in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to building structure. Maintain manufacturer's recommended clearances.

C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

D. Provide miscellaneous supports required for installation of equipment, conduit and wiring.

3.11 PAINTING

A. Confirm Painting requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:

1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces, i.e. hangers, hanger rods, equipment stands, with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
2. In electrical and mechanical room, on roof or other exposed areas, equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
3. See individual equipment Specifications for other painting.
4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
5. Conduit: Clean, primer coat and paint interior conduit exposed in finished areas with two coats paint suitable for metallic surfaces. Color selected by Architect.

3.12 DEMOLITION

A. Confirm requirements in Division 01, General Requirements and Division 02, Existing Conditions. In the absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:

1. Scope:
   a. It is the intent of these documents to provide necessary information and adjustments to electronic safety system required to meet code, and accommodate installation of new work.
   b. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve underground utilities. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.
   c. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access, access to different areas. Owner will cooperate to best of their ability to assist in coordinated schedule, but will remain final authority as to time of work permitted.
2. Examination:
   a. Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to locate and preserve utilities. Replace damaged items with new material to match existing.
   b. Verify that abandoned wiring and equipment serve only abandoned facilities.
   c. Demolition drawings are based on casual field observation and existing record documents.
      1) Verify accuracy of information shown prior to bidding and provide such labor and material as is necessary to accomplish work.
      2) Verify location and number of electronic safety system devices, panels, etc. in field.
   d. Report discrepancies to Architect before disturbing existing installation.
3. Promptly notify Owner if systems are found which are not shown on Drawings.
4. Execution:

a. Remove existing electronic safety equipment, devices and associated wiring from walls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or demolition unless shown as retained or relocated on Drawings.

b. Provide temporary wiring and connections to maintain electrical continuity of existing systems during construction. Remove or relocate electrical boxes, conduit, wiring and equipment as encountered in removed or remodeled areas in existing construction affected by this work.

c. Remove and restore wiring which serves usable existing outlets clear of construction or demolition.

d. If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing electrical equipment which is being retained, provide new conduit and wire to bypass abandoned outlets.

e. If existing conduits pass through partitions or ceiling which are being removed or remodeled, provide new conduit and wire to reroute clear of construction or demolition and maintain service to existing load.

f. Extend circuiting and devices in existing walls to be furred out.

g. Remove abandoned wiring to source of supply.

h. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

i. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

j. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

k. Existing electronic safety system components are indicated on demolition plans. Verify exact location and number of existing devices and components in field. Only partial existing systems shown. Locations of items shown on Drawings as existing are partially based on Record and other Drawings which may contain errors. Verify accuracy of information shown prior to bidding and provide such labor and material as is necessary to accomplish intent of Contract Documents.

l. Remove abandoned wiring to leave site clean.

m. If existing electrical equipment contains PCBs (Polychlorinated Biphenyl), replace with new non-PCB equipment. Dispose of material containing PCBs as required by federal and local regulations.

n. Repair adjacent construction and finishes damaged during demolition work.

o. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

5. Existing Fire Alarm System: Maintain existing system in service during construction. Disable system only to make switchovers and connections.

a. Notify Owner before partially or completely disabling system.

b. Notify local fire service.

c. Make notifications at least five working days in advance.

d. Make temporary connections to maintain service in areas adjacent to work area.

3.13 ACCEPTANCE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:

1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
    a. Cleaning
    b. Operation and Maintenance Manuals
    c. Training of Operating Personnel
    d. Record Drawings
    e. Warranty and Guaranty Certificates
    f. Start-up/test Documents and Commissioning Reports

3.14 FIELD QUALITY CONTROL

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:

1. Tests:
    a. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in Closeout Documents.
    b. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.15 LETTER OF CONFORMANCE

A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement in letter that electronic safety systems were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in operating and maintenance manuals.

END OF SECTION

SECTION 28 31 00
FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:
   1. Fire Alarm Control Units
   2. Notification Appliance Circuit Panels
   3. Manual Pull Stations
   4. Fixed Temperature Heat Detectors
   5. Rate-of-Rise and Fixed Temperature Heat Detectors
   6. Photoelectric Type Detectors
   7. Duct-Mounted Smoke Detectors
   8. Relay Modules
   9. Control Modules
   10. Input Modules
   11. Fault Isolation Modules
   12. Combination Horn/Strobes
   13. Strobes
   14. Horns
   15. Miscellaneous Accessories

B. Scope:
   1. Provide modification and extension of the existing fire alarm system to accommodate seismic upgrade and roof replacement.
   2. Remove existing devices and appliances in areas of seismic upgrades.
   3. Relocate and extend raceway as needed to accommodate seismic upgrades and reinstall devices and appliances.
   4. Pull new wiring from nearest device/appliance as needed for extension of circuits for relocation/re-installation of devices/appliances. Splicing of wiring is not allowed.
   5. Provide new devices and appliances as needed or required by AHJ.

C. In addition, provide design for the following as required in these Contract Documents: Fire Alarm System.

D. System Design:
   1. Design Criteria: These are Contractor designed systems. Contact AHJ prior to bid to verify systems' requirements. Design systems in compliance with code as interpreted by the AHJ.
   2. Design of Fire Alarm System:
      a. Provide design of the fire alarm system as required by code.
      b. Fire Alarm Sequence of Operation: Match Existing.
      c. Supervisory Sequence of Operation: Match Existing.
      d. Trouble Sequence of Operation: Match Existing.

1.02 RELATED SECTIONS

A. Contents of Division 28, Electronic Safety and Division 01, General Requirements apply to this Section.

B. Division 26, Electrical requirements apply to this section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Beaverton School District Technical Standards(https://www.beaverton.k12.or.us/departments/facilities-development/technical-standards), Division 28, Electronic Safety and Division 01, General Requirements.

B. In addition, meet the following:

1. NFPA 72, National Fire Alarm and Signaling Code, adopted edition.
2. NFPA 70, National Electrical Code, adopted edition.

1.04 SUBMITTALS

A. Submittals as required by Division 28, Electronic Safety and Division 01, General Requirements.

B. In addition, provide:

1. Shop drawings to include the following:
    a. Provide system designer NICET certification number or Engineer's signature and seal on shop drawings.
    b. Identification of system designer and evidence of qualification or certification of designer as required by AHJ.
    c. Floor plans indicating walls, doors, partitions, room descriptions, device/component locations.
    d. Ceiling height and ceiling construction details.
    e. A symbol legend with device catalog number, description, back box size and mounting requirements.
    f. Detailed riser diagram.
    g. Device address adjacent to each device symbol. Notification appliance circuit and number adjacent to each notification appliance symbol.
    h. Point to point wiring indicating the quantity and gauge of the conductors and size of conduit/raceway used.
    i. Wiring connection diagrams for control equipment, annunciators, power supplies, chargers, initiating devices, notification appliances, components being connected to the system and interfaces to associated equipment.
    j. Battery calculations for each battery backed fire alarm control unit.
    k. Voltage drop calculations for each notification appliance circuit, indicating individual appliance current draw, conductor run length and size.
    l. Complete sequence of operation.
2. Prior to final acceptance, submit a letter confirming that inspections have been completed and system is installed and functioning in accordance with Specifications. Include manufacturer representative's certification of installation and letter of warranty.
3. Operation and Maintenance Manuals. Provide manuals containing the following:
    a. Catalog Cut Sheets
    b. System Components, Initiating Devices and Notification Appliances' Installation Sheets
    c. Manufacturer's Installation, Operation and Maintenance Manual
    d. Program Data File Printout
    e. Program Data File on Electronic Storage Media
    f. Record Drawings
    g. Record Drawings on Electronic Storage Media
    h. One year warranty agreement including parts and labor. Warranty period begins upon date of completion.

i. Record of Completion
j. Test Reports
k. Instruction Chart

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Division 28, Electronic Safety and Division 01, General Requirements.

B. In addition, meet City of Beaverton, Oregon requirements, ordinances and amendments.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Division 28, Electronic Safety and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Fire Alarm Control Units: Existing Simplex.

B. Notification Appliance Circuit Panels:
1. Same manufacturer as fire alarm control equipment.
2. Or approved equivalent.

C. Manual Pull Stations:
1. Same manufacturer as fire alarm control equipment.
2. No substitutions permitted.

D. Fixed Temperature Heat Detectors:
1. Same manufacturer as fire alarm control equipment.
2. No substitutions permitted.

E. Rate-of-Rise and Fixed Temperature Heat Detectors:
1. Same manufacturer as fire alarm control equipment.
2. No substitutions permitted.

F. Photoelectric Type Detectors:
1. Same manufacturer as fire alarm control equipment.
2. No substitutions permitted.

G. Duct-Mounted Smoke Detectors:
1. Same manufacturer as fire alarm control equipment.
2. No substitutions permitted.

H. Relay Modules:
1. Same manufacturer as fire alarm control equipment.
2. No substitutions permitted.

I. Control Modules:
1. Same manufacturer as fire alarm control equipment.
2. No substitutions permitted.

J. Input Modules:
1. Same manufacturer as fire alarm control equipment.
2. No substitutions permitted.

K. Fault Isolation Modules:
1. Same manufacturer as fire alarm control equipment.
2. No substitutions permitted.

L. Combination Horn/Strobes:

1. Must be compatible with fire alarm control equipment and notification appliance circuit panels.
2. Same manufacturer as fire alarm control equipment.
3. Or approved equivalent.

M. Strobes:
1. Must be compatible with fire alarm control equipment and notification appliance circuit panels.
2. Same manufacturer as fire alarm control equipment.
3. Or approved equivalent.

N. Horns:
1. Must be compatible with fire alarm control equipment and notification appliance circuit panels.
2. Same manufacturer as fire alarm control equipment.
3. Or approved equivalent.

O. Miscellaneous Accessories:
1. Weatherproof/Surface Backboxes:
   a. Same manufacturer as fire alarm detection devices or notification appliances.
   b. Or approved equivalent.
2. Protective Guard:
   a. Wire Guard:
      1) Same manufacturer as fire alarm control equipment.
      2) American Wire Guards
      3) Chase Security Systems
      4) Safety Technology International
      5) Shaw-Perkins
      6) Or approved equivalent.
   b. Protective Cover:
      1) Safety Technology International
      2) Or approved equivalent.
3. Circuit Conductors:
   a. Allied Wire and Cable
   b. Belden
   c. CCI
   d. West Penn Wire
   e. Or approved equivalent.
4. Surge Protection:
   a. Ditek
   b. Transtector
   c. Or approved equivalent.
5. Batteries:
   a. Same manufacturer as fire alarm control equipment.
   b. Power-Sonic
   c. Werker
   d. Or approved equivalent.
6. Locks and Keys:

a. Same manufacturer as fire alarm control equipment.

b. Or approved equivalent.

P. Substitutions:

1. For other acceptable manufacturers of specified control units, submit product data showing equivalent features and compliance with Contract Documents.

2. For substitution of products by manufacturers not listed, submit product data showing features and certification by Contractor that the design will comply with contract documents.

Q. Equipment to be supplied by a certified manufacturer representative.

2.02 FIRE ALARM CONTROL UNITS

A. Existing Simplex.

B. Power Supply: Provide power supply(s), adequate to serve control panel modules, remote annunciators, addressable devices, notification appliances and other connected devices.

C. Power Requirements:

1. Loss of 120VAC power automatically causes system to transfer to battery power. Indicate battery power operation by yellow lamp and audible annunciation at control panel and remote annunciator panels. Upon return of 120VAC power, unit recharges batteries to full capacity and maintains battery on float charge. Provide trickle charge adequate capacity to maintain battery fully charged with automatic rate charge.

2. Provide batteries in locking cabinet manufactured for purpose.

D. Addressing: Provide each initiating device with its own discrete address.

2.03 NOTIFICATION APPLIANCE CIRCUIT PANELS

A. Provide power supply(s), adequate to serve modules, remote annunciators, addressable devices, notification appliances and other connected devices or appliances.

B. Loss of normal and emergency power automatically causes system to transfer to battery power. Indicate battery power operation by yellow lamp and audible annunciation at control panel and remote annunciator panels. Upon return of 120VAC power, unit recharges batteries to full capacity and maintains battery on float charge. Provide trickle charge adequate capacity to maintain battery fully charged with automatic rate charge.

C. Provide batteries in locking cabinet manufactured for purpose.

2.04 MANUAL PULL STATIONS

A. Provide flush mounted units where installed in finished areas; in unfinished areas, surface mounted units are acceptable, unless otherwise noted.

B. Semi-flush, red finish, nongrasping operation; maximum pull strength as allowed per ADA criteria.

C. Stations do not allow closure without keyed reset.

2.05 FIXED TEMPERATURE HEAT DETECTORS

A. Provide flush mounted units where installed in finished areas; in unfinished areas, surface mounted units are acceptable, unless otherwise noted.

B. Rated 135 degrees F or 190 degrees F as required by space use.

C. Provide off-white, low-profile detectors.

2.06 RATE-OF-RISE AND FIXED TEMPERATURE HEAT DETECTORS

A. Provide flush mounted units where installed in finished areas; in unfinished areas, surface mounted units are acceptable, unless otherwise noted.

B. Responding to 15 degrees F temperature rise per minute and to 135 degrees F fixed temperature as required by space use.

C. Provide off-white, low-profile detectors.

2.07 PHOTOELECTRIC TYPE DETECTORS

A. Provide flush mounted units where installed in finished areas; in unfinished areas, surface mounted units are acceptable, unless otherwise noted.

B. Panel adjustable sensitivity, LED source, multiple cell, 360 degree smoke entry, visual latching operation indicator, insect screen, functional test switch, two-wire operation and vandal-resistant locking feature.

2.08 DUCT-MOUNTED SMOKE DETECTORS

A. Photoelectric type. Duct sampling tubes extending width of duct, visual indication of detector actuation, direct housing mount. Detector powered from control panel, power on indicator light. Detector rated for air velocity, humidity and temperature of duct and environment where installed.

2.09 RELAY MODULES

A. Signaling line circuit interface module that connects to other building systems for control of fire/life safety functions, e.g., air-handler shutdown, fire/smoke damper closure, elevator recall.

B. Module powered from control panel.

2.10 CONTROL MODULES

A. Signaling line circuit interface module that provides notification appliance circuits or system control outputs.

B. Module powered from control panel.

2.11 INPUT MODULES

A. Signaling line circuit interface module that provides initiating device circuits for connection to contact closure initiating devices.

B. Module powered from control panel.

2.12 FAULT ISOLATION MODULES

A. Signaling line circuit interface modules that provide isolation of wire-to-wire shorts on a signaling line circuit with automatic reconnection upon correction of short circuit.

B. Provide module with status indicator LED.

2.13 COMBINATION HORN/STROBES

A. Multi-candela, flush wall and ceiling mount, red finish, insect-proof.

B. Provide horn/strobes that meet the latest requirements of NFPA 72, ANSI 117.1 and UL 1971. Candela rating as required by NFPA 72.

2.14 STROBES

A. Multi-candela, flush wall and ceiling mount, red finish, insect-proof.

B. Provide strobes that meet the latest requirements of NFPA 72, ANSI 117.1 and UL 1971. Candela rating as required by NFPA 72.

2.15 HORNS

A. Flush wall and ceiling mount, red finish, insect-proof.

B. Provide horns that meet the latest requirements of NFPA 72.

2.16 MISCELLANEOUS ACCESSORIES

A. Protective Guard:

1. Wire Guard: Steel wire guard.
2. Protective Cover: Polycarbonate construction.

B. Circuit Conductors: Copper or optical fiber; color code and label. Type FPL, FPLR and FPLP as required by NEC. Minimum signaling line circuit and initiating device circuit wire size: AWG18. Minimum notification appliance circuit wire size: AWG14, or as approved by Engineer. Fiber optic cable as required by manufacturer.

C. Surge Protection: In accordance with IEEE C62.41 B3 combination waveform and NFPA 70; except for optical fiber conductors.

D. Batteries: Sealed lead acid type. Provide additional cabinet, if required due to space limitations in control panels.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Obtain Architect's approval of locations of devices, appliances and annunciators before installation.

B. Circuits:

1. Signaling Line Circuits (SLC): Class B
2. Notification Appliance Circuits (NAC): Class B.

C. Spare Capacity:

1. Notification Appliance Circuits (New Circuit): Minimum 25 percent spare current capacity. Utilize UL maximum current draw values for notification appliances. Maximum 10 percent voltage drop.
2. Notification Appliance Circuits (Adding to an Existing Circuit): Utilize UL maximum current draw values for notification appliances. Not to exceed manufacturers listed loading for the circuit and/or power supply. Voltage drop for last device must be within the manufacturers listed requirements.
3. Signaling Line Circuit: Minimum 10 percent spare capacity.

D. Power Sources:

1. Primary: Dedicated branch circuits of facility power distribution system.
2. Secondary: Storage batteries.
3. Capacity: Sufficient to operate fire alarm system under normal supervisory condition for 24 hours and operate alarm signals for five minutes at end of standby period.

E. Obtain approval of system design from AHJ prior to installation. Do not begin installation without approval from AHJ and submittal review comments from Engineer.

F. Install in accordance with applicable codes, NFPA 72, NFPA 70 and the Contract Documents.

G. In accordance with manufacturer's instructions, provide wiring, conduit and outlet boxes required for the erection of a complete system as described in these specifications, as shown on Drawings and as required by AHJ.

H. Conceal wiring, conduit, boxes and supports where installed in finished areas.

I. Provide raceway system for cabling concealed in walls and hard ceilings and in locations where cabling is exposed. Where exposed, provide surface raceway in finished areas and surface mounted EMT in non-finished areas.

J. Provide cabling and conduits system suitable for wet locations for below grade systems.

K. At junction boxes and termination points, provide identification tags on wires and cables.

L. Route wiring to avoid blocking access to equipment requiring service, access, or adjustment.

M. Existing Components:

1. Existing Fire Alarm System: Maintain fully operational during construction in all areas except areas of remodel.
2. Disable system only to make switchovers and connections.
   a. Notify Owner before partially or completely disabling system.
   b. Notify local fire service.
   c. Make notifications at least five working days in advance.

d. Make temporary connections to maintain service in areas adjacent to work area.

3. Provide fire watch in areas where the system is not functioning if required by the AHJ.

4. Equipment Removal:

a. Remove existing system after acceptance of new fire alarm system. Restore damaged surfaces.

b. Package operational fire alarm and detection equipment that has been removed and deliver to Owner.

c. Remove from site and legally dispose of remainder of existing material.

5. On-Premises Supervising Station: Include, as part of this work, modifications necessary to existing supervising station to accommodate new fire alarm work.

N. Fire Safety Systems Interfaces:

1. Provide conduit, wiring, boxes and terminations from fire alarm system to monitored components.

a. Alarm Inputs: Provide connection in accordance with NFPA 72 for the following systems and components:

1) Fire sprinkler water flow switches.

2) Other alarm inputs.

b. Supervisory Inputs: Provide connection in accordance with NFPA 72 for the following systems and components:

1) Fire sprinkler water control valve tamper switches.

2) Other supervisory inputs.

c. Trouble Inputs: Provide connection in accordance with NFPA 72 for the following systems and components:

1) Other trouble inputs.

2. Fire Safety Functions: Provide power and control conduit, wiring, boxes and terminations to power devices and interface to fire alarm system.

a. HVAC Systems:

1) Fire/Smoke Dampers and Smoke Dampers:

(a) Provide required smoke detectors, relays, wiring and the like.

(b) Connect control and power wiring to dampers per manufacturer's instructions.

(c) Verify quantities, location and requirements of dampers with Division 23, HVAC Drawings and Specifications and mechanical system installer.

2) Air Moving Systems:

(a) Provide duct-mounted smoke detectors on air systems with air flow rates exceeding 2000 CFM. Coordinate with Division 23, HVAC.

(b) Install duct-mounted smoke detector(s) on return side of air system.

(c) Provide control wiring from addressable relay contacts to air handling equipment controller. Connect to controller so that when duct-mounted smoke detector is activated, the air handling equipment is shut down.

(d) Provide duct-mounted smoke detectors rated for air velocity, temperature and humidity of duct. Verify

quantities, locations and requirements with Division 23, HVAC Drawings and mechanical system installer.

(e) Where duct-mounted smoke detectors are mounted in inaccessible building void spaces provide access hatch. Provide access hatch with fire rating equivalent to rating of wall, ceiling, or shaft being penetrated.

O. Inspection and Testing for Completion:

1. System testing and commissioning to be performed by a certified manufacturer representative.
2. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.
3. Document audibility measurements and verify intelligibility for each space on record drawings.
4. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction and adjustments.
5. Provide tools, software and supplies required to accomplish inspection and testing.
6. Prepare for testing by ensuring that work is complete and correct; perform preliminary tests as required to test system.
7. Correct defective work, adjust for proper operation and retest until entire system complies with Contract Documents.
8. Notify Owner seven days prior to beginning completion inspections and tests.
9. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
10. Diagnostic Period: After successful completion of inspections and tests, operate system in normal mode for at least 14 days without any system or equipment malfunctions.
    a. Record all system operations and malfunctions.
    b. If a malfunction occurs, start diagnostic period over after correction of malfunction.
    c. Owner will provide attendant operator personnel during diagnostic period; schedule training to allow Owner personnel to perform normal duties.
    d. At end of successful diagnostic period, complete and submit NFPA 72 "Inspection and Testing Form."

P. Owner Personnel Instruction:

1. Provide the following instruction to designated Owner personnel:
    a. Hands-On Instruction: On-site, using operational system.
    b. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.
2. Basic Operation: One-hour sessions for attendant personnel, security officers and engineering staff. Combination of classroom and hands-on refresher training; one session post-occupancy.
3. Detailed Operation: Two-hour sessions for engineering and maintenance staff. Combination of classroom and hands-on refresher training; one session post-occupancy.
4. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data and record drawings available during instruction.
5. Provide means of evaluation of trainees suitable to type of training given; report results to Owner.

Q. Closeout:

1. Closeout Demonstration:
   a. Demonstrate proper operation of functions to Owner.
   b. Be prepared to conduct any of the required tests.
   c. Have at least one copy of operation and maintenance data, copy of project record drawings, input/output matrix and operator instruction chart(s) available during demonstration.
   d. Have authorized technical representative of control unit manufacturer present during demonstration.
   e. Demonstration may be combined with inspection and testing required by AHJ. Notify AHJ in time to schedule demonstration.
   f. Repeat demonstration until successful.
2. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
   a. Specified diagnostic period without malfunction has been completed.
   b. Approved operating and maintenance data has been delivered.
   c. Spare parts, extra materials and tools have been delivered.
   d. All aspects of operation have been demonstrated to Architect.
   e. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
   f. Occupancy permit has been granted.
   g. Specified pre-closeout instruction is complete.
3. Perform post-occupancy instruction within three months after date of occupancy.

3.02 FIRE ALARM CONTROL UNITS

A. Existing Simplex.

B. Reference 3.01, General Installation Requirements.

C. Do not install cabinets or equipment below the battery cabinet. Do not locate battery and charging system cabinets in ceiling space.

D. Perform system programming at the fire alarm control panel. Program the system without shutting the system down. Programming is done off line. Update and maintain hard copy and CD-ROM copy of program at the site.

E. Room Name Labeling: Control unit schedules, programming and labeling for electrical equipment, to use the room names and room numbers that the Architect adopts at the date of substantial completion of construction. This work is to be done at no added cost to the Owner.

3.03 NOTIFICATION APPLIANCE CIRCUIT PANELS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide notification appliance circuit panel power supplies with 120VAC dedicated circuit per NFPA requirements.

D. Do not install cabinets or equipment below the battery cabinet. Do not locate battery and charging system cabinets in ceiling space.

3.04 MANUAL PULL STATIONS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

D. Provide protective guard where device is subject to abuse and where required by AHJ.

3.05 FIXED TEMPERATURE HEAT DETECTORS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

D. Provide protective guard where device is subject to abuse and where required by AHJ.

3.06 RATE-OF-RISE AND FIXED TEMPERATURE HEAT DETECTORS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

D. Provide protective guard where device is subject to abuse and where required by AHJ.

3.07 PHOTOELECTRIC TYPE DETECTORS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

D. Provide protective guard where device is subject to abuse and where required by AHJ.

3.08 DUCT-MOUNTED SMOKE DETECTORS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

3.09 RELAY MODULES

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

3.10 CONTROL MODULES

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

3.11 INPUT MODULES

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

3.12 FAULT ISOLATION MODULES

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

D. Provide Fault Isolator Modules for signaling line circuit per code requirements and manufacturer instructions.

3.13 COMBINATION HORN/STROBES

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide machine printed labels on notification appliances with appliance circuit number and sequence. Labels to be visible from the floor without magnification.

D. Provide protective guard where device is subject to abuse and where required by AHJ.

3.14 STROBES

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide machine printed labels on notification appliances with appliance circuit number and sequence. Labels to be visible from the floor without magnification.

D. Provide wire guards or protective covers where device is subject to abuse and where required by AHJ.

3.15 HORNS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide machine printed labels on notification appliances with appliance circuit number and sequence. Labels to be visible from the floor without magnification.

D. Provide protective guard where device is subject to abuse and where required by AHJ.

3.16 MISCELLANEOUS ACCESSORIES

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Weatherproof/Surface Backboxes: Provide manufacturer's weatherproof backbox listed for use in areas where the device or appliance is subject to humidity in excess of listed rating. Provide manufacturer surface backboxes where devices cannot be installed recessed.

D. Protective Guard:

1. Wire Guard.
2. Protective Cover.

E. Circuit Conductors: Provide wiring to meet the requirements of national, state and local electrical codes. Provide color coded wiring as recommended and specified by the fire alarm and detection system manufacturer. Provide Type FPLR cable when in a riser application or FPLP cable when installed in plenums.

F. Surge Protection; Equipment Connected to Alternating Current Circuits: Maximum let through voltage of 350 V(ac), line-to-neutral and 350 V(ac), line-to-line; do not use fuses.

END OF SECTION