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BASIC FIRE SUPPRESSION REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide all materials, labor and equipment required to install complete and fully operational fire protection systems as indicated by the contract drawings, this specification, and requirements of authority(ies) having jurisdiction (AHJ).
- B. Contractor shall provide complete engineering calculations and design of the fire protection system satisfying the direction and criteria of this specification and all other supporting documents and drawings.
- C. Provide the design and all materials, labor and equipment required to install a complete and fully operational fire protection system as indicated by the contract drawings and this specification.
- D. Contractor shall not compromise or diminish any existing building system, service or function in his execution of the work. Any such potential impacts shall be immediately brought to the attention of the Architect/Engineer.
- E. Obtain and pay for all permits, licenses, fees and taxes applicable to this project as required by law.
- F. Cooperate with other trades in furnishing material and information required for installation and operation of mechanical items.
- G. Requirements for the following are included:
 - 1. Related work (other Contract Documents and specification sections) that must be combined with the requirements of this Section.
 - 2. Design performance.
 - 3. Delivery, storage, and handling.
 - 4. Quality assurance and standards.
 - 5. Submittals.
 - 6. Product quality, basic type, and finishes.
 - 7. Equipment identification.
 - 8. Installation.
 - 9. Mounting and shimming.
 - 10. Inspection.
 - 11. Safety considerations.
 - 12. Cleaning, startup, and adjustments.

1.2 RELATED WORK

- A. This general section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for the project equipment and systems:
 - 1. Division 1 sections included in this Project specifications.
 - 2. The Contract.

3. General and specific mechanical specifications and drawings included in the project.
4. Section 079200 - Joint Sealants.

1.3 DEFINITIONS

- A. "Indicated": Refers to graphic representations, notes or schedules in the Drawings; or to other paragraphs or schedules in Specifications and similar requirements in the Contract Documents.
 1. Terms such as "shown", "noted", "scheduled", and "specified", are used to notify or help the user to locate reference. Location is not limited.
- B. "Directed": Terms such as "directed", "Requested", "authorized", "selected", "approved", "required", and "permitted" mean directed by Architect/Engineer, approved by Architect/Engineer and similar phrases.
- C. "Approved": When used in conjunction with Architect/Engineer's action on contract submittals, applications, requests, is limited to Architect/Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- D. "Regulations": Includes laws, ordinances, statutes and lawful orders issued by authorities having jurisdiction, as well as rules, conventions and agreements within the construction industry that control performance of Work.
- E. "Furnish": Means to supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation and similar operations.
- F. "Install": Describes operations at Project site including actual unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, supporting, isolating, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations.
- G. "Provide": Means to furnish and install.
- H. "Installer": A contractor, or another entity engaged by the contractor, either as an employee, subcontractor, or contractor of a lower tier, to perform a particular construction activity including installation, erection, application or similar operations.
 1. Installers are required to be experienced in operations they are engaged to perform.
 2. The term "experience" means having successfully completed a minimum of three previous projects similar in scope and size to this Project and within the time frame indicated in the "Quality Assurance" section of the Specifications. In addition, it means being familiar with special requirements indicated and having complied with requirements of authorities having jurisdiction.
- I. "Project Site": Is defined as the space available to the Contractor for performing construction activities, either exclusively or in conjunction with others performing other work as part of Project.

1.4 DESIGN PERFORMANCE

- A. Compliance by the Contractor and/or Vendor with the provisions of this Specification does not relieve him of the responsibilities of furnishing equipment and materials of proper design, mechanically suited to meet operating guarantees at the specified service conditions.

1.5 SUBMITTALS

- A. Product Data: Submit complete sets of manufacturer's product data for approval. Literature submitted shall clearly indicate the model number, capacity, rated operating conditions, size, weight, support requirements, electrical power requirements, utility (fuel, air, cooling water, etc.) requirements, and options furnished. Submittals shall include, but are not necessarily limited to the following;
 - 1. Fire Protection: Piping materials, valves, fittings, supports, switches, alarms, sprinkler heads, compressors, fire pumps, and the like . Provide minimum 36 x 24 size system layout shop drawings. Provide hydraulic calculations.
 - 2. Calculations: Provide for sizing of all utility services, including fire sprinkler main and all building piping; pumps head and flow sizing for all systems; thermal expansion and seismic restraints; and all other calculations consistent with good engineering practice. Include design criteria used and assumptions made.
- B. Operation and Maintenance Data: Submit complete sets of manufacturer's product data in .PDF format for approval All submittals are to be received in no more than three (3) packages. See Division 1 for more information regarding submittal requirements. Literature submitted shall clearly indicated the model number, capacity, rated operating conditions, noise levels, size, weight, support requirements, rough-in data and dimensions, electrical power requirements, wiring diagrams, and options furnished. Data shall include installation, start-up, and maintenance instructions, parts lists, and wiring diagrams.
- C. Substitutions: System design was based upon the equipment and materials listed on the drawings and specifications herein. At contractor's option, another manufacturer's equipment of similar quality, capacity and features may be submitted for prior approval per Section 012500. Prior permission to substitute does not relieve the contractor of the responsibility of including this information in the bound submittal packages.

1.6 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the provisions of the following codes, standards and specifications, except where more stringent requirements are shown or specified:
 - 1. State of Washington "IBC".
 - 2. State of Washington "IMC".
 - 3. State of Washington "UPC".
 - 4. State of Washington "IFC".
 - 5. NPC Codes and Standards including, but not limited to, NFPA 13, NFPA 14, NFPA 20, NFPA 22, and NFPA 25.
- B. Drawings: All drawings are diagrammatic and show general design, arrangement, and extent of the systems. Do not scale drawings for rough-in dimensions, nor use as shop drawings.
- C. Installer Qualifications: Company specializing in performing the work required with a minimum of five years documented experience.

1.7 DELIVERY, STORAGE AND PROTECTION

- A. Delivery: Deliver to site with manufacturer's labels intact and legible.
- B. Preparation for shipment:

1. Each unit shall be suitably prepared for the shipment specified and for storage in accordance with manufacturer's instructions in a manner requiring no disassembly prior to operation.
 2. The Contractor shall be solely responsible for the adequacy of the Preparation for Shipment provisions employed with respect to materials and application.
 3. One complete set of Installations, Operating and Maintenance Instructions shall be packed and shipped with the equipment. This set is in addition to the sets that are to be sent directly to the Owner.
- C. Handling: Avoid damage. Comply with manufacturer's installation instruction requirements for rigging, unloading and transporting units.
- D. Storage: Inside protected from weather, dirt and construction dust. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping. Cap all pipe ends. Taping pipe ends is not adequate or allowable.

1.8 PROJECT CONDITIONS

- A. General: Provide products which are compatible with other portions of the work and provide products with the proper power characteristics and similar adaptations for the project.
- B. Arrangement: Arrange piping parallel with primary lines of the building construction and with a minimum 7 feet overhead clearance in unfinished equipment rooms where possible. Conceal all piping where possible unless indicated otherwise. Locate operating and control equipment properly to provide easy access for operation and maintenance. Give right-of-way to piping which must be sloped for drainage. Set all equipment level or as recommended by manufacturer.
- C. Coordination: Where several elements of the work must be sequenced and positioned in order to fit the available space, prepare shop drawings showing the actual physical dimensions (at accurate scale) required for installation and submit prior to purchase/fabrication/installation of any of the elements involved in the coordination.

1.9 STANDARDS

- A. General: Provide all new materials and equipment, identical to apparatus or equipment in successful operation for a minimum of five years. Provide materials of comparable quality omitted here but necessary to complete the work. Maximum allowable variation from stated capacities, minus 5% to plus 10% as approved in each case.
- B. Governing Standards: The following are typical standards generally referenced in these specifications and identified by their acronym. Factory Mutual (FM), Federal Specifications (FS), American Society for Testing Materials (ASTM), American National Standards Institute (ANSI), Manufacturer's Standardization Society of the Valve and Fitting Industry, Standard Practice (MSS SP-69), Underwriters Laboratory (UL) numbers are given.

1.10 WARRANTIES

- A. Contractor shall provide a 1 year warranty on all equipment, materials and workmanship for a period of one year from the date of owner's acceptance.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 LAYOUT AND COORDINATION

- A. Site Examination: Before starting work, carefully examine site and all Contract Drawings. Become thoroughly familiar with conditions governing work on this project. Verify all indicated elevations, building measurements, rough-in dimensions and equipment locations before proceeding with any work.
- B. Utility Locations: The location of all utilities, wires, conduits, pipes, ducts, or other service facilities are shown in a general way only on the drawings and in some instances are taken from existing drawings. Ascertain whether any additional facilities other than those shown on the plans may be present and determine the exact location and elevations of all utilities prior to commencing installation.
- C. Discrepancies: Any error, conflict or discrepancy in Drawings, Specifications and/or existing conditions shall be reported immediately. Do not proceed with any questionable items of work until clarification of same has been made. Should rearrangement or re-routing of piping or ductwork be necessary, provide for approval the simplest layout possible for that particular portion of the work. Under no circumstances shall beams, girders, footings or columns be cut for mechanical items. Casting of pipes into concrete is prohibited unless so shown on Drawings.
- D. The Contractor shall cooperate with others to avoid interferences and delays in the construction work.
- E. Interference as a result of poor coordination or lack of cooperation with other trades shall be corrected at the Contractor's expense.

3.2 CONTINUITY OF EXISTING SERVICES

- A. Existing water, power, heat, ventilation, air conditioning and other services shall remain in service during new construction work. Coordinate any interruption in service during new construction work. Coordinate any interruption of these services with the Owner's representative a minimum of twenty-four (24) hours in advance.
- B. Protect from damage active utilities existing and evident by reasonable inspection of the site whether shown or not on the Drawings. Protect, relocate or abandon utilities encountered in the work which were not shown on the Drawings or evident by inspection of the work as directed by the Architect. Maintain continuity of all utility services to existing buildings.

3.3 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 1.
- B. Protection: During cutting and patching, protect adjacent installations. Provide temporary barriers to prevent the spread of dust and dirt outside of the immediate work area.

- C. Repair: Patch finished surfaces and building components using new materials to match the existing.
- D. Inspection: Upon written direction from the Architect, uncover and restore work to provide for observation of concealed work.

3.4 EQUIPMENT REMOVAL

- A. All removed equipment is the property of the Contractor unless indicated otherwise. Disconnect and remove all such equipment from the property. Cap all piping in walls, below floors, and/or above ceilings in finished rooms.
- B. Where equipment is to be reused, reconnect piping, wiring and/or controls to allow this equipment to function as it had prior to this renovation unless indicated otherwise.

3.5 MECHANICAL EQUIPMENT WIRING

- A. Provide all motor starters, control devices, and wiring complete from power source indicated on Drawings.
- B. Equipment and systems shown on the Drawings and/or specifications, are based upon requirements of specific manufacturers which are intended as somewhat typical of several makes which may be approved. Provide all field wiring and/or devices necessary for a complete and operable system controls for the actual selected equipment/system.

3.6 INSTALLATION

- A. Locating and Positioning Equipment: Observe all Codes and Regulations and good common practice in locating and installing equipment and material so that completed installation presents the least possible hazard. Maintain recommended clearances for repair and service to all equipment.
- B. Anchorage: Anchor and/or brace all mechanical equipment, piping and ductwork to resist displacement due to seismic action, include snubbers on equipment mounted on spring isolators.
- C. Where mounting heights or locations are not identified, install systems, equipment and materials to provide maximum headroom.
- D. Provide clearance for installation of insulation and access to valves, fittings, etc., on pipe systems.
- E. Install systems, materials and equipment giving right of way to systems required to be installed at a specific slope or operation by gravity.
- F. Installation shall be in accordance with the requirements of the equipment manufacturer, including special requirements for seismic restraints.
- G. Equipment Manufacturer's Responsibility and Services:
 - 1. A manufacturer's representative for major equipment and operating systems shall be provided as necessary to assist the Contractor during installation, and to provide written

- certification that the equipment has been installed as specified and in accordance with the manufacturer's representative.
2. The manufacturer's representative shall provide the initial startup of equipment in the presence of the Owner.
 - a. Provide a pre-start check of all piping, valves, control devices, control panels, and equipment.
 - b. Calibrate and adjust equipment and controls for operation at the specified design and conditions.
 - c. Provide a record of all startup events noting problems and their resolution.
 - d. Provide a record of all set points for operational controls and devices.
 3. Upon the completion of the equipment startup, provide instructional time with the Owner's personnel to review the operations and maintenance manuals and perform each step necessary for startup, shutdown, troubleshooting, and routine maintenance. The instructional time shall be scheduled through the Owner.
 4. Upon completion of the inspections, startup, testing, and checkout procedures, the equipment manufacturer shall submit written notice to the Owner that the units are ready for use by the Owner. Provide a certificate of calibration for all equipment.

3.7 MOUNTING AND SHIMMING

- A. Mount equipment as shown on the Drawings. Provisions for mounting special equipment on spring isolators, snubbers, and inertia bases are specified in Division 21.
- B. Level the equipment by means of 304 stainless steel wedges (stainless steel plates and stainless steel shims) or PVC/poly wedges in areas of extreme corrosive environments. Wedge taper shall not be greater than 1/4 inch per foot. Use double wedges to provide a level bearing surface for the equipment. Secure each pair of wedges in their final positions with one tack weld on each side after leveling is complete. Wedging shall be executed in a manner that will prevent a change in level or springing of the Baseplate when the anchor bolts are tightened.
 1. Adjust rotating equipment assemblies such that the driving units are properly aligned, plumb and level with the driven units and all interconnecting shafts and couplings.
 2. All rotating equipment shall be checked for proper alignment with dial indicators or laser after completion of grouting. The alignment must be within the tolerances required by the equipment manufacturer. The final alignment check shall be witnessed by the Owner.

3.8 INSPECTION

- A. The Contractor shall inspect his work to ensure the installation and workmanship is in accordance with these specifications and acceptable industry standards.
- B. All materials, equipment, and workmanship shall be subject to inspection at any time by the Owner. Contractor shall correct any work, materials, or equipment not in accordance with the Contract Documents.

3.9 SAFETY CONSIDERATIONS

- A. All equipment shall be installed with suitable access clearances that satisfy OSHA and code requirements for maintenance or removal of replaceable parts and components, and with

necessary unions or flanges to perform the maintenance or removal without removing the connecting appurtenances.

3.10 CLEANING, START-UP, AND ADJUSTING

- A. The Contractors shall be responsible for proper operation of all systems, minor subsystems, and services provided under this section. He shall coordinate start-up procedures, calibration, and system checkout with all project managers. Any system operational problems shall be diagnosed; all correctional procedures shall be initiated as required to bring out the system into compliance with the design, and the problem then shall be rechecked to verify that the system operates normally.
- B. Thoroughly clean all parts of the installation at the completion of the work. The Contractor shall clean up and remove from the premises all refuse material, crates, and rubbish arising from his work. All motors and bearings shall be lubricated in accordance with the manufacturer's service manuals prior to equipment start-up. Provide a lubrication schedule for every item of equipment furnished under this section. The schedule shall include the type of lubricant and the application frequency.

END OF SECTION

FIRE PROTECTION BASIC MATERIALS AND METHODS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Pipe, fittings, valves, and connections for sprinkler.
- B. Above ground piping.
- C. Pipe hangers and supports.

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 099113 - Exterior Painting: Preparation and painting of exterior fire protection piping systems.
- C. Section 099123 - Interior Painting: Preparation and painting of interior fire protection piping systems.
- D. Section 211200 - Fire-Suppression Standpipes: Standpipe design.
- E. Section 211300 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.

1.3 REFERENCE STANDARDS

- A. ASME A112.18.1 - Plumbing Supply Fittings; 2024.
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2026.
- C. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2021.
- D. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard; 2025.
- E. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings; 2024.
- F. ASME B16.25 - Buttwelding Ends; 2022.
- G. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025, with Errata.
- H. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- I. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

- J. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe; 2021.
- K. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2021.
- L. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2024.
- M. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.
- N. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.
- O. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2023.
- P. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- Q. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; 2024.
- R. UL (DIR) - Online Certifications Directory; Current Edition.
- S. UL 262 - Gate Valves for Fire-Protection Service; Current Edition, Including All Revisions.
- T. UL 312 - Check Valves for Fire-Protection Service; Current Edition, Including All Revisions.
- U. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information. Indicate valve data and ratings.
- C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, and floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections. Shop drawings shall be minimum 36 x 24 size.
- D. Project Record Documents: Record actual locations of components and tag numbering.
- E. Operation and Maintenance Data: Include installation instructions and spare parts lists.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section.
 - 1. Minimum three years experience.

- C. Comply with FM (AG), UL (DIR), and ITS (DIR) or Warnock Hersey requirements.
- D. Valves: Bear FM (AG), UL (DIR), and ITS (DIR) or Warnock Hersey product listing label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- E. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.
- F. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers, with labeling in place.
- 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.

1.7 WARRANTY

- A. See Section 017700 - Closeout Procedures for additional warranty requirements.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Sprinkler-based System:
 - 1. Comply with NFPA 13.
 - 2. See Section 211300.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.
- C. Provide system pipes, fittings, sleeves, escutcheons, seals, and other related accessories.

2.2 ABOVE GROUND PIPING

- A. Steel Pipe: ASTM A795 Schedule 10, ASTM A53 Schedule 40, ASTM A135/A135M Schedule 10, ASTM A135/A135M UL listed light wall type, or ASTM A795 Schedule 40, Black or Galvanized.
 - 1. Steel Fittings: ASME B16.9 wrought steel, buttwelded, ASME B16.25 buttweld ends, ASTM A234/A234M wrought carbon steel or alloy steel, ASME B16.5 steel flanges and fittings, or ASME B16.11 forged steel socket welded and threaded.
 - 2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
 - 3. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
 - 4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

5. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.

2.3 FLEXIBLE SPRINKLER HOSE FITTINGS

- A. FlexHead Industries flexible sprinkler connections.

2.4 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable Iron or Carbon Steel, adjustable swivel, split ring.
- B. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
- C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- D. Vertical Support: Steel riser clamp or Angle ring.
- E. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

2.5 GATE VALVES

- A. Up to and including 2 inches:
 1. Bronze body, bronze trim, rising stem, handwheel, solid wedge or disc, threaded ends.
- B. Over 2 inches:
 1. Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, handwheel, OS&Y, solid rubber covered bronze or cast iron wedge, flanged ends.
- C. Over 4 inches:
 1. Iron body, bronze trim, non-rising stem with bolted bonnet, solid bronze wedge, flanged ends, iron body indicator post assembly.

2.6 ANGLE VALVES

- A. Up to and including 2 inches:
 1. Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable rubber disc, threaded ends, with backseating capacity repackable under pressure.
- B. Over 2 inches:
 1. Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

2.7 BALL VALVES

- A. Up to and including 2 inches:
 1. Bronze two piece body, brass, chrome plated bronze, or stainless steel ball, teflon seats and stuffing box ring, lever handle and balancing stops, threaded ends with union.

2.8 CHECK VALVES

- A. Up to and including 2 inches:
 - 1. Bronze body and swing disc, rubber seat, threaded ends.
- B. Over 2 inches:
 - 1. Iron body, bronze trim, swing check with rubber disc, renewable disc and seat, flanged ends with automatic ball check.
- C. 4 inches and Over:
 - 1. Iron body, bronze disc, stainless steel spring, resilient seal, threaded, wafer, or flanged ends.

2.9 DRAIN VALVES

- A. Ball Valve:
 - 1. Brass with cap and chain, 3/4 inch hose thread.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, to not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. 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.
- G. Pipe Hangers and Supports:

1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 2. Place hangers within 12 inches of each horizontal elbow.
 3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 6. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
 - a. Painting of interior fire suppression systems is specified in Section 099123.
 - b. Painting of exterior fire suppression systems is specified in Section 099113.
- H. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- I. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
 1. Painting of interior fire suppression systems is specified in Section 099123.
 2. Painting of exterior fire suppression systems is specified in Section 099113.
- J. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.
- K. Die-cut threaded joints with full-cut, standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
- L. Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.
- M. Provide gate or ball valves for shut-off or isolating service.
- N. Provide drain valves at main shut-off valves, low points of piping and apparatus.
- O. The fire sprinkler contractor shall coordinate and provide for the location of all fire sprinkler drain piping and drain receptor piping, whether or not indicated on the contract documents. The routing of low point drains to any location where there is no drain receptor is NOT acceptable.

END OF SECTION

FIRE-SUPPRESSION SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wet-pipe sprinkler system.
- B. System design, installation, and certification.

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 083343 - Overhead Coiling Fire and Smoke Curtains.
- C. Section 210500 - Fire Protection Basic Materials and Methods: Pipe and fittings.
- D. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.
- E. Section 284600 - Fire Detection and Alarm.

1.3 REFERENCE STANDARDS

- A. FM (AG) - FM Approval Guide; Current Edition.
- B. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).
- C. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).
- D. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).
- E. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.
- F. ITS (DIR) - Directory of Listed Products; Current Edition.
- G. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies; 2025.
- I. NFPA 1963 - Standard for Fire Hose Connections; 2019.
- J. UL (DIR) - Online Certifications Directory; Current Edition.

- K. UL 405 - Standard for Safety Fire Department Connection Devices; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.5 SUBMITTALS

- A. See Section 013300 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Shop Drawings:
 - 1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
 - 2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components, and accessories. Indicate system controls.
 - 3. Submit shop drawings, product data, and hydraulic calculations to Authorities Having Jurisdiction for approval. Submit proof of approval to Architect/Engineer.
 - 4. Shop drawings shall be minimum 36" x 24".
- D. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.
- E. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements for additional provisions.
 - 2. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
 - 3. Sprinkler Wrenches: For each sprinkler type.
- G. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

1.6 QUALITY ASSURANCE

- A. Maintain one copy of referenced design and installation standard on site.
- B. Comply with UL (DIR) requirements.
- C. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in Washington.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

- E. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience and approved by manufacturer.
- F. Equipment and Components: Provide products that bear UL (DIR) label or marking.
- G. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.1 SPRINKLER SYSTEM

- A. Sprinkler System: Provide coverage for renovation area.
- B. Occupancy: Light hazard. Verify classification with NFPA 13 and comply with all applicable NFPA 13 requirements.
- C. Water Supply: Determine volume and pressure from water flow test data.
 - 1. If test data is not available, assume 2000 gpm at 20 psig.
 - 2. Revise design when test data available prior to submittals.
- D. Interface system with building fire and smoke alarm system.
- E. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.
- F. Pipe Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
 - 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 - 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 - 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 - 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 - 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
 - 6. Other Types: As required.
 - 7. Manufacturers:
 - a. Powers Fasteners, Inc www.powers.com/#sle.
 - b. Substitutions: See Section 012500 - Substitution Procedures.

2.2 SPRINKLERS

- A. Suspended Ceiling Type: Semi-recessed pendant type with matching push on escutcheon plate.
 - 1. Response Type: Quick or Standard.
 - 2. Coverage Type: Standard or Extended.
 - 3. Finish: Chrome plated.
 - 4. Escutcheon Plate Finish: Chrome plated.

5. Fusible Link: Fusible solder link type or Glass bulb type temperature rated for specific area hazard.
 6. Manufacturers:
 - a. Tyco Fire Protection Products: www.tyco-fire.com/#sle.
 - b. Reliable: www.reliablesprinkler.com.
 - c. Viking.
- B. Exposed Area Type: Standard type.
1. Response Type: Quick or Standard.
 2. Coverage Type: Standard or Extended.
 3. Finish: Brass.
 4. Fusible Link: Fusible solder link type or Glass bulb type temperature rated for specific area hazard.
 5. Manufacturers:
 - a. Tyco Fire Protection Products: www.tyco-fire.com/#sle..
 - b. Viking.
 - c. Reliable: www.reliablesprinkler.com.
- C. Sidewall Type: Recessed horizontal sidewall type with matching push on escutcheon plate.
1. Response Type: Quick or Standard.
 2. Coverage Type: Standard or Extended .
 3. Finish: Chrome plated.
 4. Escutcheon Plate Finish: Chrome plated.
 5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
 6. Manufacturers:
 - a. Tyco Fire Protection Products: www.tyco-fire.com/#sle..
 - b. Viking.
 - c. Reliable: www.reliablesprinkler.com.
- D. Dry Sprinklers: Recessed pendant type with matching push on escutcheon plate.
1. Response Type: Quick or Standard.
 2. Coverage Type: Standard or Extended.
 3. Finish: Brass.
 4. Cover Plate Finish: Brass.
 5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
 6. Manufacturers:
 - a. Viking.
 - b. Tyco Fire Protection Products: www.tyco-fire.com/#sle..
 - c. Reliable: www.reliablesprinkler.com.

2.3 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber-faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:
1. Activate electric alarm.
 2. Test and drain valve.
- B. Electric Alarm: Electrically operated red enameled gong with pressure alarm switch.

- C. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.
 - 1. Manufacturers:
 - a. Grinnel:Model VSR-1.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with referenced NFPA design and installation standard.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Install buried shut-off valves in valve box. Provide post indicator.
- D. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.
- E. Locate outside alarm gong on building wall as indicated.
- F. Place pipe runs to minimize obstruction to other work.
- G. Place piping in concealed spaces above finished ceilings.
- H. Center sprinklers in one direction only in ceiling tile with location in other direction variable, dependent upon spacing and coordination with ceiling elements.
- I. Provide oversized escutcheons on all sprinklers to allow for seismic movement.
- J. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- K. Flush entire piping system of foreign matter.
- L. Hydrostatically test entire system.
- M. Require test be witnessed by Fire Marshal and Architect/Engineer.

3.2 INTERFACE WITH OTHER PRODUCTS

- A. Ensure required devices are installed and connected as required to fire alarm system.

3.3 START-UP AND TESTING

- A. Starting Procedures: Follow manufacturer's written procedures. If no procedures are prescribed by manufacturer, proceed as follows:
 - 1. Verify that specialty valves, trim, fittings, controls, and accessories have been installed correctly and operate correctly.
 - 2. Verify that specified tests of piping are complete.

Fire-Suppression Sprinkler Systems

3. Check that damaged sprinkler and sprinklers with paint or coating not specified have been replaced with new, correct type of sprinklers.
4. Check that sprinklers are correct type, have correct finish and temperature ratings, and have guards where required for applications.
5. Check that potable water supplies have correct type of backflow preventer.
6. Check that hose valves and fire department connections have threads compatible with local fire department equipment and have correct pressure rating.
7. Fill wet-pipe sprinkler systems with water.
8. Energize circuits to electrical equipment and devices.
9. Adjust operating controls and pressure settings.

3.4 DEMONSTRATION

- A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.
- B. Schedule demonstration with at least 7 days advance notice.

END OF SECTION

BASIC PLUMBING REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. This Section specifies the basic requirements for all Contractor installed equipment. It applies to all sections included in Division 22. The requirements herein are an expansion upon the requirements of Division 1.
- B. Provide all materials, labor and equipment required to install complete and fully operational plumbing systems as indicated by the contract drawings and this specification.
- C. Obtain and pay for all permits, licenses, fees and taxes applicable to this project as required by law.
- D. Cooperate with other trades in furnishing material and information required for installation and operation of mechanical items.
- E. Requirements for the following are included:
 - 1. Related work (other Contract Documents and specification sections) that must be combined with the requirements of this Section.
 - 2. Design performance.
 - 3. Delivery, storage, and handling.
 - 4. Quality assurance and standards.
 - 5. Submittals.
 - 6. Product quality, basic type, and finishes.
 - 7. Equipment identification.
 - 8. Excavation and backfill.
 - 9. Installation.
 - 10. Mounting and shimming.
 - 11. Inspection.
 - 12. Safety considerations.
 - 13. Cleaning, startup, and adjustments.

1.2 RELATED WORK

- A. This general section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for the project equipment and systems:
 - 1. Division 1 sections included in this Project specifications.
 - 2. The Contract.
 - 3. General and specific mechanical specifications and drawings included in the project.

1.3 DEFINITIONS

- A. "Indicated": Refers to graphic representations, notes or schedules in the Drawings; or to other paragraphs or schedules in Specifications and similar requirements in the Contract Documents.

1. Terms such as “shown”, “noted”, “scheduled”, and “specified”, are used to notify or help the user to locate reference. Location is not limited.
- B. “Directed”: Terms such as “directed”, “Requested”, “authorized”, “selected”, “approved”, “required”, and “permitted” mean directed by Architect/Engineer, approved by Architect/Engineer and similar phrases.
- C. “Approved”: When used in conjunction with Architect/Engineer's action on contract submittals, applications, requests, is limited to Architect/Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- D. “Regulations”: Includes laws, ordinances, statutes and lawful orders issued by authorities having jurisdiction, as well as rules, conventions and agreements within the construction industry that control performance of Work.
- E. “Furnish”: Means to supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation and similar operations.
- F. “Install”: Describes operations at Project site including actual unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, supporting, isolating, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations.
- G. “Provide”: Means to furnish and install.
- H. “Installer”: A contractor, or another entity engaged by the contractor, either as an employee, subcontractor, or contractor of a lower tier, to perform a particular construction activity including installation, erection, application or similar operations.
 1. Installers are required to be experienced in operations they are engaged to perform.
 2. The term “experience” means having successfully completed a minimum of three previous projects similar in scope and size to this Project and within the time frame indicated in the “Quality Assurance” section of the Specifications. In addition, it means being familiar with special requirements indicated and having complied with requirements of authorities having jurisdiction.
- I. “Project Site”: Is defined as the space available to the Contractor for performing construction activities, either exclusively or in conjunction with others performing other work as part of Project.

1.4 DESIGN PERFORMANCE

- A. Compliance by the Contractor and/or Vendor with the provisions of this Specification does not relieve him of the responsibilities of furnishing equipment and materials of proper design, mechanically suited to meet operating guarantees at the specified service conditions.

1.5 SUBMITTALS

- A. Product Data: Submit complete sets of manufacturer's product data in .PDF format for approval. All submittals are to be received in no more than (3) three packages. See Division 1 for further information regarding submittal requirements. Literature submitted shall clearly indicate the model number, capacity, rated operating conditions, noise levels, size, weight, support requirements, rough-in data and dimensions, electrical power requirements, wiring

diagrams, utility (fuel, air, cooling water, etc.) requirements, and options furnished. Submittals shall include, but are not necessarily limited to the following;

1. Plumbing: Piping and insulation; Plumbing fixtures, including trim; insulation; valves; hangers and supports; equipment bases; isolators; water heaters; booster pumps and the like.
- B. Operation and Maintenance Data: Submit three complete sets of manufacturer's literature in .PDF format for approval. Data shall include installation, start-up, and maintenance instructions, parts lists, and wiring diagrams. Include all material on a CD-ROM or USB device.
- C. Substitutions: System design was based upon the equipment and materials listed on the drawings and specifications herein. At contractor's option, another manufacturer's equipment of similar quality, capacity and features may be submitted for prior approval per Section 012500. Prior permission to substitute does not relieve the contractor of the responsibility of including this information in the bound submittal packages.

1.6 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the provisions of the following codes, standards and specifications, except where more stringent requirements are shown or specified:
 1. State of Washington "IBC".
 2. State of Washington "IMC".
 3. State of Washington "UPC".
 4. State of Washington "IFC".
 5. ANSI/ASHRAE 90 - "Energy Efficient Design of New Buildings...."
 6. ANSI B31.9 "Building Service Piping".
 7. NFPA 54 and NFPA 90B.
- B. Drawings: All drawings are diagrammatic and show general design, arrangement, and extent of the systems. Do not scale drawings for rough-in dimensions, nor use as shop drawings.
- C. Installer Qualifications: Company specializing in performing the work required with a minimum of five years documented experience.
- D. Contractor shall furnish and install all work in accordance with manufacturers' recommendations and instructions.

1.7 DELIVERY, STORAGE AND PROTECTION

- A. Delivery: Deliver to site with manufacturer's labels intact and legible.
- B. Preparation for shipment:
 1. Each unit shall be suitably prepared for the shipment specified and for storage in accordance with manufacturer's instructions in a manner requiring no disassembly prior to operation.
 2. The Contractor shall be solely responsible for the adequacy of the Preparation for Shipment provisions employed with respect to materials and application.
 3. One complete set of Installations, Operating and Maintenance Instructions shall be packed and shipped with the equipment. This set is in addition to the sets that are to be sent directly to the Owner.

- C. Handling: Avoid damage. Comply with manufacturer's installation instruction requirements for rigging, unloading and transporting units.
- D. Storage: Inside protected from weather, dirt and construction dust. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping. Cap all pipe ends. Taping pipe ends is not adequate or allowable.

1.8 PROJECT CONDITIONS

- A. General: Provide products which are compatible with other portions of the work and provide products with the proper power characteristics and similar adaptations for the project.
- B. Arrangement: Arrange piping parallel with primary lines of the building construction and with a minimum 7 feet overhead clearance in unfinished equipment rooms where possible. Conceal all piping where possible unless indicated otherwise. Locate operating and control equipment properly to provide easy access for operation and maintenance. Give right-of-way to piping which must be sloped for drainage. Set all equipment level or as recommended by manufacturer.
- C. Coordination: Where several elements of the work must be sequenced and positioned in order to fit the available space, prepare shop drawings showing the actual physical dimensions (at accurate scale) required for installation and submit prior to purchase/fabrication/installation of any of the elements involved in the coordination.

1.9 STANDARDS

- A. General: Provide all new materials and equipment, identical to apparatus or equipment in successful operation for a minimum of five years. Provide materials of comparable quality omitted here but necessary to complete the work. Maximum allowable variation from stated capacities, minus 5% to plus 10% as approved in each case.
- B. Governing Standards: The following are typical standards generally referenced in these specifications and identified by their acronym. Federal Specifications (FS), American Society for Testing Materials (ASTM), American National Standards Institute (ANSI), Manufacturer's Standardization Society of the Valve and Fitting Industry, Standard Practice (MSS SP-69), Cast Iron Soil Pipe Institute (CISPI), Underwriters Laboratory (UL) numbers are given.

1.10 WARRANTIES

- A. Contractor shall provide a 1 year warranty on all equipment, materials and workmanship for a period of one year from the date of owner's acceptance.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 LAYOUT AND COORDINATION

- A. Site Examination: Before starting work, carefully examine site and all Contract Drawings. Become thoroughly familiar with conditions governing work on this project. Verify all

indicated elevations, building measurements, rough-in dimensions and equipment locations before proceeding with any work.

- B. Utility Locations: The location of all utilities, wires, conduits, pipes, ducts, or other service facilities are shown in a general way only on the drawings and in some instances are taken from existing drawings. Ascertain whether any additional facilities other than those shown on the plans may be present and determine the exact location and elevations of all utilities prior to commencing installation.
- C. Discrepancies: Any error, omission, conflict or discrepancy in Drawings, Specifications and/or existing conditions shall be reported immediately. Do not proceed with any questionable items of work until clarification of same has been made. Should rearrangement or re-routing of piping or ductwork be necessary, provide for approval the simplest layout possible for that particular portion of the work. Under no circumstances shall beams, girders, footings or columns be cut for mechanical items. Casting of pipes into concrete is prohibited unless so shown on Drawings.
- D. The Contractor shall cooperate with others to avoid interferences and delays in the construction work.
- E. Interference as a result of poor coordination or lack of cooperation with other trades shall be corrected at the Contractor's expense.

3.2 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 1.
- B. Protection: During cutting and patching, protect adjacent installations. Provide temporary barriers to prevent the spread of dust and dirt outside of the immediate work area.
- C. Repair: Patch finished surfaces and building components using new materials to match the existing.
- D. Inspection: Upon written direction from the Architect, uncover and restore work to provide for observation of concealed work.

3.3 EXCAVATION AND BACKFILL

- A. General: Perform all necessary excavation and backfill required for the installation of mechanical work. Any piping or other work damaged by the Contractor's operations shall be repaired at the Contractor's expense.
- B. Water: Keep all excavations free of standing water. Excavations damaged or softened by water or frost shall be re-excavated and filled back to original level with approved material at the Contractor's expense.
- C. Test: During the progress of the work for compacted fill, the Owner reserves the right to request compaction tests made under the direction of a testing laboratory.

- D. Trench Excavation: Excavate trenches to the necessary depth and width, removing rocks, unstable soil (silt, peat, etc.) roots and stumps. Width of trench shall be adequate for proper installation of piping or conduit.
- E. Foundation and Bedding:
 - 1. Proper preparation of foundation, placement of foundation material where required, and placement of bedding material shall precede the installation of the pipe. This shall include leveling of the trench bottom as well as placement and compaction of required bedding material to a uniform grade so that piping rests upon a continuous and uniform bedding.
 - 2. Where excavation has been made below the required grade, the Contractor shall provide, place and compact suitable bedding material to restore the proper grade elevation.
- F. Provide tracer wire over top of piping.
 - 1. Construction:
 - a. Conductor: Solid or stranded copper per spec ASTM B3.
 - b. Insulation: High Molecular Weight Polyethylene (HMWPE) ASTM D-1248. Various insulation colors dependant on usage.
 - c. Temperature: 70 degrees C dry and wet.
 - d. Voltage: 20 and 30 Mil = 30 to 300 volts. 45 Mil = 600 volts.
- G. Backfilling: Upon acceptance of installed piping systems, trenches shall be backfilled in lifts. Backfill material shall be placed and compacted in lifts not to exceed 6 inches in depth to a height of 1 inch above the top of trench. Backfill shall be placed to obtain contact with the entire periphery of the pipe without disturbing pipe placement.
- H. Compaction: One of the following methods or combination thereof shall be required; 1) Mechanical Tamper or Vibratory Compactor. Compaction shall be sufficient to attain 95% of maximum density at optimum moisture content. Water "puddling" or "washing" is prohibited.
- I. Bedding/Backfill Material: Where native material has been removed, necessary foundation material consisting of 3/4 inch minus crushed rock or fill sand shall be placed and compacted to form a firm base of the required thickness. Backfill material shall be the same. Follow the pipe manufacturer's installation instructions when specified materials are specifically prohibited.

3.4 EQUIPMENT REMOVAL

- A. All removed equipment is the property of the Contractor unless indicated otherwise. Disconnect and remove all such equipment from the property. Cap all piping in walls, below floors, and/or above ceilings in finished rooms.
- B. Where equipment is to be reused, reconnect piping, wiring and/or controls to allow this equipment to function as it had prior to this renovation unless indicated otherwise.

3.5 MECHANICAL EQUIPMENT WIRING

- A. Provide all motor starters, control devices, and wiring complete from power source indicated on Drawings.

- B. Equipment and systems shown on the Drawings and/or specifications, are based upon requirements of specific manufacturers which are intended as somewhat typical of several makes which may be approved. Provide all field wiring and/or devices necessary for a complete and operable system controls for the actual selected equipment/system.

3.6 INSTALLATION

- A. Locating and Positioning Equipment: Observe all Codes and Regulations and good common practice in locating and installing mechanical equipment and material so that completed installation presents the least possible hazard. Maintain recommended clearances for repair and service to all equipment.
- B. Anchorage: Anchor and/or brace all mechanical equipment, piping to resist displacement due to seismic action, include snubbers on equipment mounted on spring isolators.
- C. Where mounting heights or locations are not identified, install systems, equipment and materials to provide maximum headroom.
- D. Provide clearance for installation of insulation and access to valves, fittings, damper actuators, etc. on pipe and duct systems.
- E. Install systems, materials and equipment giving right of way to systems required to be installed at a specific slope or operation by gravity.
- F. Provide condensate drain piping to over nearest floor drain for all coils, furnaces, boilers, domestic water heaters and the likes.
- G. Flush clean and disinfect domestic water system.
- H. Provide chrome plated rigid or flexible supplies to fixtures with stops, reducers, and escutcheons.
- I. Provide trap primers and piping for floor drains and floor sinks.
- J. Installation shall be in accordance with the requirements of the equipment manufacturer, including special requirements for seismic restraints.
- K. Equipment Manufacturer's Responsibility and Services:
 - 1. A manufacturer's representative for major equipment and operating systems shall be provided as necessary to assist the Contractor during installation, and to provide written certification that the equipment has been installed as specified and in accordance with the manufacturer's representative.
 - 2. The manufacturer's representative shall provide the initial startup of equipment in the presence of the Owner.
 - a. Provide a pre-start check of all piping, valves, control devices, control panels, and equipment.
 - b. Calibrate and adjust equipment and controls for operation at the specified design and conditions.
 - c. Provide a record of all startup events noting problems and their resolution.
 - d. Provide a record of all set points for operational controls and devices.

3. Upon the completion of the equipment startup, provide instructional time with the Owner's personnel to review the operations and maintenance manuals and perform each step necessary for startup, shutdown, troubleshooting, and routine maintenance. The instructional time shall be scheduled through the Owner.
4. Upon completion of the inspections, startup, testing, and checkout procedures, the equipment manufacturer shall submit written notice to the Owner that the units are ready for use by the Owner. Provide a certificate of calibration for all equipment.

3.7 MOUNTING AND SHIMMING

- A. Mount equipment as shown on the Drawings. Provisions for mounting special equipment on spring isolators, snubbers, and inertia bases are specified in Section 220548, Vibration Isolation and Sound and Seismic Controls for Plumbing Piping and Equipment.
- B. Level the equipment by means of 304 stainless steel wedges (stainless steel plates and stainless steel shims). Wedge taper shall not be greater than 1/4 inch per foot. Use double wedges to provide a level bearing surface for the equipment. Secure each pair of wedges in their final positions with one tack weld on each side after leveling is complete. Wedging shall be executed in a manner that will prevent a change in level or springing of the Baseplate when the anchor bolts are tightened.
 1. Adjust rotating equipment assemblies such that the driving units are properly aligned, plumb and level with the driven units and all interconnecting shafts and couplings.
 2. All rotating equipment shall be checked for proper alignment with dial indicators or laser after completion of grouting. The alignment must be within the tolerances required by the equipment manufacturer. The final alignment check shall be witnessed by the Owner.

3.8 INSPECTION

- A. The Contractor shall inspect his work to ensure the installation and workmanship is in accordance with these specifications and acceptable industry standards for the work being done.
- B. All materials, equipment, and workmanship shall be subject to inspection at any time by the Owner. Contractor shall correct any work, materials, or equipment not in accordance with the Contract Documents.

3.9 SAFETY CONSIDERATIONS

- A. All equipment shall be installed with suitable access clearances that satisfy OSHA and code requirements for maintenance or removal of replaceable parts and components, and with necessary inions or flanges to perform the maintenance or removal without removing the connecting appurtenances.
- B. Where equipment requiring periodic maintenance cannot be reached by normal walkways because of interference with ductwork, piping, or other obstructions the Contractor shall notify the Owner and propose an alternate safe means of access. These may include construction of an overhead platform with stairway or ladder ends and safety railings or handholds, or walk-through duct plenums with hinged access doors, or as required to meet OSHA standards for safe maintenance procedures.

3.10 CLEANING, START-UP, AND ADJUSTING

- A. The Contractors shall be responsible for proper operation of all systems, minor subsystems, and services provided under this section. He shall coordinate start-up procedures, calibration, and system checkout with all project managers. Any system operational problems shall be diagnosed; all correctional procedures shall be initiated as required to bring out the system into compliance with the design, and the problem then shall be rechecked to verify that the system operates normally.
- B. Thoroughly clean all parts of the installation at the completion of the work. The Contractor shall clean up and remove from the premises all refuse material, crates, and rubbish arising from his work. Remove, clean, and reinstall all filters. Belt-drive tensions and alignments shall be checked. All motors and bearings shall be lubricated in accordance with the manufacturer's service manuals prior to equipment start-up. Provide a lubrication schedule for every item of equipment furnished under this section. The schedule shall include the type of lubricant and the application frequency.

END OF SECTION

METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pressure Gauges and Pressure Gauge Tappings.
 - 1. Bourdon tube for liquids and gases.
- B. Thermometers and Thermometer Wells.
- C. Pressure-Temperature test plugs.

1.2 RELATED REQUIREMENTS

- A. Section 221005 - Plumbing Piping.

1.3 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2025).
- C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- D. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2024.
- E. AWWA C701 - Cold-Water Meters -- Turbine Type, for Customer Service; 2024.
- F. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold- Water Meters; 2010.
- G. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2026.
- H. NSF 61 - Drinking Water System Components - Health Effects; 2025, with Addendum
- I. NSF 372 - Drinking Water System Components - Lead Content; 2024.
- J. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.
- K. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013300 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

- C. Project Record Documents: Record actual locations of components and instrumentation.
- D. Operation and Maintenance Data: See Section 017700 - Closeout Procedures.

PART 2 PRODUCTS

2.1 PRESSURE GAUGES

- A. Manufacturers:
 - 1. Weksler Glass Thermometer Corp; Model 401: www.wekslerglass.com/#sle.
 - 2. Tretice; Model 700 Series: www.tretice.com.
 - 3. Ametek (U.S.Gauge); Model Series 540: www.ameteusg.com.
 - 4. Marshalltown: www.marshalltown.com.
 - 5. Weiss: www.weissinstruments.com
 - 6. Ashcroft, Inc: www.ashcroft.com.
 - 7. Substitutions: See Section 012500 - Substitution Procedures.
- B. Bourdon Tube for Liquids and Gases:
 - 1. Dial Size and Cover: 4-1/2 inch diameter scale with safety glass window.
 - 2. Dial Text and Markings: Black color on white background with scaled units.
 - 3. Accuracy: ASME B40.100, adjustable industrial grade (A) with 1 percent at mid-range of span.
 - 4. Process Connection: Lower-back, 1/4 inch NPT male except where noted.
 - 5. Corrosion Resistant Gauge Wetted Materials: Painted steel case and brass socket rated to match process pressure and temperature range.
 - 6. Comply with UL 393 when used for fire protection service or UL 404 when used for compressed gas service.
- C. Accessories:
 - 1. Gauge Cock: Brass with tee or lever handle for maximum 150 psi.
 - 2. Needle Valve: Brass, 1/4 inch NPT female for noncorrosive service.
 - 3. Siphon: 213 seamless steel, 1/4 inch NPT male for rated capacity.
 - 4. Pressure Snubber (Pulsation Damper): Brass, 1/4 inch NPT male.
 - 5. Diaphragm Seal: 316L Stainless steel wetted material rated at 125 psi (8.6 bar), threaded. Select top size to match gauge size.

2.2 THERMOMETERS

- A. Manufacturers:
 - 1. Weiss Instruments, LLC: www.weissinstruments.com/#sle.
 - 2. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
 - 3. Tretice & Ametek.
 - 4. Substitutions: See Section 012500 - Substitution Procedures.
- B. General:
 - 1. Product Compliance: ASTM E1.
 - 2. Lens: Clear glass, except where stated.
 - 3. Accuracy: Two percent, when tested in accordance with ASTM E77, except where stated.

4. Scale: Black markings depicting single scale in degrees F where expected process value falls half-span of standard temperature range.
- C. Thermometers - Straight with 90-degree Back Angled Stem: 9 inch v-shape aluminum case with clear glass window scale, 2 inch NPT stem, 3-1/4 inch NPT thermowell, and red or blue non-toxic organic liquid filled glass tube.
- D. Thermometers - Adjustable Angle: 9 inch v-shape aluminum case with clear glass window scale, 3-1/2 inch NPT stem, red or blue organic non-toxic liquid filled glass tube, and adjustable joint with positive locking device allowing 360 degrees in horizontal plane or 180 degrees in vertical plane adjustments.
- E. Thermometers - Dial Type:
 1. Adjustable Angle: 5 inch diameter dial with black pointer, stainless steel case, silicone damping bimetal element, hermetically sealed lens, recalibrating screw, and 2-1/2 inch NPT stem.

2.3 PRESSURE-TEMPERATURE TEST PLUGS:

- A. Size: 500 psi capacity; 1/2 inch MPT brass fitting with gasket, cap, and retaining strap for 1/8 inch pressure gauge or temperature probe.
- B. Wetted Materials per Temperature Range:
 1. Up to 200 degrees F: Brass (lead free) probe with neoprene core.
- C. Accessories: Lead-free brass, ball valve, bar stock needle (valve), lever-handle cock, heavy-duty tee handle cock, siphon, snubber-filter, and tee-handle cock.
- D. Test Kit: Internally padded carrying case fitted with two 2-1/2 inch diameter pressure gauges, adapters, two 1/8 inch probes, and 1-1/2 inch dual-scale dial thermometers.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify Utility Service Provider piping readiness to receive meter.
- B. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports, and test plugs.

3.2 INSTALLATION

- A. Install pressure gauges as follows:
 1. At Pumps: Place single gauge before strainer, suction side and discharge side.
 2. Include gauge cock and pressure snubber (pulsation-damper) to isolate each gauge and extend nipples for insulation clearance.
 3. Include siphons on high temperature systems and select type according to service rating.
 4. Adjust gauges to selected viewing angle, clean thoroughly, and calibrate to zero.
- B. Install thermometers as follows:

Meters and Gauges for Plumbing Piping

1. Hot Water Heaters: Place upstream and downstream of heater. Add one on the inlet end when using steam as the water heating medium.
 2. Piping: Install thermometers in branch butt weld connection fitting or socket-weld thermowell. Enlarge pipes smaller than 2-1/2 inch to accommodate sockets. Ensure sockets are above insulation clearance.
- C. Locate PT (pressure-temperature) test plugs as indicated on drawings.

END OF SECTION

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Prefabricated trapeze-framed systems.
- B. Strut systems for pipe or equipment support.
- C. Beam clamps.
- D. Pipe hangers.
- E. Hanger rods.
- F. Pipe rollers and roller supports.
- G. Pipe supports, guides, sleeves, sleeve seals, shields, and saddles.
- H. Firestopping and firestopping accessories.
- I. Nonpenetrating rooftop supports for low-slope roofs.
- J. Anchors and fasteners.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 055000 - Metal Fabrications.
- C. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- D. Section 220719 - Plumbing Piping Insulation.

1.3 REFERENCE STANDARDS

- A. ASME B31.9 - Building Services Piping; 2025.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

- F. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2025.
- G. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.
- H. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.
- J. 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; 2025.
- K. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- L. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- N. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- O. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.
- P. FM (AG) - FM Approval Guide; Current Edition.
- Q. MFMA-4 - Metal Framing Standards Publication; 2004.
- R. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.
- S. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- T. UL (DIR) - Online Certifications Directory; Current Edition.
- U. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.
- V. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

Hangers and Supports for Plumbing Piping and Equipment

1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, thermal insulated pipe supports, sleeves, sleeve seals, and firestopping.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.
- D. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.
- E. Installer's Qualifications: Include evidence of compliance with specified requirements.
- F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.
- D. Installer Qualifications for Field-Welding: As specified in Section 055000.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.
- B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.
- C. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 3. Include consideration for vibration, equipment operation, and shock loads where applicable.
- D. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
- E. Fire Resistance: Provide hardware rated for 60 minutes resistance unless specifically indicated by the authority having jurisdiction.
- F. Vibration Isolation and Seismic Restraint Requirements: See Section 220548.
- G. Materials for Metal Fabricated Supports: Comply with Section 055000.
 - 1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.
 - 2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.
- H. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.
 - 1. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - 2. Outdoor, Damp, or Wet-Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.

2.2 MANUFACTURERS

- A. Anvil International, LLC: www.asc-es.com/#sle.
- B. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
- C. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
- D. FNW: www.fnw.com/#sle.
- E. nVent Caddy, a brand of nVent: www.erico.com/#sle.

- F. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
- G. PHP Systems/Design: www.phpsd.com/#sle.
- H. Substitutions: See Section 016000 - Product Requirements.

2.3 PREFABRICATED TRAPEZE-FRAMED SYSTEMS

- A. Prefabricated Trapeze-Framed Metal Strut Systems:
 - 1. MFMA-4 compliant, pre-fabricated, MSS SP-58 Type 59, low profile continuous-slot metal strut channel with associated tracks, fittings, and related accessories.
 - 2. MFMA-4 compliant, prefabricated, side-loading continuous-slot metal strut channel bracket with associated tracks, fittings, and related accessories.
- B. Strut Channel or Bracket Material:
 - 1. Indoor Dry Locations: Use zinc-plated steel or galvanized steel.
 - 2. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 - 3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
 - 4. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
 - 5. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, vibration dampeners, and the like.

2.4 STRUT SYSTEMS FOR PIPE OR EQUIPMENT SUPPORT

- A. Strut Channels:
 - 1. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
 - 2. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.
- B. Hanger Rods:
 - 1. Threaded zinc-plated steel unless otherwise indicated.
 - 2. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Piping up to 1 inch: 1/4 inch diameter.
 - c. Piping larger than 1 inch: 3/8 inch diameter.
 - d. Trapeze Support for Multiple Pipes: 3/8 inch in length.
- C. Channel Nuts:
 - 1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. Provide carbon steel channel nut with epoxy copper or zinc finish and spring.

2.5 BEAM CLAMPS

- A. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
- B. C-Clamp: MSS SP-58 type 23, malleable iron or steel with plain finish.

- C. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
- D. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
- E. Center load Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
- F. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish.
- G. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- H. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

2.6 PIPE HANGERS

- A. Band Hangers, Adjustable:
 - 1. MSS SP-58 type 7 or 9, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
- B. J-Hangers, Adjustable:
 - 1. MSS SP-58 type 5, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel..
 - 2. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.
- C. Swivel Ring Hangers, Adjustable:
 - 1. MSS SP-58 type 10, epoxy-painted, zinc-colored.
 - 2. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 - 3. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.
 - 4. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.
- D. Clevis Hangers, Adjustable:
 - 1. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.
 - 2. Felt-Lined: MSS SP-58 type 1, zinc-plated, silicone-free carbon steel.
 - 3. Light-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
 - 4. Standard-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
 - 5. UL (DIR) listed: Pipe sizes 4 to 8 inch.
 - 6. FM (AG) listed: Pipe sizes 4 to 8 inch.

2.7 PIPE CLAMPS

- A. Riser Clamps:
 - 1. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
 - 2. MSS SP-58 type 1 or 8, carbon steel with epoxy plated or zinc plated finish.
 - 3. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel with epoxy plated finish.
 - 4. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.

5. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.
 6. Isolate riser clamp from structure by use by use of Hubbard Enterprisers/Holdrite #274 or #278 riser pad or approved.
- B. Extension Split Pipe Clamp:
1. MSS SP-58 type 12, hinged split ring and yoke roller hanger with epoxy copper finish.
 2. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
 3. Provide hanger rod and nuts of the same type and material for a given pipe run.
 4. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
- C. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.
- D. Strut Clamps:
1. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
 2. Cushioned Pipe or Tubing Strut Clamp: Provide strut clamp with thermoplastic elastomer cushion having dielectric strength of 670 V/mil.
 3. Service Temperature Range: Minus 65 to 275 degrees F.
- E. Insulation Coupling:
1. Two bolt-type clamps designed for installation under insulation.
 2. Material: Carbon steel with epoxy copper or zinc finish.

2.8 PIPE ROLLERS AND ROLLER SUPPORTS

- A. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.
- B. Steel Yoke Type: MSS SP-58 type 44, vertically adjustable, nonconductive, and corrosion resistant.
- C. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.

2.9 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

- A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- B. Stanchions:
1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
 2. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
 3. For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.
- C. U-Bolts:
1. MSS SP-58 type 24, carbon steel u-bolt for pipe support or anchoring.
- D. Intermediate Anchors and Pipe Alignment Guides:
1. Pipe Sizes 6 inch and Smaller: Minimum clearance of 0.16 inch.

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2. Pipe Size 8 inch: 0.625 inch U-bolt with double nuts providing minimum clearance of 0.28 inch.
 3. Pipe Size 10 inch: 0.75 inch U-bolt.
 4. Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
- E. Pipe Alignment Guides, Galvanized steel:
1. Pipe Sizes 8 inch and Smaller: Spider or sleeve type.
 2. Pipe Sizes 10 inch and Larger: Roller type.
- F. Pipe Shields for Insulated Piping:
1. MSS SP-58 type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
 2. General Construction and Requirements:
 - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
 - b. Shields Material: UV-resistant polypropylene with glass fill.
 - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
 - d. Service Temperature: Minus 40 to 178 degrees F.
 - e. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- G. Sleeves:
1. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.
 2. Sleeves for Pipes Through Non-fire Rated Beams Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
 3. Sealant: Acrylic; refer to Section 079200 - Joint Sealers.
 4. Sleeves Through Rated Concrete Decks: ASTM E814 (UL 1479), UL Classified for W, L, F, T, and FM approved. Hilti Model Series CP/CPS; HoldRite "Hydroflame" Pro Series, or 3M Fire Barrier Cast-In Devices.
 5. Sleeve Through Rated Concrete Floors: 3-hour per ASTM E-81A, UL W, L, F, T, and FM approved. Hilti Model Series CP/CPS; HoldRite "Hydroflame" Pro Series.
- H. Mechanical sleeve seals.
1. Manufacturers:
 - a. Thunderline Link-Seal, Inc. Model Series LS.
 - b. NMP Corporation.
 - c. Substitutions: See Section 016000 - Product Requirements.
 2. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
- I. Pipe Supports:
1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 2. Liquid Temperatures Up to 122 degrees F:
 - a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
 - b. Support From Below: MSS SP-58 types 35 through 38.
 3. Operating Temperatures from 122 to 446 degrees F:
 - a. Overhead Support: MSS SP-58 type 1 or 3 through 12 clamps with appropriate saddle of MSS SP-58 type 40 for insulated pipe.

- b. Roller Chair: MSS SP-58 types 41 or 43 through 46 roller chair support with appropriate saddle of MSS SP-58 type 39 for insulated pipe.
- c. Sliding Support: MSS SP-58 types 35 through 38.

2.10 NONPENETRATING ROOFTOP SUPPORTS FOR LOW-SLOPE ROOFS

- A. Manufacturers:
 - 1. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- B. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
- C. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
- D. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
- E. Mounting Height: Provide minimum clearance of 12 inches under supported component to top of roofing.

2.11 ANCHORS AND FASTENERS

- A. Manufacturers - Mechanical Anchors:
 - 1. FNW; 7502: www.fnw.com/#sle.
 - 2. Hilti, Inc: www.us.hilti.com/#sle.
 - 3. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
 - 4. Powers Fasteners, Inc: www.powers.com/#sle.
 - 5. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 - 6. Substitutions: See Section 016000 - Product Requirements.
- B. Manufacturers - Powder-Actuated Fastening Systems:
 - 1. Hilti, Inc: www.us.hilti.com/#sle.
 - 2. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.
 - 3. Powers Fasteners, Inc: www.powers.com/#sle.
 - 4. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 - 5. Substitutions: See Section 016000 - Product Requirements.
- C. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
- D. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
- E. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
- F. Hollow Masonry: Use toggle bolts.
- G. Hollow Stud Walls: Use toggle bolts.

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- H. Steel: Use beam ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
- I. Beam Ceiling Flanges: ASTM A47/A47M Grade 32510, malleable iron with plain finish.
- J. Sheet Metal: Use sheet metal screws.
- K. Wood: Use wood screws.
- L. Plastic and lead anchors are not permitted.
- M. Powder-actuated fasteners are permitted only as follows:
 - 1. Where approved by Architect.
 - 2. Use only threaded studs; do not use pins.
- N. Hammer-driven anchors and fasteners are not permitted.
- O. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
- P. Preset Concrete Inserts: Continuous metal strut channel and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - 1. Channel Material: Use galvanized steel.
 - 2. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
 - 3. Manufacturer: Same as manufacturer of metal strut channel framing system.
- Q. Concrete Inserts:
 - 1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2.12 FIRESTOPPING

- A. Manufacturers:
 - 1. Specified Technology Inc. (STI) Model SpecSeal Series 100.
 - 2. Dow Corning Corp.
 - 3. Hilti Corp.
 - 4. International Protective Coating Corp.
 - 5. 3M fire Protection Products.
 - 6. Substitutions: See Section 016000 - Product Requirements.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Single or multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Single or Multiple component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.

5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.
8. Color: As selected from manufacturer's full range of colors.

2.13 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 1. Mineral fiberboard.
 2. Mineral fiber matting.
 3. Sheet metal.
 4. Plywood or particle board.
 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
 1. Furnish UL listed products.
 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION - GENERAL

- A. Furnish hardware, fittings, and accessories from single manufacture.
- B. Install products in accordance with manufacturer's instructions.

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- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, un-poured metal floor decking, or other systems.
- E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- H. Field-Welding (where approved by Architect): Comply with Section 055000.
- I. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- J. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- K. Secure fasteners according to manufacturer's recommended torque settings.
- L. Remove temporary supports.

3.3 INSTALLATION - EQUIPMENT SUPPORT AND ATTACHMENT:

- A. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
- B. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
- C. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
- D. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.
- E. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

3.4 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install 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 4 inches and larger.

- 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 above slab.

3.5 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.9.
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inches minimum vertical adjustment.
- F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- H. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- I. Support riser piping independently of connected horizontal piping.
- J. Provide copper plated hangers and supports for copper piping.
- K. Design hangers for pipe movement without disengagement of supported pipe.
- L. Prime coat exposed steel hangers and supports. Refer to Section 099123 - Interior Painting and Coating. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- M. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to 220716 - Plumbing Equipment Insulation.
- N. Support of pipe and equipment is to be accomplished by means of engineered products specific to each application. Make shift field devised methods will not be allowed.

3.6 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond all anchor bolts for supported equipment. Refer to Section 033000 - Cast-in-Place Concrete.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members, formed steel channel, steel pipe and fittings. Brace and fasten with flanges bolted to structure.

- D. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

3.7 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inch sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- D. Seal floor, shower and mop sink drains watertight to adjacent materials.
- E. Provide acoustical lead flashing around pipes penetrating equipment rooms and roofs for sound control.
- F. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.8 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing or fire-stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.9 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply fire-stopping material in sufficient thickness to achieve required fire and smoke rating to uniform density and texture.

- D. Compress fibered material to maximum 40 percent of its uncompressed size.
- E. Place foamed material in layers to ensure homogenous density, filling cavities and spaces.
- F. Place sealant to completely seal junctions with adjacent dissimilar materials.
- G. Place intumescent coating in sufficient coats to achieve rating required.
- H. Remove dam material after firestopping material has cured.
- I. Fire Rated Surface:
 - 1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - e. Where cable tray, bus, cable bus, conduit, wire-way, trough, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- J. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition, floor, ceiling and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - 2. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - a. Install type of firestopping material recommended by manufacturer.
 - b. Install escutcheons, floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - c. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
 - d. Interior partitions: Seal pipe penetrations at clean rooms, laboratories, hospital spaces, computer rooms, telecommunication rooms, data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.10 SCHEDULES

Pipe Size (inches)	Maximum Hanger Spacing (feet)	Hanger Rod Diameter(inches)
1/2 to 1-1/4	6.5	3/8
1-1/2 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 6	10	5/8
8 to 12	14	7/8

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PVC (All Sizes)	6	3/8
C.I. Bell and Spigot (or No Hub) and at Joint	5	3/8

END OF SECTION

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Vibration isolation requirements.
- B. Seismic control requirements.
 - 1. Includes requirements for seismic qualification of equipment not specified in this section.
- C. Vibration-isolated equipment support bases.
- D. Vibration isolators.
- E. External seismic snubber assemblies.
- F. Seismic restraint systems.
- G. Vibration-isolated and/or seismically engineered roof curbs.

1.2 RELATED REQUIREMENTS

- A. Section 014500 - Quality Control: Special Inspection Requirements.
- B. Section 033000 - Cast-in-Place Concrete.
- C. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

1.3 DEFINITIONS

- A. Plumbing Component: Where referenced in this section in regards to seismic controls, applies to any portion of the plumbing system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.4 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.
- C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.

- D. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2014.
- E. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
- F. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.
- G. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.
- H. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2020).
- J. MFMA-4 - Metal Framing Standards Publication; 2004.
- K. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2024.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Seismic Controls:
 - a. Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
 - b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.6 SUBMITTALS

- A. See Section 013300 - Submittal Procedures for submittal procedures.
- B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
 - 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.

2. Seismic Controls: Include seismic load capacities.
- D. Shop Drawings - Vibration Isolation Systems:
1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
 2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.
- E. Shop Drawings - Seismic Controls:
1. Include dimensioned plan views and sections indicating proposed plumbing component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
 2. Identify mounting conditions required for equipment seismic qualification.
 3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
 4. Indicate proposed arrangement of distributed system trapeze support groupings.
 5. Indicate proposed locations for distributed system flexible fittings and/or connections.
 6. Indicate locations of seismic separations where applicable.
 7. Include point load drawings indicating design loads transmitted to structure at each attachment location.
- F. Seismic Design Data:
1. Compile information on project-specific characteristics of actual installed plumbing components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.
 - a. Component operating weight and center of gravity.
 - b. Component elevation in the building in relation to the roof elevation (z/h).
 - c. Component importance factor (I_p).
 - d. For distributed systems, component materials and connection methods.
 - e. Component amplification factor (a_p) and component response modification factor (R_p), determined in accordance with ASCE 7 tables.
 - f. Applicability of overstrength factor (for certain anchorage in concrete and masonry).
 2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.
- G. Certification for seismically qualified equipment; identify basis for certification.
- H. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.
- I. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- J. Evidence of qualifications for seismic controls designer.
- K. Evidence of qualifications for manufacturer.
- L. Manufacturer's detailed field testing and inspection procedures.

- M. Field quality control test reports.

1.7 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Seismic Controls Designer Qualifications: Registered professional engineer licensed in Washington and with minimum five years experience designing seismic restraints for nonstructural components.
 - 1. Designer may be employed by the manufacturer of the seismic restraint products.
- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 VIBRATION ISOLATION REQUIREMENTS

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing plumbing equipment and/or plumbing connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
 - 1. Select vibration isolators to provide required static deflection.
 - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
 - 3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
 - 4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
 - 5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch operating clearance beneath base unless otherwise indicated.
- D. Equipment Isolation: As indicated on drawings.
- E. Piping Isolation:
 - 1. Provide vibration isolators for piping supports:
 - a. Located in equipment rooms.
 - b. Located within 50 feet of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.

- c. For piping over 2 inch located below or within 50 feet of noise-sensitive areas indicated.
- 2. Minimum Static Deflection:
 - a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
 - b. Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
- 3. Suspended Piping, Nonseismic Applications: Use spring isolator hangers.
- 4. Suspended Piping, Seismic Applications: Use seismic type spring isolator hangers.
- 5. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.
- 6. Floor-Mounted Piping, Seismic Applications: Use seismic type restrained spring isolators.
- 7. Use approved resilient material where vibration-isolated piping penetrates building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.

2.2 SEISMIC CONTROL REQUIREMENTS

- A. Design and provide plumbing component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor plumbing components.
- B. Seismic Design Criteria: Obtain from project Structural Engineer of Record.
- C. Component Importance Factor (I_p): Plumbing components to be assigned a component importance factor (I_p) of 1.5 unless otherwise indicated.
- D. Component Importance Factor (I_p): Plumbing components essential to life safety to be assigned a component importance factor (I_p) of 1.5 as indicated or as required. This includes but is not limited to:
 - 1. Plumbing components required to function for life safety purposes after an earthquake.
 - 2. Plumbing components that support or otherwise contain hazardous substances.
- E. Seismic Qualification of Equipment:
 - 1. Provide special certification for plumbing equipment furnished under other sections and assigned a component importance factor (I_p) of 1.5, certifying that equipment will remain operable following a design level earthquake.
 - 2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
 - 3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
 - 4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.
- F. Premanufactured Modular Plumbing Equipment: Where not otherwise seismically qualified, premanufactured modules 6 feet high and taller furnished under other sections to be designed in accordance with seismic provisions for nonbuilding structures.
- G. Seismic Restraints:

1. Provide seismic restraints for plumbing components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
2. Seismic Restraint Exemptions:
 - a. Exemptions for Seismic Design Category C:
 - 1) Plumbing components where either of the following apply:
 - (a) The component importance factor (I_p) is 1.0 and the component is positively attached to the structure.
 - (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
 - 2) Plumbing piping with component importance factor (I_p) of 1.5 and nominal pipe size of 2 inch or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
 - b. Exemptions for Seismic Design Category D, E, and F:
 - 1) Discrete plumbing components that are positively attached to the structure where either of the following apply:
 - (a) The component weighs 400 pounds or less, has a center of mass located 4 feet or less above the adjacent floor level, flexible connections are provided between the component and associated ductwork, piping, and conduit, and the component importance factor (I_p) is 1.0.
 - (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
 - 2) Plumbing piping with component importance factor (I_p) of 1.0 and nominal pipe size of 3 inch or less, or with component importance factor (I_p) of 1.5 and nominal pipe size of 1 inch or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
 - c. Plumbing Piping Exemptions, All Seismic Design Categories:
 - 1) Plumbing piping where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, where piping is positively attached to the structure, and where one of the following apply:
 - (a) Trapeze supported piping weighing less than 10 pounds per foot, where all pipes supported meet size requirements for exemption as single pipes described under specific seismic design category exemptions above.
 - (b) Trapeze supported piping with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (I_p) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.

- (c) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (I_p) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 200 pounds or less.
 - (d) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (I_p) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.
 - (e) Hanger supported piping with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, where pipe has a component importance factor (I_p) of 1.0 and meets size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single rod is 50 pounds or less.
- 3. Seismic Restraint Exemptions:
 - a. Exemptions for Seismic Design Category C:
 - 1) Plumbing components with component importance factor (I_p) of 1.0.
 - 2) Plumbing piping with component importance factor (I_p) of 1.5 and nominal pipe size of 2 inch or less; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
 - b. Exemptions for Seismic Design Category D, E, and F:
 - 1) Plumbing components with component importance factor (I_p) of 1.0 where all of the following apply:
 - (a) The component is positively attached to the structure.
 - (b) Flexible connections are provided between the component and associated ductwork, piping, and conduit.
 - (c) Either:
 - (1) The component weighs 400 pounds or less and has a center of mass located 4 feet or less above the adjacent floor level.
 - (2) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
 - 2) Plumbing piping with component importance factor (I_p) of 1.0 and nominal pipe size of 3 inch or less, or with component importance factor (I_p) of 1.5 and nominal pipe size of 1 inch or less; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
 - c. Plumbing Piping Exemptions, All Seismic Design Categories:
 - 1) Trapeze supported piping weighing less than 10 pounds per foot, where all pipes supported meet requirements for exemption as single pipes described under specific seismic design category exemptions above.

- 2) Hanger supported piping where each hanger in the piping run is 12 inches or less in length from the pipe support to the supporting structure; rod hangers, where used, to be equipped with swivels.
4. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
 - a. FEMA 412.
 - b. FEMA 413.
 - c. FEMA 414.
 - d. FEMA E-74.
 - e. SMACNA (SRM).
5. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
6. Seismic Type Vibration Isolators:
 - a. Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
7. External Seismic Snubber Assemblies:
 - a. Provide quantity and arrangement of external seismic snubber assemblies as required to restrain equipment in all directions (both lateral and vertical).
 - b. Do not use external seismic snubber assemblies that restrain equipment only in one or more lateral directions (but not vertical) except where uplift forces are zero or are addressed by other restraints.
8. Seismic Restraint Systems:
 - a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
 - b. Use only cable restraints to restrain vibration-isolated plumbing components, including distributed systems.
 - c. Use only one restraint system type for a given plumbing component or distributed system (e.g., piping) run; mixing of cable and rigid restraints on a given component/run is not permitted.
 - d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain plumbing component in all lateral directions; consider bracket geometry in anchor load calculations.
 - e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported plumbing component weight.
 - f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported plumbing component weight.
 - g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
 - h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
 - i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.
 - j. Manufacturer's certified seismic restraint design may be submitted as an alternative to project-specific design and documentation, subject to approval of authorities having jurisdiction.

H. Seismic Attachments:

1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
3. Do not use power-actuated fasteners except where permitted by applicable code.
4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
6. Concrete Housekeeping Pads:
 - a. Increase size of pad as required to comply with anchor requirements.
 - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

I. Seismic Interactions:

1. Include provisions to prevent seismic impact between plumbing components and other structural or nonstructural components.
2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
3. Comply with minimum clearance requirements between plumbing equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.

J. Seismic Relative Displacement Provisions:

1. Use suitable fittings or flexible connections to accommodate:
 - a. Relative displacements at connections between components, including distributed systems (e.g., piping); do not exceed load limits for equipment utility connections.
 - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
 - c. Design displacements at seismic separations.
 - d. Anticipated drifts between floors.
2. Include provisions to prevent interruption of utility service due to seismic displacements.

2.3 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

A. Manufacturers:

1. Vibration-Isolated Equipment Support Bases:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. M.W. Sausse & Co: www.vibrex.net.
 - d. Amber/Booth (VMC): www.thvmcgroup.com.
 - e. Substitutions: See Section 012500 - Substitution Procedures.
2. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

- B. Vibration-Isolated Structural Steel Bases:
 - 1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
- C. Vibration-Isolated Concrete Inertia Bases:
 - 1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
 - 2. Minimum Base Depth: 6 inches.
 - 3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
 - 4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
 - 5. Concrete: Filled on site with minimum 3000 psi concrete in accordance with Section 033000.
 - 6. Pump Applications: Size and configure bases for piping elbow supports as required.

2.4 VIBRATION ISOLATORS

- A. Manufacturers:
 - 1. Vibration Isolators:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. M.W. Sausse & Co: www.vibrex.net.
 - d. Amber/Booth (VMC): www.thevmcgroup.com.
 - e. Substitutions: See Section 012500 - Substitution Procedures.
 - 2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.
- B. General Requirements:
 - 1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
 - 2. Spring Elements for Spring Isolators:
 - a. Color code or otherwise identify springs to indicate load capacity.
 - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
 - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
 - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
 - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
 - f. Selected to function without undue stress or overloading.
 - 3. Seismic Snubbing Elements for Seismic Isolators:
 - a. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
 - b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.
- C. Vibration Isolators for Seismic Applications:
 - 1. Resilient Material Isolator Mounts, Seismic:
 - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.

2. Restrained Spring Isolators, Seismic:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g., neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
 - b. Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
 - d. Provides constant free and operating height.
3. Resilient Material Isolator Hangers, Seismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
4. Spring Isolator Hangers, Seismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

2.5 ACOUSTICAL AND VIBRATION ISOLATORS

- A. Manufacturers:
 1. Acoustical and Vibration Isolators:
 - a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - b. Substitutions: See Section 012500 - Substitution Procedures.
 2. Source Limitations: Furnish isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.
- B. General Requirements:
 1. Acoustical Isolation System: Through-stud isolators, pipe clamps, riser clamp pads, neoprene and felt lining material and associated support brackets.

2.6 EXTERNAL SEISMIC SNUBBER ASSEMBLIES

- A. Manufacturers:

1. External Seismic Snubber Assemblies:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. M.W. Sausse & Co: www.vibrex.net.
 - d. Amber/Booth (VMC): www.thevmcgroup.com.
 - e. Substitutions: See Section 012500 - Substitution Procedures.
 2. Source Limitations: Furnish external seismic snubber assemblies and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.
- C. Seismic Snubbing Elements:
1. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
 2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

2.7 SEISMIC RESTRAINT SYSTEMS

- A. Manufacturers:
1. Seismic Restraint Systems:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. AFCON, a brand of Anvil International: www.anvilintl.com/#sle.
 - d. Substitutions: See Section 012500 - Substitution Procedures.
 2. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.
- B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.
- C. Cable Restraints:
1. Comply with ASCE 19.
 2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
 3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
 4. Use protective thimbles for cable loops where potential for cable damage exists.
- D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

2.8 VIBRATION-ISOLATED AND/OR SEISMICALLY ENGINEERED ROOF CURBS

- A. Manufacturers:
1. Vibration-Isolated and/or Seismically Engineered Roof Curbs:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. BRD Noise and Vibration Control; Hushcore HIG: www.hushcore.net.
 - c. CDI; Iso Curb: www.cdicurbs.com.

- d. Thybar; Vibro-Curb III www.thybar.com.
 - e. Substitutions: See Section 012500 - Substitution Procedures.
 - 2. Source Limitations: Furnish vibration-isolated roof curbs and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Vibration Isolation Curbs:
 - 1. Seismic Curb:
 - a. Location: Between structure and rooftop equipment.
 - b. Construction: Steel.
 - c. Integral vibration isolation to comply with requirements of this section.
 - d. Snubbers consist of minimum 0.25 inch thick resilient pads to avoid metal-to-metal contact without compromising vibration isolating capabilities.
 - e. Weather exposed components consist of corrosion resistant materials.
- C. Seismic Type Nonisolated Curb and Fabricated Equipment Piers:
 - 1. Location: Between structure and rooftop equipment.
 - 2. Construction: Steel.
 - 3. Weather exposed components consist of corrosion resistant materials.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 CODE-REQUIRED SPECIAL INSPECTIONS

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 014533 and statement of special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
 - 1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
 - 2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Seismic special inspections include, but are not limited to:
 - 1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with the certificate of compliance.

2. Installation and anchorage of piping systems designed to carry hazardous materials and their associated mechanical units for Seismic Design Categories C, D, E, and F; periodic inspection.
 3. Installation and anchorage of vibration isolation systems for Seismic Design Categories C, D, E, and F where the approved Contract Documents require a nominal clearance of 1/4 inch or less between equipment support frame and seismic restraint; periodic inspection.
 4. Verification of required clearances between plumbing equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.
- D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.
- E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Field-Welding (where approved by Architect): Comply with Section 055000.
- E. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- F. Vibration Isolation Systems:
1. Vibration-Isolated Equipment Support Bases:
 - a. Provide specified minimum clearance beneath base.
 2. Spring Isolators:
 - a. Position equipment at operating height; provide temporary blocking as required.
 - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
 - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
 3. Isolator Hangers:
 - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
 - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
 4. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
 5. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
 6. Adjust isolators to be free of isolation short circuits during normal operation.

7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.
- G. Seismic Controls:
1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris, or other obstructions.
 2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
 3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
 4. Equipment with Sheet Metal Housings:
 - a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
 - b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
 - c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
 5. Concrete Housekeeping Pads:
 - a. Size in accordance with seismic design to meet anchor requirements.
 - b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
 6. Seismic Restraint Systems:
 - a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
 - b. Install restraints within permissible angles in accordance with seismic design.
 - c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
 - d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
 - e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.4 FIELD QUALITY CONTROL

- A. See Section 014500 - Quality Control, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Provide manufacturer representative or authorized technician services to assist with inspection and testing of vibration isolation systems and seismic controls. Submit a detailed copy of manufacturer recommended inspection, testing, and field report procedures.
- D. Vibration Isolation Systems:
1. Verify isolator static deflections.
 2. Verify required clearance beneath vibration-isolated equipment support bases.
 3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- E. Seismic Controls:
1. Verify snubbing element air gaps.

Vibration and Seismic Controls for Plumbing Piping and Equipment

- F. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.
- G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.
- D. Labels.
- E. Lockout devices

1.2 RELATED REQUIREMENTS

- A. Section 099123 - Interior Painting: Identification painting.

1.3 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2025.

1.4 SUBMITTALS

- A. See Section 013300 - Substitution Procedures for submittal procedures.
- B. Schedules:
 - 1. Submit plumbing component identification schedule listing equipment, piping, and valves.
 - 2. Detail proposed component identification data in terms of of wording, symbols, letter size, and color coding to be applied to corresponding product.
 - 3. Valve Data Format: Include id-number, location, function, and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- E. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
 - 1. Brady Corporation: www.bradycorp.com.
 - 2. Safety Sign Company: www.safetysignco.com.

3. Seton Identification Products: www.seton.com/#sle.
 4. Substitutions: See Section 012500 - Substitution Procedures.
- B. Description: Laminated three-layer plastic with engraved letters.
1. Letter Color: Black.
 2. Letter Height: 1/2 inch.
 3. Background Color: Yellow.
 4. Nameplate Material:
 - a. Flexible: Plastic per ASTM D709.

2.2 TAGS

- A. Manufacturers:
1. Brady Corporation: www.bradycorp.com.
 2. Safety Sign Company: www.safetysignco.com.
 3. Seton Identification Products: www.seton.com/#sle.
 4. Substitutions: See Section 012500 - Substitution Procedures.
- B. Flexible: Laminated three-layer Plastic with engraved black letters on light contrasting background color. Minimum tag size 1-1/2 inch in diameter.
- C. Metal: Brass with stamped letters, tag size minimum 1-1/2 inch in diameter.
- D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.3 PIPE MARKERS

- A. Comply with ASME A13.1.
- B. Plastic Marker: Factory fabricated, flexible, semi-rigid, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid conveyed.
- C. Plastic Tape Marker: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- D. Underground Plastic Marker: Bright-colored continuously printed ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.4 LABELS

- A. Description: Aluminum, size 1.9 x 0.75 inches, adhesive backed with printed identification.

2.5 LOCKOUT DEVICES

- A. Lockout Hasps:
1. Manufacturers:
 2. Anodized aluminum or reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches.
- B. Valve Lockout Devices:

1. Steel device preventing access to valve operator, accepting lock shackle.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive identification products.

3.2 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install tags in clear view and align with axis of piping
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- G. Identify pumps, heat transfer equipment, tanks, and water treatment devices with 8 x 4 inch plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- H. Identify control panels and major control components outside panels with plastic nameplates.
- I. Identify valves in main and branch piping with tags.
- J. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

PLUMBING PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glass fiber insulation.
- B. Jacketing and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 099113 - Exterior Painting: Painting insulation jacket.
- C. Section 099123 - Interior Painting: Painting insulation jacket.
- D. Section 221005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.3 REFERENCE STANDARDS

- A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2024).
- C. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2024).
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- E. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013300 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 3 years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.7 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER INSULATION

- A. Manufacturers:
 - 1. Johns Manville Corporation; Micro-Lok HP: www.jm.com/#sle.
 - 2. Owens Corning Corporation; Model SSL II: www.ocbuildingspec.com/#sle.
 - 3. Certain Teed Corporation: www.certainteed.com.
 - 4. Knauf Insulation; Pipe Insulation ASJ-SSL: www.knaufusa.com
 - 5. Substitutions: See Section 012500 - Substitution Procedures.
- B. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm.
- C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- D. Vapor Barrier Lap Adhesive: Compatible with insulation.
- E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- F. Indoor Vapor Barrier Finish:
 - 1. Cloth: Untreated; 9 oz/sq yd weight.
 - 2. Vinyl emulsion type acrylic, compatible with insulation, black color.
- G. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

- H. Outdoor Breather Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- I. Insulating Cement: ASTM C449.

2.3 JACKETING AND ACCESSORIES

A. PVC Plastic Jacket:

- 1. Manufacturers:
 - a. Johns Manville Corporation: www.jm.com/#sle.
 - b. Substitutions: See Section 012500 - Substitution Procedures.
- 2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 20 mil, 0.020 inch.
 - e. Connections: Brush on welding adhesive.
- 3. Covering Adhesive Mastic: Compatible with insulation.

B. Aluminum Jacket:

- 1. Manufacturers:
 - a. Childers Products Co.: www.fosterproducts.com.
 - b. Substitutions: See Section 012500 - Substitution Procedures.
- 2. Thickness: 0.016 inch sheet.
- 3. Finish: Embossed.
- 4. Joining: Longitudinal slip joints and 2 inch laps.
- 5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
- 6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
- 7. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.

- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Glass fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- G. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- H. Glass fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- I. Inserts and Shields:
 - 1. Application: Piping 1-1/2 inches diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert Location: Between support shield and piping and under the finish jacket.
 - 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
- J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 078400.
- K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.
- L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- M. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil, 0.001 inch thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
- N. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 SCHEDULES

A. Plumbing Systems:

1. Domestic Hot Water Supply and Recirculation:
 - a. Glass Fiber, Rigid, Insulation:
 - 1) Pipe Size Range: Under 1-1/2 inch.
 - 2) Thickness: 1 inch.
 - 3) Pipe Size Range: 1-1/2 inch and over.
 - 4) Thickness: 1-1/2 inch.
2. Domestic Cold Water:
 - a. Glass Fiber, Rigid, Insulation
 - 1) Pipe Size Range: 1 inch and under.
 - 2) Thickness: 1/2 inch.
 - 3) Pipe Size Range: Over 1 inch.
 - 4) Thickness: 1 inch.
3. Roof Drain Bodies: Flexible Duct Wrap with multi-purpose, foil-scrim-kraft jacket. Use tie-wire to secure in place. Minimum thickness: 1 inch.
4. Roof Drainage Within 10 Feet of the Exterior:
 - a. Glass Fiber, Rigid, Insulation:
 - 1) Pipe Size Range: All sizes.
 - 2) Thickness: 1 inch.

END OF SECTION

PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sanitary waste piping, buried within 5 feet of building.
- B. Sanitary waste piping, above grade.
- C. Domestic water piping, buried within 5 feet of building.
- D. Domestic water piping, above grade.
- E. Pipe flanges, unions, and couplings.
- F. Ball valves.
- G. Flow-balancing valves.
- H. Swing check valves.
- I. Pressure-temperature valves.
- J. Strainers.

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 220516 - Expansion Fittings and Loops for Plumbing Piping.
- C. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- D. Section 220553 - Identification for Plumbing Piping and Equipment.
- E. Section 312316 - Excavation.
- F. Section 312323 - Fill.

1.3 REFERENCE STANDARDS

- A. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2025).
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- D. ASME B31.9 - Building Services Piping; 2025.

- E. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2025, with Errata.
- F. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025, with Errata.
- G. ASSE 1003 - Water Pressure Reducing Valves for Potable Water Distribution Systems; 2023.
- H. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2024).
- I. ASTM B32 - Standard Specification for Solder Metal; 2020.
- J. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2025.
- K. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- L. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- M. ASTM B813 - Standard Specification for Water Flushable Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2024.
- N. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2023.
- O. ASTM C1053 - Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications; 2000 (Reapproved 2015).
- P. ASTM C1277 - Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
- Q. ASTM D-1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable; Current Edition, Including All Revisions.
- R. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable; Current Edition, Including All Revisions.
- S. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.
- T. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings; 2022.
- U. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2026.
- V. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020 (Reapproved 2024).
- W. ASTM D2661 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings; 2024.

- X. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2025.
- Y. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping; 2020 (Reapproved 2025).
- Z. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020 (Reapproved 2024).
- AA. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2024, with Editorial Revision (2025).
- BB. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- CC. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2014 (Reapproved 2021).
- DD. ASTM F628 - ASTM F628 2012 Edition, November 15, 2012 Complete Document Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core; 2012.
- EE. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings; 2021.
- FF. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2026.
- GG. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems; 2025.
- HH. ASTM F891 - Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core; Current Edition, Including All Revisions.
- II. ASTM F1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-Linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing; 2024.
- JJ. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2026.
- KK. AWWA C550 - Protective Interior Coatings for Valves and Hydrants; 2024.
- LL. AWWA C651 - Disinfecting Water Mains; 2023.
- MM. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.
- NN. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.
- OO. MSS SP-67 - Butterfly Valves; 2022.

- PP. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
- QQ. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- RR. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- SS. MSS SP-136 - Ductile Iron Swing Check Valves; Current Edition, Including All Revisions .
- TT. NSF 61 - Drinking Water System Components - Health Effects; 2025, with Addendum
- UU. NSF 372 - Drinking Water System Components - Lead Content; 2024.
- VV. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013300 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- C. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.
- D. Project Record Documents: Record actual locations of valves.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with all applicable local codes and standards.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.6 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. Store pipe on sleepers, a minimum of 4 inches above surrounding grade, at all times.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.2 SANITARY WASTE PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: CISPI 301, hubless.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies. Mission Heavyweight, Husky 4000, Clamp-All 120 system, Ideal Triden, or approved.

2.3 SANITARY WASTE PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, ASTM C1277, neoprene gaskets and stainless steel clamp-and-shield assemblies. Mission Heavyweight, Husky 4000, Clamp-All 120 system, Ideal Triden, or approved.

2.4 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Copper Pipe: ASTM B88, Type K, annealed.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
 - 2. Joints: AWS A5.8M/A5.8, BCuP silver braze.

2.5 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B32, alloy Sn95 solder.
- B. PEX-A Cross-Linked Polyethylene Pipe: ASTM F876 or ASTM F877.
 - 1. Fittings: ASTM F877 / ASTM F1960, engineered polymer (EP) type and PEX compression ring with end stops matching tube dimensions.
 - 2. Manifold: ASTM F877 / ASTM F1960, multi-outlet, engineered polymer (EP) assembly with corrosion resistant brass valve for each outlet.
 - 3. Application within public restrooms limited to 3/4-inch diameter and smaller for individual future drops for lavatories, sinks, and drinking fountains.

2.6 PIPE FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 inch and Under:
 - 1. Ferrous Pipe: Class 150 malleable iron threaded unions.
 - 2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
- B. Flanges for Pipe Sizes Over 1 inch:
 - 1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
 - 2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
- C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.7 BALL VALVES

- A. Manufacturers:
 - 1. Hammond Valve Co.; Model 8501 or 8901: www.hammondvalve.com.
 - 2. Nibco, Inc; Model T/S-FP-600A or T/S-585-80-LF: www.nibco.com/#sle.
 - 3. Watts; Model FBV-1 or B-6000: www.watts.com.
 - 4. Stockham; Model S216-BR-R-T : www.stockham.com
 - 5. Apollo Valves; Model 77CLF: www.apollovalves.com/#sle.
 - 6. Milwaukee Valve Company; Model BA-125 or BA-100 : www.milwaukeevalve.com.
 - 7. Substitutions: See Section 012500 - Substitution Procedures.
- B. Construction, 4 inch and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, threaded or grooved ends with union.
- C. Up to and including 3-inches:
 - 1. MSS SP-110, 600 psi CWP, bronze, two-piece body, lead free brass ball, full port, teflon seats and stuffing box ring, blow-out proof stem, lever handle solder or threaded ends.

2.8 FLOW-BALANCING VALVES

- A. Manufacturers:
 - 1. NIBCO, Inc.; Model T/S-1805-LF: www.nibco.com.
 - 2. ITT Bell & Gossett: www.bellgossett.com/#sle.
 - 3. Griswold Controls: www.griswoldcontrols.com/#sle.
 - 4. Taco, Inc: www.taco-hvac.com/#sle.
 - 5. Substitutions: See Section 012500 - Substitution Procedures.
- B. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.
- C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

2.9 SWING CHECK VALVES

- A. Manufactures:
 - 1. Hammond Valve Co.; Model IB940 or IR1124: www.hammondvalve.com.
 - 2. Nibco, Inc; Model T/S-413-Y-LF or F-938-33: www.nibco.com/#sle.
 - 3. Stockham; Model B-320 or G-931: www.stockham.com
 - 4. Milwaukee Valve Company; Model F-2974: www.milwaukeevalve.com.
 - 5. Apollo Valves; 161TLF or 910F: www.apollovalves.com/#sle.
 - 6. Substitutions: See Section 012500 - Substitution Procedures.
- B. Up to 3 Inches:
 - 1. 1, Class 125, lead free bronze body, cap and swing disc with PTFE seat, solder or threaded ends.
- C. Over 3 Inches:
 - 1. MSS SP-136, Class 125, iron body, stainless steel disc, renewable disc seal and seat, flanged ends.

2.10 SPRING LOADED CHECK VALVES

- A. Manufactures:
 - 1. Hammond Valve Co.; Model IR9354: www.hammondvalve.com.
 - 2. Nibco, Inc; Model F-910-LF: www.nibco.com/#sle.
 - 3. Milwaukee Valve Company; Model Series 1800: www.milwaukeevalve.com.
 - 4. Apollo Valves; 910WB: www.apollovalves.com/#sle.
 - 5. Substitutions: See Section 012500 - Substitution Procedures.
- B. Class 125, globe style, iron body, bronze trim, stainless steel springs, bronze disc, seals, flanged ends.

2.11 PRESSURE-TEMPERATURE VALVES

- A. Manufacturers:
 - 1. Watts Regulator Company: www.wattsregulator.com/#sle.
 - 2. Cash-Acme: www.cashacme.com.
 - 3. Zurn/Wilkins: www.zurn.com
 - 4. Apollo Valves: www.apollovalves.com
 - 5. Substitutions: See Section 012500 - Substitution Procedures.
- B. ANSI Z21.22, AGA certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME BPVC-IV certified and labelled.

2.12 STRAINERS

- A. Manufacturers:
 - 1. Watts Regulator Company: www.wattsregulator.com.
 - 2. Hammond Valve: www.hammondvalve.com.
 - 3. Milwaukee Valve Company: www.milwaukeevalve.com.
 - 4. Apollo Valves: www.apollowalves.com.
 - 5. Stockham: www.stockham.com.

6. Substitutions: See Section 012500 - Substitution Procedures.
- B. Size 2 inch and Smaller:
 1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
 2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
- C. Size 1-1/2 inch to 4 inch:
 1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.
- D. Size 5 inch and Larger:
 1. Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- 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.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 220516.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- H. Provide access where valves and fittings are not exposed.
- I. Establish elevations of buried piping outside the building to ensure not less than 2 ft of cover.

- J. Provide tracer wire over top of piping.
 - 1. Construction:
 - a. Conductor: Solid or stranded copper per spec ASTM B3.
 - b. Insulation: High Molecular Weight Polyethylene (HMWPE) ASTM D-1248. Various insulation colors dependant on usage.
 - c. Temperature: 70 degrees C dry and wet.
 - d. Voltage: 20 and 30 Mil = 30 to 300 volts. 45 Mil = 600 volts.
- K. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.
- L. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
- M. Provide support for utility meters in accordance with requirements of utility companies.
- N. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.
- O. Excavate in accordance with specifications.
- P. Backfill in accordance with specifications.
- Q. Bury PVC and ABP pipe per ASTM D2321.
- R. Install valves with stems upright or horizontal, not inverted. See Section 220523.
- S. Install water piping to ASME B31.9.
- T. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- U. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- V. Sleeve pipes passing through partitions, walls, and floors.
- W. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9.
 - 2. Support horizontal piping as indicated.
 - 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches of each horizontal elbow.
 - 5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 8. Provide copper plated hangers and supports for copper piping or sheet lead packing between hanger or support and piping.
 - 9. Provide hangers adjacent to motor-driven equipment with vibration isolation; see Section 220548.

10. Support cast iron drainage piping at every joint.
11. Support of pipe tubing and equipment is to be accomplished by means of engineered products specific to each application. Makeshift field devised methods will not be allowed.

3.4 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install globe valves for throttling, bypass, or manual flow control services.
- E. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.
- F. Provide spring-loaded check valves on discharge of water pumps.
- G. Provide flow controls in water recirculating systems where indicated.

3.5 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope.
- B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed, and clean.
- B. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.7 SERVICE CONNECTIONS

- A. Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with bypass valves, pressure reducing valve, and sand strainer.
 - 1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
 - 2. Provide 18 gauge, 0.0478-inch galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

END OF SECTION

PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Drains.
- B. Cleanouts.
- C. Hose bibbs.
- D. Hydrants.
- E. Refrigerator valve and recessed box.
- F. Backflow preventers.
- G. Double check valve assemblies.
- H. Water hammer arrestors.
- I. Trap primers.
- J. Mixing valves.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Manhole bottoms.
- B. Section 221005 - Plumbing Piping.
- C. Section 223000 - Plumbing Equipment.
- D. Section 224000 - Plumbing Fixtures.
- E. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2023.
- C. ASME A112.6.3 - Floor and Trench Drains 2022.
- D. ASME A112.6.4 - Roof, Deck, and Balcony Drains 2022.
- E. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers 2023.

- F. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent 2021.
- G. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies 2021.
- H. ASSE 1018 - Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied 2023.
- I. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance 2011 (Reaffirmed 2016).
- J. ASTM C478/C478M - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections 2022.
- K. NSF 61 - Drinking Water System Components - Health Effects 2022.
- L. NSF 372 - Drinking Water System Components - Lead Content 2022.
- M. PDI-WH 201 - Water Hammer Arresters 2017.
- N. IEEE 515.1 - IEEE Approved Draft Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications 2022.
- O. ITS (DIR) - Directory of Listed Products Current Edition.
- P. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- Q. UL (DIR) - Online Certifications Directory Current Edition.

1.4 SUBMITTALS

- A. See Section 013300 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- C. Shop Drawings: Indicate dimensions, weights, and placement of openings holes, and layout of electric heat tracing.
- D. Certificates: Certify that grease interceptors meet or exceed specified requirements.
- E. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
- F. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, and water hammer arrestors.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements for additional provisions.
 - 2. Extra Loose Keys for Outside Hose Bibbs: Two.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.6 WARRANTY

- A. Provide two year manufacturer warranty for all heat trace components.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.2 DRAINS

- A. Roof Drains (RD-1):
 - 1. Assembly: ASME A112.6.4.
 - 2. Body: Square top heavy-duty drain, oven cured acid resistant epoxy coated aluminum body with bottom outlet, top membrane clamping collar, anti-ponding slots, sediment bucket and heavy duty anti-tilt hinged slotted grate with stainless steel hinge pins.
 - 3. Accessories: Coordinate with roofing type, see Section 075423:
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Adjustable under deck clamp.
 - c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Controlled flow weir.
 - f. Leveling frame.
 - g. Adjustable extension sleeve for roof insulation.
 - h. Perforated or slotted ballast guard extension for inverted roof.
 - i. Perforated stainless steel ballast guard extension.
 - 4. Manufacturers:
 - a. Zurn Industries, Model Z535, LLC: www.zurn.com/#sle.
 - b. Wade: www.wadedrains.com.
 - c. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
 - d. MIFAB, Inc: www.mifab.com/#sle.
 - e. Sioux Chief: www.siouxchief.com.
 - f. Substitutions: See Section 012500 - Substitution Procedures.
- B. Roof Overflow Drains (OD-1):
 - 1. Square top heavy-duty drain, oven cured acid resistant epoxy coated aluminum body with bottom outlet, top membrane clamping collar, anti-ponding slots, sediment bucket and heavy-duty anti-tilt hinged slotted grate with stainless steel hinge pins.
 - 2. Manufacturers:
 - a. Zurn Industries, Model Z535, Inc.: www.zurn.com.
 - b. MIFAB Inc: www.mifab.com.
 - c. Wade: www.wadedrains.com.

- d. Jay R Smith Manufacturing Company: www.jayrsmith.com.
 - e. Sioux Chief; Model 868-istp2: www.siouxchief.com.
 - f. Substitutions: See Section 012500 - Substitution Procedures.
- 3. Accessories: Coordinate with roofing type, refer to Architectural specifications.
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Adjustable under deck clamp.
 - c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Controlled flow weir.
 - f. Leveling frame.
 - g. Adjustable extension sleeve for roof insulation.
 - h. Perforated or slotted ballast guard extension for inverted roof.
 - i. Perforated stainless steel ballast guard extension.
- C. Floor Drain (FD-1):
 - 1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.
 - 2. Manufacturers:
 - a. Jay R Smith Manufacturing Company; Model 2005-A or Model 2005-B: www.jayrsmith.com.
 - b. MIFAB Inc: www.mifab.com.
 - c. Wade: www.wadedrains.com.
 - d. Zurn Industries, Inc.: www.zurn.com.
 - e. Sioux Chief Finish Line; Model 833-NR and Model 833-NQ: www.siouxchief.com
 - f. Substitutions: See Section 012500 - Substitution Procedures.
- D. Floor Drain (FD-2):
 - 1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable cast iron strainer with acid resistant coating.
 - 2. Manufacturers:
 - a. Jay R Smith Manufacturing Company; Model 2110 or Model 2130: www.jayrsmith.com.
 - b. MIFAB Inc: www.mifab.com.
 - c. Wade: www.wadedrains.com.
 - d. Zurn Industries, Inc.: www.zurn.com.
 - e. Sioux Chief Finish Line; Model 860-i: www.siouxchief.com
 - f. Substitutions: See Section 012500 - Substitution Procedures.
- E. Prefabricated Trench Drain (TD-1): Trench drain system assembled from factory fabricated, polymer concrete castings in standard lengths and variable depths, with integral joint flanges and integral grating support rails; includes joint gaskets and grating.
 - 1. Manufacturer:
 - a. ACO Polymer Products, Inc., KlassikDrain, Slab Drain, Flow Drain or Power Drain: www.acousa.com/#sle.
 - b. Sioux Chief; 865 Series: www.siouxchief.com.
 - c. Eric'sons Dura Trench: www.duratrench.com.

- d. Watts: www.watts.com
 - e. Mifab: www.mifab.com.
 - f. Substitutions: See Section 012500 - Substitution Procedures.
 - 2. Load Class: DIN 19580, Class C, or D.
 - 3. ADA Standards compliant.
 - 4. Chemical Resistant.
 - 5. Shallow Invert.
 - 6. Grating Material and Style: Slotted ductile iron.
 - 7. Grating Material and Style: Longitudinally slotted ductile iron.
 - 8. Grating Material and Style: Ductile iron grid.
 - 9. Grating Material and Style: ADA Standards compliant ductile iron.
- F. Prefabricated Heavy Duty Trench Drain (TD-2): Trench drain system assembled from factory fabricated, polymer concrete castings in standard lengths and variable depths, with integral joint flanges and integral grating support rails; includes joint gaskets and grating.
- 1. Manufacturer:
 - a. ACO Polymer Products, Inc., PowerDrain: www.acousa.com/#sle.
 - b. Sioux Chief; 865 Series: www.siuoxchief.com.
 - c. Eric'sons Dura Trench: www.duratrench.com.
 - d. Watts: www.watts.com.
 - e. Mifab: www.mifab.com.
 - f. Substitutions: See Section 012500 - Substitution Procedures.
 - 2. Load Class: DIN 19580, Class C or D.
 - 3. ADA Standards compliant.
 - 4. Chemical Resistant.
 - 5. Grating Material and Style: ADA Standards compliant slotted ductile iron.
 - 6. Trench Width: 4 inches.
 - 7. Trench Section Length: 39 inches and 19-1/2 inches.
 - 8. Grating Support Rail: Stainless steel.
 - 9. Accessories:
 - a. Foul air trap.
 - b. Oval to round pipe connection.
 - c. Vertical outlet strainer.
- G. Floor Sink (FS-1):
- 1. Lacquered cast iron body with dome strainer and seepage flange.
 - 2. Manufacturers:
 - a. Jay R Smith Manufacturing Company: www.jayrsmith.com.
 - b. MIFAB Inc: www.mifab.com.
 - c. Wade: www.wadedrains.com.
 - d. Zurn Industries, Inc.: www.zurn.com.
 - e. Sioux Chief; 861 Series: www.siuoxchief.com
 - 3. Substitutions: See Section 012500 - Substitution Procedures.
- H. Floor Sink (FS-2):
- 1. Round or Square lacquered cast iron body with integral seepage pan, epoxy coated interior, aluminum dome strainer, nickel bronze frame, and clamp collar.
 - 2. Manufacturers:
 - a. Jay R Smith Manufacturing Company: www.jayrsmith.com.
 - b. MIFAB Inc: www.mifab.com.

- c. Wade: www.wadedrains.com.
- 3. Zurn Industries, Inc.: www.zurn.com.
 - a. Sioux Chief; Model 861-iN: www.sioxchief.com
 - b. Substitutions: See Section 012500 - Substitution Procedures.

2.3 CLEANOUTS

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
 - 2. MIFAB, Inc: www.mifab.com/#sle.
 - 3. Wade: www.wadedrains.com
 - 4. Zurn Industries, LLC: www.zurn.com/#sle.
 - 5. Sioux Chief Finish Line: www.sioxchief.com
 - 6. Substitutions: See Section 012500 - Substitution Procedures.
- B. Cleanouts at Exterior Surfaced Areas (CO-1):
 - 1. Round cast nickel bronze access frame and non-skid cover.
 - 2. Manufacturers:
 - a. Jay R. Smith Manufacturing Company; Model 4250: www.jrsmith.com/#sle.
 - b. Sioux Chief; Model 834-DNR: www.sioxchief.com.
- C. Cleanouts at Interior Finished Floor Areas (CO-2):
 - 1. Lacquered cast iron body with anchor flange, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.
- D. Cleanouts at Interior Finished Wall Areas (CO-3):
 - 1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

2.4 HOSE BIBBS

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
 - 2. MIFAB Inc: www.mifab.com.
 - 3. Zurn Industries, LLC: www.zurn.com/#sle.
 - 4. Woodford Manufacturing Co: www.woodfordmfg.com/woodford.
 - 5. Substitutions: See Section 012500 - Substitution Procedures.
- B. Interior Hose Bibbs:
 - 1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome-plated where exposed with lockshield and removable key, vacuum breaker in compliance with ASSE 1011.

2.5 HYDRANTS

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
 - 2. MIFAB Inc.: www.mifab.com.
 - 3. Zurn Industries, LLC: www.zurn.com/#sle.
 - 4. Woodford Manufacturing Co.: www.woodfordmfg.com/woodford.

- 5. Substitutions: See Section 012500 - Substitution Procedures.
- B. Wall Hydrants:
 - 1. Manufacturing:
 - a. Woodford Manufacturing Co.; Model B67C: www.woodfordmfg.com/woodford.
 - b. Zurn Industries, Inc.; Model Z-1320-C: www.zurn.com.
 - 2. ASSE 1019; freeze resistant, self-draining type with chrome-plated wall plate hose thread spout, handwheel, and integral vacuum breaker.
- C. Roof Hydrants:
 - 1. Manufacturers:
 - a. Woodford Manufacturing Co.; Model Model SRH-MS.
 - 2. ASSE 1057, freeze-less, ASSE 1052, double check backflow, hose thread spout, lift handle, deck flange and clamp, hydrant support with EPDM cover.

2.6 REFRIGERATOR VALVE AND RECESSED BOX

- A. Box Manufacturers:
 - 1. Sioux Chief; 696 Series: www.siouxchief.com.
 - 2. Substitutions: See Section 012500 - Substitution Procedures.
- B. Description: Plastic preformed rough-in box with brass valves with wheel handle, slip in finishing cover.

2.7 BACKFLOW PREVENTERS

- A. Manufacturers:
 - 1. Febco: www.febcoonline.com.
 - 2. Zurn Industries, LLC: www.zurn.com/#sle.
 - 3. Apollo Valves: www.apollovalves.com/#sle.
 - 4. Substitutions: See Section 012500 - Substitution Procedures.
- B. Reduced Pressure Backflow Preventer Assembly:
 - 1. ASSE 1013; cast bronze body and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure, and non-threaded vent outlet.
 - 2. Assembly with two gate valves.
 - 3. Accessories: Provide 4 test cocks and strainer.

2.8 DOUBLE CHECK-VALVE ASSEMBLIES

- A. Manufacturers:
 - 1. Febco: www.febcoonline.com.
 - 2. Zurn Industries,; www.zurn.com/#sle.
 - 3. Apollo Valves: www.apollovalves.com/#sle.
 - 4. Substitutions: See Section 012500 - Substitution Procedures.
- B. Double Check Valve Assembly:
 - 1. ASSE 1012; cast bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

2.9 WATER HAMMER ARRESTORS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
2. MIFAB, Inc: www.mifab.com.
3. Zurn Industries, LLC: www.zurn.com/#sle.
4. Precision Plumbing Products, Inc.: www.ppcinc.com.
5. Sioux Chief: www.siouxchief.com.
6. Substitutions: See Section 012500 - Substitution Procedures.

B. Water Hammer Arrestors:

1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

2.10 TRAP PRIMERS

A. Manufacturers:

1. Precisions Products (PPP); Model PRO 01-500.

B. In-line trap primer valve, 1/2 inch, lead free brass, vacuum breaker, internal check valve, activation at minimum flow of 0.5 gpm at 20 psi, ASSE 1018.

C. Accessories: Provide distribution unit for multiple design connections.

D. Service shut-off valve.

2.11 MIXING VALVES

A. Thermostatic Mixing Valves:

1. Manufacturers:

- a. Powers: www.powerscontrols.com.
- b. Leonard Valve Company: www.leonardvalve.com/#sle.
- c. Symmons Industries, Inc.: www.symmons.com.
- d. Substitutions: See Section 012500 - Substitution Procedures.

2. Valve: Chrome-plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.

3. Unit Rating: As indicated in the Drawing Schedule.

4. Accessories:

- a. Check valve on inlets.
- b. Volume control shut-off valve on outlet.
- c. Stem thermometer on outlet.
- d. Strainer stop checks on inlets.

5. Cabinet: 16 gauge, 0.0598 inch enameled steel, for surface mounting with keyed lock.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- F. Pipe relief from backflow preventer to nearest drain.
- G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatory sinks, or washing machine outlets.
- H. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 3/4 inch minimum, and minimum 18 inches long.
- I. Install service shutoff valve for trap primers.
- J. Heat Trace:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. Verify all heat trace piping lengths and coordinate final power requirements with electrical contractor to provide a complete working system.
 - 3. Comply with installation requirements of IEEE 515.1 and NFPA 70, Article 427.
 - 4. Apply heating cable linearly on pipe with fiberglass tape only after piping has successfully completed any required pressure testing.

END OF SECTION

PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electric heat pump with water heaters.
- B. Diaphragm-type compression tanks.
- C. In-line circulator pumps.
- D. Pressure booster systems.

1.2 RELATED REQUIREMENTS

- A. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- B. ANSI Z21.10.1 - Gas Water Heaters, Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less; 2019 (Reaffirmed 2024).
- C. ANSI Z21.10.3 - Gas-Fired Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous; 2019 (Reaffirmed 2024).
- D. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks; 2024, with Errata (2026).
- F. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2025, with Errata .
- G. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- H. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013300 - Submittal Procedures for submittals procedures.
- B. Product Data:

1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
 2. Indicate pump type, capacity, power requirements.
 3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
 4. Provide electrical characteristics and connection requirements.
- C. Shop Drawings:
1. Indicate heat exchanger dimensions, size of tappings, and performance data.
 2. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
- D. Project Record Documents: Record actual locations of components.
- E. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements for additional provisions.
 2. Extra Pump Seals: Two of each type and size.
 3. Extra Water Softener Salt: 50 pounds.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Certifications:
1. Water Heaters: NSF approved.
 2. Electric Water Heaters: UL listed and labeled to UL 174.
 3. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.
- D. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.7 WARRANTY

- A. See Section 017700 - Closeout Procedures for additional warranty requirements.

- B. Provide five year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.1 WATER HEATERS

- A. Manufacturers:
 - 1. A.O. Smith Water Products Co; Model CAHP: www.hotwater.com/#sle.
 - 2. EeMAX: www.eemax.com.
 - 3. Bradford-White: www.bradforwhite.com.
 - 4. Rheem Manufacturing Company: www.rheem.com/#sle.
 - 5. Substitutions: See Section 012500 - Substitution Procedures.

2.2 ELECTRIC HEAT PUMP WITH WATER HEATERS (EWH 1,2)

- A. Type: Automatic, electric, heat pump, vertical storage.
- B. Performance:
 - 1. As indicated on Drawings.
- C. Electrical Characteristics:
 - 1. Refer to Division 26.
- D. Tank: Glass lined welded steel, thermally insulated with 2 inch thick foam; encased in corrosion-resistant steel jacket; baked-on enamel finish.
- E. Controls: Automatic water thermostat with externally adjustable electronic interface temperature range from 80 to 170 degrees F, flanged or screw-in nichrome elements, enclosed controls and electrical junction box. Self-contained heat pump integrated into top of tank. Multiple modes with back-up electric elements.
- F. Accessories: Provide:
 - 1. CTA 2045 Modular Communications Interface.
 - 2. Water Connections: Brass.
 - 3. Dip tube: Brass.
 - 4. Drain Valve.
 - 5. Anode: Magnesium.
 - 6. Temperature and Pressure Relief Valve: ASME labelled.
 - 7. Air duct adapter kit.

2.3 DIAPHRAGM-TYPE COMPRESSION TANKS

- A. Manufacturers:
 - 1. Amtrol Inc; Model ST-C: www.amtrol.com/#sle.
 - 2. Bell & Gossett, a brand of Xylem, Inc; PTA: www.bellgossett.com/#sle.
 - 3. Taco, Inc: www.taco-hvac.com/#sle.
 - 4. Substitutions: See Section 012500 - Substitution Procedures.

- B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- C. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge as indicated on the drawings.

2.4 IN-LINE CIRCULATOR PUMPS (CP-1)

- A. Manufacturers:
 - 1. Armstrong Fluid Technology: www.armstrongfluidtechnology.com/#sle.
 - 2. Bell & Gossett, a brand of Xylem, Inc: www.bellgossett.com/#sle.
 - 3. Taco, Inc.: www.taco-hvac.com.
 - 4. Substitutions: See Section 012500 - Substitution Procedures.
- B. Casing: Bronze, rated for 125 psig working pressure, with stainless steel rotor assembly.
- C. Impeller: Bronze.
- D. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.
- E. Seal: Carbon rotating against a stationary ceramic seat.
- F. Drive: Flexible coupling.
- G. Performance:
 - 1. Unit Rating: As indicated in the Drawing Schedule.
 - 2. Electrical Characteristics:
 - a. Refer to Division 26.

2.5 SUBMERSIBLE SUMP PUMPS (SP-1; SP-2)

- A. Manufacturers:
 - 1. Armstrong Fluid Technology: www.armstrongfluidtechnology.com/#sle.
 - 2. Goulds Water Technology, a xylem brand: www.goulds.com/#sle.
 - 3. Zoeller Company: www.zoeller.com/#sle.
 - 4. Substitutions: See Section 012500 - Substitution Procedures.
- B. Type: Completely submersible, vertical, centrifugal.
- C. Casing: Cast iron pump body and oil filled motor chamber.
- D. Impeller: Cast iron; open non-clog, stainless steel shaft.
- E. Bearings: Ball bearings.
- F. Sump: Elevator pit.
- G. Accessories: Oil resistant 6 foot cord and plug with three-prong connector for connection to electric wiring system including grounding connector.

- H. Servicing: Slide-away coupling consisting of discharge elbow secure to sump floor, movable bracket, guide pipe system, lifting chain and chain hooks.
- I. Controls: Integral diaphragm type level controls with separate liquid level control high level alarm.
- J. Controls: Motor control panel containing across-the-line electric motor starters with ambient compensated quick trip overloads in each phase with manual trip button and reset button, circuit breaker, control transformer, electro mechanical alternator, hand-off-automatic selector switches, pilot lights, high water alarm pilot light, reset button and alarm horn. Provide mercury switch liquid level controls, steel shell switch encased in polyurethane foam with cast iron weight for pump on each pump, pump off, and alarm.
- K. Performance:
 - 1. As indicated in the Drawing Schedule.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.
- C. Domestic Water Storage Tanks:
 - 1. Provide steel pipe support, independent of building structural framing members.
 - 2. Clean and flush prior to delivery to site. Seal until pipe connections are made.
- D. Pumps:
 - 1. Ensure shaft length allows sump pumps to be located minimum 24 inches below lowest invert into sump pit and minimum 6 inches clearance from bottom of sump pit.
 - 2. Provide air cock and drain connection on horizontal pump casings.
 - 3. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
 - 4. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
 - 5. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

END OF SECTION

PLUMBING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flush valve water closets.
- B. Wall hung urinals.
- C. Lavatories.
- D. Sinks.
- E. Electric water coolers Bottle filling stations..
- F. Service sinks.

1.2 RELATED REQUIREMENTS

- A. Section 064000 - Architectural Wood Casework: Counters for sinks and lavatories.
- B. Section 079200 - Joint Sealants: Sealing joints between fixtures and walls and floors.
- C. Section 221005 - Plumbing Piping.
- D. Section 221006 - Plumbing Piping Specialties.
- E. Section 223000 - Plumbing Equipment.
- F. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment; 2014, with Editorial Revision (2020).
- C. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration; 2008 (Reaffirmed 2013).
- D. ASME A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).
- E. ASME A112.18.1 - Plumbing Supply Fittings; 2024.
- F. ASME A112.19.1 - Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures; 2024.
- G. ASME A112.19.1 - Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures; 2024.

- H. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2024.
- I. ASME A112.19.3 - Stainless Steel Plumbing Fixtures; 2022.
- J. ASME A112.19.14 - Six-Liter Water Closets Equipped with a Dual Flushing Device; 2013 (Reaffirmed 2018).
- K. IAPMO PS 106 - Tileable Shower Receptors and Shower Kits; 2015, with Editorial Revision.
- L. IAPMO Z124 - Plastic Plumbing Fixtures; 2022, with Editorial Revision.
- M. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- N. NSF 61 - Drinking Water System Components - Health Effects; 2025, with Addendum
- O. NSF 372 - Drinking Water System Components - Lead Content; 2024.

1.4 SUBMITTALS

- A. See Section 013300 - Substitution Procedures for submittal procedures.
- B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Manufacturer's Instructions: Indicate installation methods and procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- F. Waterless Urinals: Submit recommended frequency of maintenance and parts replacement, methods of cleaning, sources of replacement supplies and parts.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements for additional provisions.
 - 2. Extra Faucet Washers: One set of each type and size.
 - 3. Extra Lavatory Supply Fittings: One set of each type and size.
 - 4. Extra Shower Heads: One of each type and size.
 - 5. Extra Toilet Seats: One of each type and size.
 - 6. Flush Valve Service Kits: One for each type and size.
 - 7. Extra Waterless Urinal Trap Seals and Supplies: One year's worth, based on normal, expected use of facility of this type.

1.5 CLOSEOUT SUBMITTALS

- A. Section 017700 - Closeout Procedures: Closeout procedures.
- B. Operation and Maintenance Data: Submit fixture, trim, exploded view and replacement parts lists.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of this section with minimum three years experience.

1.7 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 PRE-INSTALLTION MEETINGS

- A. Section 013300 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Accept fixtures on site in factory packaging. Inspect for damage.
- C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.10 WARRANTY

- A. See Section 017700 - Closeout Procedures for additional warranty requirements.

PART 2 PRODUCTS

2.1 REFER TO DRAWINGS FOR PLUMBING FIXTURES.

2.2 LAVATORY INSULATION KIT

- A. Manufacturers:
 - 1. TruBro ;Model Lav. Guard.
 - 2. Substitutions: See Section 012500 - Substitution Procedures.
- B. Product Description: Where Lavatories are noted to be insulated for ADA compliance, furnish the following: Safety Covers conforming to ANSI A177.1 and consisting of insulation kit of molded closed cell vinyl construction, 3/16 inch thick, white or gray color, for insulating tailpiece, P-trap, valves, and supply piping. Furnish with weep hole and angle valve access covers.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.
- C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install work in accordance with applicable codes.
- B. Install each fixture with trap, easily removable for servicing and cleaning.
- C. Provide chrome-plated rigid or flexible supplies to fixtures with screwdriver stops, reducers, and escutcheons.
- D. Install components level and plumb.
- E. Install and secure fixtures in place with wall supports and bolts.
- F. Seal fixtures to wall and floor surfaces with sealant as specified in Section 079200, color to match fixture.
- G. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.
- H. For ADA accessible water closets, install flush valve with handle to wide side of stall.

3.4 INTERFACE WITH WORK OF OTHER SECTIONS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.5 ADJUSTING

- A. Section 017700 - Closeout Procedures: Testing, adjusting, and balancing.
- B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.

- B. Do not permit use of fixtures by construction personnel.
- C. Repair or replace damaged products before Date of Substantial Completion.

3.7 SCHEDULES

- A. Fixture Heights: Install fixtures to heights above finished floor as indicated.
 - 1. Water Closet:
 - a. Standard: 15 inches to top of bowl rim.
 - b. Accessible: 18 inches to top of seat.
 - 2. Water Closet Flush Valves:
 - a. Standard: 11 inches min. above bowl rim.
 - b. Recessed: 10 inches min. above bowl rim.
 - 3. Urinal:
 - a. Standard: 22 inches to top of bowl rim.
 - b. Accessible: 17 inches to top of bowl rim.
 - 4. Lavatory:
 - a. Standard: 31 inches to top of basin rim.
 - b. Accessible: 34 inches to top of basin rim.
 - 5. Drinking Fountain:
 - a. Child: 30 inches to top of basin rim.
 - b. Standard Adult: 40 inches to top of basin rim.
 - c. Accessible: 36 inches to top of spout.

END OF SECTION

BASIC HVAC REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. This Section specifies the basic requirements for all Contractor installed equipment. It applies to all sections included in Division 23. The requirements herein are an expansion upon the requirements of Division 1.
- B. Provide all materials, labor and equipment required to install complete and fully operational HVAC systems as indicated by the contract drawings and this specification.
- C. Obtain and pay for all permits, licenses, fees and taxes applicable to this project as required by law.
- D. Cooperate with other trades in furnishing material and information required for installation and operation of mechanical items.
- E. Requirements for the following are included:
 - 1. Related work (other Contract Documents and specification sections) that must be combined with the requirements of this Section.
 - 2. Design performance.
 - 3. Delivery, storage, and handling.
 - 4. Quality assurance and standards.
 - 5. Submittals.
 - 6. Product quality, basic type, and finishes.
 - 7. Equipment identification.
 - 8. Design criteria.
 - 9. Installation.
 - 10. Mounting and shimming.
 - 11. Inspection.
 - 12. Safety considerations.
 - 13. Cleaning, startup, and adjustments.

1.2 RELATED WORK

- A. This general section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for the project equipment and systems:
 - 1. Division 1 sections included in this Project specifications.
 - 2. The Contract.
 - 3. General and specific mechanical specifications and drawings included in the project.

1.3 DEFINITIONS

- A. "Indicated": Refers to graphic representations, notes or schedules in the Drawings; or to other paragraphs or schedules in Specifications and similar requirements in the Contract Documents.

1. Terms such as “shown”, “noted”, “scheduled”, and “specified”, are used to notify or help the user to locate reference. Location is not limited.
- B. “Directed”: Terms such as “directed”, “Requested”, “authorized”, “selected”, “approved”, “required”, and “permitted” mean directed by Architect/Engineer, approved by Architect/Engineer and similar phrases.
- C. “Approved”: When used in conjunction with Architect/Engineer's action on contract submittals, applications, requests, is limited to Architect/Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- D. “Regulations”: Includes laws, ordinances, statutes and lawful orders issued by authorities having jurisdiction, as well as rules, conventions and agreements within the construction industry that control performance of Work.
- E. “Furnish”: Means to supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation and similar operations.
- F. “Install”: Describes operations at Project site including actual unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, supporting, isolating, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations.
- G. “Provide”: Means to furnish and install.
- H. “Installer”: A contractor, or another entity engaged by the contractor, either as an employee, subcontractor, or contractor of a lower tier, to perform a particular construction activity including installation, erection, application or similar operations.
 1. Installers are required to be experienced in operations they are engaged to perform.
 2. The term “experience” means having successfully completed a minimum of three previous projects similar in scope and size to this Project and within the time frame indicated in the “Quality Assurance” section of the Specifications. In addition, it means being familiar with special requirements indicated and having complied with requirements of authorities having jurisdiction.
- I. “Project Site”: Is defined as the space available to the Contractor for performing construction activities, either exclusively or in conjunction with others performing other work as part of Project.

1.4 DESIGN PERFORMANCE

- A. Compliance by the Contractor and/or Vendor with the provisions of this Specification does not relieve him of the responsibilities of furnishing equipment and materials of proper design, mechanically suited to meet operating guarantees at the specified service conditions.

1.5 SUBMITTALS

- A. Product Data: Submit complete sets of manufacturer's product data in .PDF format for approval. All submittals are to be received in no more than (3) three packages. See Division 1 for further information regarding submittal requirements. Literature submitted shall clearly indicate the model number, capacity, rated operating conditions, noise levels, size, weight, support requirements, rough-in data and dimensions, electrical power requirements, wiring

diagrams, utility (fuel, air, cooling water, etc.) requirements, and options furnished. Submittals shall include, but are not necessarily limited to the following;

1. HVAC: Air handling units; DOAS units; split-system HP; fans; piping; valves; supports and anchors; louvers; grilles; diffusers; controls and the like.
 2. Calculations: Provide for factory selection and sizing of all noise attenuation; vibration; isolation; thermal expansion and seismic restraints; with good engineering practice. Include design criteria used and assumptions made.
- B. Operation and Maintenance Data: Submit three complete sets of manufacturer's literature bound in a three ring binder for approval. Data shall include installation, start-up, and maintenance instructions, parts lists, and wiring diagrams. Include all material on a CD-ROM or USB device.
- C. Substitutions: System design was based upon the equipment and materials listed on the drawings and specifications herein. At contractor's option, another manufacturer's equipment of similar quality, capacity and features may be submitted for prior approval per Section 012500.
1. Prior permission to substitute does not relieve the contractor of the responsibility of including this information in the bound submittal packages.
- D. When specified, prepare and submit shop drawings and prints of plans, sections, details and diagrams to minimum scale ($1/4" = 1'-0"$). Mechanical and pump rooms shall be $1/2" = 1'-0"$ minimum scale. Drawings shall be coordinated, dimensioned and indicate equipment, recommended clearances, pipe, duct, fire protection and electrical in relation to architectural and structural features. Include minor piping, drains, valves and the like. Indicate exact locations and elevations of valves, piping specialties, access doors, dampers and the like.
- E. Shop drawings shall be created and submitted on AutoCAD release 2017 or later.
- F. Air Balancing Report: Provide .PDF reports stating the design air and hydronic flow requirements per, air inlet and air outlet and the final adjusted airflow volume for the same.

1.6 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the provisions of the following codes, standards and specifications, except where more stringent requirements are shown or specified:
1. State of Washington "IBC".
 2. State of Washington "IMC".
 3. State of Washington "UPC".
 4. State of Washington "IFC".
 5. ANSI/ASHRAE 90 - "Energy Efficient Design of New Buildings...."
 6. ANSI/ASHRAE 62 - "Ventilation for Acceptable Indoor Air Quality."
 7. NEBB - "Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems."
 8. ANSI B31.9 "Building Service Piping".
 9. SMACNA - "HVAC Duct Construction Standards".
 10. NFPA 90B.
- B. Wherever the specification call for or describe materials or construction of better quality or larger sizes than are required by the above rules and regulations, these specifications shall

govern. Should there be any direct conflict between the above rules and regulations and the specifications the rules shall govern.

- C. Drawings: All drawings are diagrammatic and show general design, arrangement, and extent of the systems. Do not scale drawings for rough-in dimensions, nor use as shop drawings.
- D. Installer Qualifications: Company specializing in performing the work required with a minimum of five years documented experience.
- E. Contractor shall furnish and install all work in accordance with manufacturers' recommendations and instructions.
- F. Equipment shall have U.L. label listing.

1.7 MATERIALS AND SUBSTITUTIONS

- A. Shop drawings of proposed material and equipment that differ from the specified basis of design materials and equipment shall be accompanied by shop drawings that define changes physical layout and performance. These drawings shall show modifications of architectural, plumbing, electrical and mechanical work required by the proposed materials and equipment such as relocation of flues, drains, piping, ducts, revised electrical circuits, relocation of roof or wall penetrations, revised foundations and the like.

1.8 DELIVERY, STORAGE AND PROTECTION

- A. Delivery: Deliver to site with manufacturer's labels intact and legible.
- B. Preparation for shipment:
 - 1. Each unit shall be suitably prepared for the shipment specified and for storage in accordance with manufacturer's instructions in a manner requiring no disassembly prior to operation.
 - 2. The Contractor shall be solely responsible for the adequacy of the Preparation for Shipment provisions employed with respect to materials and application.
 - 3. One complete set of Installations, Operating and Maintenance Instructions shall be packed and shipped with the equipment. This set is in addition to the sets that are to be sent directly to the Owner.
- C. Handling: Avoid damage. Comply with manufacturer's installation instruction requirements for rigging, unloading and transporting units.
- D. Storage: Inside protected from weather, dirt and construction dust. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping. Cap all pipe ends. Taping pipe ends is not adequate or allowable.

1.9 PROJECT CONDITIONS

- A. General: Provide products which are compatible with other portions of the work and provide products with the proper power characteristics and similar adaptations for the project.
- B. Arrangement: Arrange ductwork and piping parallel with primary lines of the building construction and with a minimum 7 feet overhead clearance in unfinished equipment rooms

where possible. Conceal all piping and ductwork where possible unless indicated otherwise. Locate operating and control equipment properly to provide easy access for operation and maintenance. Give right-of-way to piping which must be sloped for drainage. Set all equipment level or as recommended by manufacturer.

- C. Coordination: Where several elements of the work must be sequenced and positioned in order to fit the available space, prepare shop drawings showing the actual physical dimensions (at accurate scale) required for installation and submit prior to purchase/fabrication/installation of any of the elements involved in the coordination.

1.10 STANDARDS

- A. General: Provide all new materials and equipment, identical to apparatus or equipment in successful operation for a minimum of five years. Provide materials of comparable quality omitted here but necessary to complete the work. Maximum allowable variation from stated capacities, minus 5% to plus 10% as approved in each case.
- B. Governing Standards: The following are typical standards generally referenced in these specifications and identified by their acronym. Federal Specifications (FS), American Society for Testing Materials (ASTM), American National Standards Institute (ANSI), Manufacturer's Standardization Society of the Valve and Fitting Industry, Standard Practice (MSS SP-69), Cast Iron Soil Pipe Institute (CISPI), Underwriters Laboratory (UL) numbers are given.
- C. Wherever the specifications call for or describe materials or construction of better quality or larger sizes than are required by the above standards or code, these specifications shall govern. For any direct conflict between the specifications and the above standards or codes, the standards and codes shall govern.

1.11 WARRANTIES

- A. Comply with Division 01 section - Project Closeout.
- B. Equipment under this section of the specifications shall be guaranteed for a period of one year from date of acceptance against defective materials, design, and workmanship.
- C. Contractor shall leave entire installation in complete working order and free from defects in material, workmanship, or finish.
- D. The HVAC contractor, by accepting these specifications and by signing the sub-contract, shall guarantee the following:
 - 1. All equipment, material, and workmanship against defects in material and workmanship for a period of one (1) year from date of final acceptance by the Owner. The HVAC contractor shall furnish written guarantee to replace defective work and materials furnished under this section, at no cost to the Owner, for this one (1) year period.
 - 2. That equipment and material will produce the results specified.
- E. The Owner reserves the right to make temporary repairs as necessary to keep equipment in operating condition without voiding the guarantees or relieving responsibility during the guarantee period.

- F. Provide, at no cost to the Owner, one qualified service technician for an 8-hour period after a period of 90 calendar days from date of acceptance of systems by Owner to repair, replace any latent deficiency.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 LAYOUT AND COORDINATION

- A. Site Examination: Before starting work, carefully examine site and all Contract Drawings. Become thoroughly familiar with conditions governing work on this project. Verify all indicated elevations, building measurements, rough-in dimensions and equipment locations before proceeding with any work.
- B. Utility Locations: The location of all utilities, wires, conduits, pipes, ducts, or other service facilities are shown in a general way only on the drawings and in some instances are taken from existing drawings. Ascertain whether any additional facilities other than those shown on the plans may be present and determine the exact location and elevations of all utilities prior to commencing installation.
- C. The inclusion and proper location of supports, pads, sleepers, openings, anchoring and the like provided by others is the responsibility of the contractor under this section. Cutting and/or boring shall be permitted under this section only with the written approval of the Architect.
- D. It shall be the contractor's responsibility to coordinate and have provided by other trades where not covered by the Contractor's work scope of work all electrical wiring and power to equipment, controls and devices, all plumbing and any other work from other trades as required to provide fully functional HVAC systems per contract documents.
- E. Discrepancies: Any error, omission, conflict or discrepancy in Drawings, Specifications and/or existing conditions shall be reported immediately. Do not proceed with any questionable items of work until clarification of same has been made. Should rearrangement or re-routing of piping or ductwork be necessary, provide for approval the simplest layout possible for that particular portion of the work. Under no circumstances shall beams, girders, footings or columns be cut for mechanical items. Casting of pipes into concrete is prohibited unless so shown on Drawings.
- F. The Contractor shall cooperate with others to avoid interferences and delays in the construction work.
- G. Interference as a result of poor coordination or lack of cooperation with other trades shall be corrected at the Contractor's expense.

3.2 CONTINUITY OF EXISTING SERVICES

- A. Existing water, power, heat, ventilation, air conditioning and other services shall remain in service during new construction work. Coordinate any interruption in service during new

construction work. Coordinate any interruption of these services with the Owner's representative a minimum of twenty-four (24) hours in advance.

- B. Protect from damage active utilities existing and evident by reasonable inspection of the site whether shown or not on the Drawings. Protect, relocate or abandon utilities encountered in the work which were not shown on the Drawings or evident by inspection of the work as directed by the Architect. Maintain continuity of all utility services to existing buildings.

3.3 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 1.
- B. Protection: During cutting and patching, protect adjacent installations. Provide temporary barriers to prevent the spread of dust and dirt outside of the immediate work area.
- C. Repair: Patch finished surfaces and building components using new materials to match the existing.
- D. Inspection: Upon written direction from the Architect, uncover and restore work to provide for observation of concealed work.

3.4 EQUIPMENT REMOVAL

- A. All removed equipment is the property of the Contractor unless indicated otherwise. Disconnect and remove all such equipment from the property. Cap all piping in walls, below floors, and/or above ceilings in finished rooms.
- B. Where equipment is to be reused, reconnect piping, wiring and/or controls to allow this equipment to function as it had prior to this renovation unless indicated otherwise.

3.5 MECHANICAL EQUIPMENT WIRING

- A. Provide all motor starters, control devices, and wiring complete from power source indicated on Drawings.
- B. Equipment and systems shown on the Drawings and/or specifications, are based upon requirements of specific manufacturers which are intended as somewhat typical of several makes which may be approved. Provide all field wiring and/or devices necessary for a complete and operable system controls for the actual selected equipment/system.

3.6 INSTALLATION

- A. Manufacturer's directions shall be followed in cases where the manufacturers of materials and equipment used in this contract furnish directions covering points not shown in the drawings and specifications.
- B. Locating and Positioning Equipment: Observe all Codes and Regulations and good common practice in locating and installing mechanical equipment and material so that completed installation presents the least possible hazard. Maintain recommended clearances for repair and service to all equipment.

- C. Anchorage: Anchor and/or brace all mechanical equipment, piping and ductwork to resist displacement due to seismic action, include snubbers on equipment mounted on spring isolators.
- D. Where mounting heights or locations are not identified, install systems, equipment and materials to provide maximum headroom.
- E. Provide clearance for installation of insulation and access to valves, fittings, damper actuators, etc. on pipe and duct systems.
- F. Install systems, materials and equipment giving right of way to systems required to be installed at a specific slope or operation by gravity.
- G. Provide condensate drain piping to over nearest floor drain for all coils, furnaces, boilers, domestic water heaters and the likes.
- H. Provide all sheaves required for final air balance. Contractor shall not make assumptions or exceptions concerning the number of sheave replacements or adjustments necessary to meet the design requirements. Balance all HVAC systems to provide the amount of air indicated at each diffuser, grille or register.
- I. Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and the fan has been test run under observation. Fans shall not be used during construction unless specifically authorized by the Owner and reviewed by the Engineer.
- J. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.
- K. Installation shall be in accordance with the requirements of the equipment manufacturer, including special requirements for seismic restraints.
- L. Equipment Manufacturer's Responsibility and Services:
 - 1. A manufacturer's representative for major equipment and operating systems shall be provided as necessary to assist the Contractor during installation, and to provide written certification that the equipment has been installed as specified and in accordance with the manufacturer's representative.
 - 2. The manufacturer's representative shall provide the initial startup of equipment in the presence of the Owner.
 - a. Provide a pre-start check of all piping, valves, control devices, control panels, and equipment.
 - b. Calibrate and adjust equipment and controls for operation at the specified design and conditions.
 - c. Provide a record of all startup events noting problems and their resolution.
 - d. Provide a record of all set points for operational controls and devices.
 - 3. Upon the completion of the equipment startup, provide instructional time with the Owner's personnel to review the operations and maintenance manuals and perform each step necessary for startup, shutdown, troubleshooting, and routine maintenance. The instructional time shall be scheduled through the Owner.
 - 4. Upon completion of the inspections, startup, testing, and checkout procedures, the equipment manufacturer shall submit written notice to the Owner that the units are ready for use by the Owner. Provide a certificate of calibration for all equipment.

3.7 MOUNTING AND SHIMMING

- A. Mount equipment as shown on the Drawings. Provisions for mounting special equipment on spring isolators, snubbers, and inertia bases are specified in Section 230548, Vibration Isolation and Sound and Seismic Controls for HVAC Piping and Equipment.
- B. Level the equipment by means of 304 stainless steel wedges (stainless steel plates and stainless steel shims). Wedge taper shall not be greater than 1/4 inch per foot. Use double wedges to provide a level bearing surface for the equipment. Secure each pair of wedges in their final positions with one tack weld on each side after leveling is complete. Wedging shall be executed in a manner that will prevent a change in level or springing of the Baseplate when the anchor bolts are tightened.
 - 1. Adjust rotating equipment assemblies such that the driving units are properly aligned, plumb and level with the driven units and all interconnecting shafts and couplings.
 - 2. All rotating equipment shall be checked for proper alignment with dial indicators or laser after completion of grouting. The alignment must be within the tolerances required by the equipment manufacturer. The final alignment check shall be witnessed by the Owner.

3.8 INSPECTION

- A. The Contractor shall inspect his work to ensure the installation and workmanship is in accordance with these specifications and acceptable industry standards for the work being done.
- B. All materials, equipment, and workmanship shall be subject to inspection at any time by the Owner. Contractor shall correct any work, materials, or equipment not in accordance with the Contract Documents.
- C. Any work enclosed or covered up prior to inspection and testing shall be uncovered. After the work has been tested, inspected and accepted, repair as necessary to return disturbed work to its original and proper condition at no cost to the Owner.

3.9 SAFETY CONSIDERATIONS

- A. All equipment shall be installed with suitable access clearances that satisfy OSHA and code requirements for maintenance or removal of replaceable parts and components, and with necessary unions or flanges to perform the maintenance or removal without removing the connecting appurtenances.
- B. Where equipment requiring periodic maintenance cannot be reached by normal walkways because of interference with ductwork, piping, or other obstructions the Contractor shall notify the Owner and propose an alternate safe means of access. These may include construction of an overhead platform with stairway or ladder ends and safety railings or handholds, or walk-through duct plenums with hinged access doors, or as required to meet OSHA standards for safe maintenance procedures.

3.10 CLEANING, START-UP, AND ADJUSTING

- A. The Contractors shall be responsible for proper operation of all systems, minor subsystems, and services provided under this section. He shall coordinate start-up procedures, calibration,

and system checkout with all project managers. Any system operational problems shall be diagnosed; all correctional procedures shall be initiated as required to bring out the system into compliance with the design, and the problem then shall be rechecked to verify that the system operates normally.

- B. Thoroughly clean all parts of the installation at the completion of the work. The Contractor shall clean up and remove from the premises all refuse material, crates, and rubbish arising from his work. Remove, clean, and reinstall all filters. Belt-drive tensions and alignments shall be checked. All motors and bearings shall be lubricated in accordance with the manufacturer's service manuals prior to equipment start-up. Provide a lubrication schedule for every item of equipment furnished under this section. The schedule shall include the type of lubricant and the application frequency.

END OF SECTION

VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Vibration isolation requirements.
- B. Seismic control requirements.
 - 1. Includes requirements for seismic qualification of equipment not specified in this section.
- C. Vibration-isolated equipment support bases.
- D. Vibration isolators.
- E. External seismic snubber assemblies.
- F. Seismic restraint systems.
- G. Vibration-isolated and/or seismically engineered roof curbs.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete.
- B. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

1.3 DEFINITIONS

- A. HVAC Component: Where referenced in this section in regards to seismic controls, applies to any portion of the HVAC system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., ductwork, piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.4 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.
- C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2014.

- E. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
- F. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.
- G. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.
- H. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2020).
- J. MFMA-4 - Metal Framing Standards Publication; 2004.
- K. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2024.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Seismic Controls:
 - a. Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
 - b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.6 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for submittal procedures.
- B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes documenting compliance with PART 2.
 - 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
 - 2. Seismic Controls: Include seismic load capacities.

- D. Shop Drawings - Vibration Isolation Systems:
 - 1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
 - 2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.
- E. Shop Drawings - Seismic Controls:
 - 1. Include dimensioned plan views and sections indicating proposed HVAC component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
 - 2. Identify mounting conditions required for equipment seismic qualification.
 - 3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
 - 4. Indicate proposed arrangement of distributed system trapeze support groupings.
 - 5. Indicate proposed locations for distributed system flexible fittings and/or connections.
 - 6. Indicate locations of seismic separations where applicable.
 - 7. Include point load drawings indicating design loads transmitted to structure at each attachment location.
- F. Seismic Design Data:
 - 1. Compile information on project-specific characteristics of actual installed HVAC components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.
 - a. Component operating weight and center of gravity.
 - b. Component elevation in the building in relation to the roof elevation (z/h).
 - c. Component importance factor (I_p).
 - d. For distributed systems, component materials and connection methods.
 - e. Component amplification factor (a_p) and component response modification factor (R_p), determined in accordance with ASCE 7 tables.
 - f. Applicability of overstrength factor (for certain anchorage in concrete and masonry).
 - 2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.
- G. Certification for seismically qualified equipment; identify basis for certification.
- H. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.
- I. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- J. Evidence of qualifications for seismic controls designer.
- K. Evidence of qualifications for manufacturer.
- L. Manufacturer's detailed field testing and inspection procedures.
- M. Field quality control test reports.

1.7 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Seismic Controls Designer Qualifications: Registered professional engineer licensed in Washington and with minimum five years experience designing seismic restraints for nonstructural components.
 - 1. Designer may be employed by the manufacturer of the seismic restraint products.
- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 VIBRATION ISOLATION REQUIREMENTS

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
 - 1. Select vibration isolators to provide required static deflection.
 - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
 - 3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
 - 4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
 - 5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch operating clearance beneath base unless otherwise indicated.
- D. Equipment Isolation: As indicated on drawings.
- E. Piping Isolation:
 - 1. Provide vibration isolators for piping supports:
 - a. Located in equipment rooms.
 - b. Located within 50 feet of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
 - c. For piping over 2 inch located below or within 50 feet of noise-sensitive areas indicated.

2. Minimum Static Deflection:
 - a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
 - b. Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
 3. Suspended Piping, Nonseismic Applications: Use spring isolator hangers.
 4. Suspended Piping, Seismic Applications: Use seismic type spring isolator hangers.
 5. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.
 6. Floor-Mounted Piping, Seismic Applications: Use seismic type restrained spring isolators.
 7. Use approved resilient material where vibration-isolated piping penetrates building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.
- F. Thrust Restraint Applications:
1. Use thrust restraints to resist horizontal motion due to thrust for fan heads, suspended fans, and base-mounted and suspended air handling equipment operating at 2.0 inches wg or greater total static pressure.
 2. Minimum Static Deflection: Same as static deflection of equipment.
 3. Limit lateral movement to 0.25 inch or less unless otherwise indicated.

2.2 SEISMIC CONTROL REQUIREMENTS

- A. Design and provide HVAC component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor HVAC components.
- B. Seismic Design Criteria: Obtain from project Structural Engineer of Record.
- C. Component Importance Factor (I_p): HVAC components to be assigned a component importance factor (I_p) of 1.5 unless otherwise indicated.
- D. Component Importance Factor (I_p): HVAC components essential to life safety to be assigned a component importance factor (I_p) of 1.5 as indicated or as required. This includes but is not limited to:
 1. HVAC components required to function for life safety purposes after an earthquake.
 2. HVAC components that support or otherwise contain hazardous substances.
- E. Seismic Qualification of Equipment:
 1. Provide special certification for HVAC equipment furnished under other sections and assigned a component importance factor (I_p) of 1.5, certifying that equipment will remain operable following a design level earthquake.
 2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
 3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
 4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.

- F. Premanufactured Modular HVAC Equipment: Where not otherwise seismically qualified, premanufactured modules 6 feet high and taller furnished under other sections to be designed in accordance with seismic provisions for nonbuilding structures.
- G. Seismic Restraints:
 - 1. Provide seismic restraints for HVAC components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
 - 2. Seismic Restraint Exemptions:
 - a. Exemptions for Seismic Design Category C:
 - 1) HVAC components where either of the following apply:
 - (a) The component importance factor (I_p) is 1.0 and the component is positively attached to the structure.
 - (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
 - 2) HVAC piping with component importance factor (I_p) of 1.5 and nominal pipe size of 2 inch or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
 - b. Exemptions for Seismic Design Category D, E, and F:
 - 1) Discrete HVAC components that are positively attached to the structure where either of the following apply:
 - (a) The component weighs 400 pounds or less, has a center of mass located 4 feet or less above the adjacent floor level, flexible connections are provided between the component and associated ductwork, piping, and conduit, and the component importance factor (I_p) is 1.0.
 - (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
 - 2) HVAC piping with component importance factor (I_p) of 1.0 and nominal pipe size of 3 inch or less, or with component importance factor (I_p) of 1.5 and nominal pipe size of 1 inch or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
 - c. Duct System Exemptions, All Seismic Design Categories:
 - 1) Duct systems not designed to carry toxic, highly toxic, or flammable gases and not used for smoke control with component importance factor (I_p) of 1.0, where flexible connections or other assemblies are provided between duct system and associated components, where duct system is positively attached to the structure, and where one of the following apply:
 - (a) Trapeze supported duct with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
 - (b) Trapeze supported duct with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support

- point connection to the supporting structure, and the total weight supported by any single trapeze is 200 pounds or less.
- (c) Trapeze supported duct with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
- (d) Hanger supported duct with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single rod is 50 pounds or less.
- 2) Duct systems not designed to carry toxic, highly toxic, or flammable gases and not used for smoke control, where there are provisions to avoid impact with other ducts or mechanical components or to protect ducts in the event of such impact, and where duct system is positively attached to the structure and has a cross sectional area of less than 6 square feet and weighs 20 pounds per foot or less.
- d. HVAC Piping Exemptions, All Seismic Design Categories:
 - 1) HVAC piping where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, where piping is positively attached to the structure, and where one of the following apply:
 - (a) Trapeze supported piping weighing less than 10 pounds per foot, where all pipes supported meet size requirements for exemption as single pipes described under specific seismic design category exemptions above.
 - (b) Trapeze supported piping with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (I_p) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.
 - (c) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (I_p) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 200 pounds or less.
 - (d) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (I_p) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.
 - (e) Hanger supported piping with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, where pipe has a component importance factor (I_p) of 1.0 and meets size requirements for

exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single rod is 50 pounds or less.

3. Seismic Restraint Exemptions:
 - a. Exemptions for Seismic Design Category C:
 - 1) HVAC components with component importance factor (I_p) of 1.0.
 - 2) HVAC piping with component importance factor (I_p) of 1.5 and nominal pipe size of 2 inch or less; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
 - b. Exemptions for Seismic Design Category D, E, and F:
 - 1) HVAC components with component importance factor (I_p) of 1.0 where all of the following apply:
 - (a) The component is positively attached to the structure.
 - (b) Flexible connections are provided between the component and associated ductwork, piping, and conduit.
 - (c) Either:
 - (1) The component weighs 400 pounds or less and has a center of mass located 4 feet or less above the adjacent floor level.
 - (2) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
 - 2) HVAC piping with component importance factor (I_p) of 1.0 and nominal pipe size of 3 inch or less, or with component importance factor (I_p) of 1.5 and nominal pipe size of 1 inch or less; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
 - c. Ductwork Exemptions, All Seismic Design Categories:
 - 1) Ductwork not designed to carry toxic, highly toxic, or flammable gases and not used for smoke control where any of the following apply:
 - (a) Trapeze supported ductwork weighing less than 10 pounds per foot.
 - (b) Hanger supported ductwork where each hanger in the duct run is 12 inches or less in length from the duct support to the supporting structure; rod hangers, where used, to be equipped with swivels.
 - (c) Ductwork having a cross sectional area of less than 6 square feet or weighing 17 pounds per foot or less, and where there are provisions to avoid impact with other ducts or mechanical components or to protect ducts in the event of such impact.
 - d. HVAC Piping Exemptions, All Seismic Design Categories:
 - 1) Trapeze supported piping weighing less than 10 pounds per foot, where all pipes supported meet requirements for exemption as single pipes described under specific seismic design category exemptions above.
 - 2) Hanger supported piping where each hanger in the piping run is 12 inches or less in length from the pipe support to the supporting structure; rod hangers, where used, to be equipped with swivels.
4. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
 - a. ASHRAE (HVACA).
 - b. FEMA 412.
 - c. FEMA 413.

- d. FEMA 414.
- e. FEMA E-74.
- f. SMACNA (SRM).
- 5. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
- 6. Seismic Type Vibration Isolators:
 - a. Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
- 7. External Seismic Snubber Assemblies:
 - a. Provide quantity and arrangement of external seismic snubber assemblies as required to restrain equipment in all directions (both lateral and vertical).
 - b. Do not use external seismic snubber assemblies that restrain equipment only in one or more lateral directions (but not vertical) except where uplift forces are zero or are addressed by other restraints.
- 8. Seismic Restraint Systems:
 - a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
 - b. Use only cable restraints to restrain vibration-isolated HVAC components, including distributed systems.
 - c. Use only one restraint system type for a given HVAC component or distributed system (e.g., ductwork, piping) run; mixing of cable and rigid restraints on a given component/run is not permitted.
 - d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain HVAC component in all lateral directions; consider bracket geometry in anchor load calculations.
 - e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported HVAC component weight.
 - f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported HVAC component weight.
 - g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
 - h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
 - i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.
 - j. Manufacturer's certified seismic restraint design may be submitted as an alternative to project-specific design and documentation, subject to approval of authorities having jurisdiction.
- 9. Ductwork Applications:
 - a. Provide independent support and seismic restraint for in-line components (e.g., fans, heat exchangers, humidifiers) having an operating weight greater than 75 pounds.
 - b. Positively attach appurtenances (e.g., dampers, louvers, diffusers) with mechanical fasteners.

H. Seismic Attachments:

1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
3. Do not use power-actuated fasteners except where permitted by applicable code.
4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
6. Concrete Housekeeping Pads:
 - a. Increase size of pad as required to comply with anchor requirements.
 - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

I. Seismic Interactions:

1. Include provisions to prevent seismic impact between HVAC components and other structural or nonstructural components.
2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
3. Comply with minimum clearance requirements between HVAC equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.

J. Seismic Relative Displacement Provisions:

1. Use suitable fittings or flexible connections to accommodate:
 - a. Relative displacements at connections between components, including distributed systems (e.g., ductwork, piping); do not exceed load limits for equipment utility connections.
 - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
 - c. Design displacements at seismic separations.
 - d. Anticipated drifts between floors.
2. Include provisions to prevent interruption of utility service due to seismic displacements.

2.3 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

A. Manufacturers:

1. Vibration-Isolated Equipment Support Bases:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. M.W. Sausse & Co., Inc.: www.vibrex.net.
 - d. Amber/Booth (VMC): www.thvmcgroup.com.
 - e. Substitutions: See Section 012500 - Substitution Procedures.
2. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

- B. Vibration-Isolated Structural Steel Bases:
 - 1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
 - 2. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.
- C. Vibration-Isolated Concrete Inertia Bases:
 - 1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
 - 2. Minimum Base Depth: 6 inches.
 - 3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
 - 4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
 - 5. Concrete: Filled on site with minimum 3000 psi concrete in accordance with Section 033000.
 - 6. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.
 - 7. Pump Applications: Size and configure bases for piping elbow supports as required.

2.4 VIBRATION ISOLATORS

- A. Manufacturers:
 - 1. Vibration Isolators:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. M.W. Sausse & Co., Inc.: www.vibrex.net.
 - d. Amber/Booth (VMC): www.thevmcgroup.com.
 - 2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.
- B. General Requirements:
 - 1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
 - 2. Spring Elements for Spring Isolators:
 - a. Color code or otherwise identify springs to indicate load capacity.
 - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
 - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
 - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
 - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
 - f. Selected to function without undue stress or overloading.
 - 3. Seismic Snubbing Elements for Seismic Isolators:
 - a. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
 - b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.
- C. Vibration Isolators for Seismic Applications:
 - 1. Resilient Material Isolator Mounts, Seismic:
 - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) isolator material; specifically

- designed and rated for seismic applications with integral snubbing in all directions.
2. Restrained Spring Isolators, Seismic:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g., neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
 - b. Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
 - d. Provides constant free and operating height.
 3. Resilient Material Isolator Hangers, Seismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
 4. Spring Isolator Hangers, Seismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
 5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

2.5 ACOUSTICAL AND VIBRATION ISOLATORS

- A. Manufacturers:
 1. Acoustical and Vibration Isolators:
 - a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - b. Substitutions: See Section 012500 - Substitution Procedures.
 2. Source Limitations: Furnish isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.
- B. General Requirements:
 1. Acoustical Isolation System: Through-stud isolators, pipe clamps, riser clamp pads, neoprene and felt lining material and associated support brackets.

2.6 EXTERNAL SEISMIC SNUBBER ASSEMBLIES

- A. Manufacturers:
 - 1. External Seismic Snubber Assemblies:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. M.W. Sausse & Co., Inc.: www.vibrex.net.
 - d. Amber/Booth: www.thevmcgroup.com.
 - e. Substitutions: See Section 012500 - Substitution Procedures.
 - 2. Source Limitations: Furnish external seismic snubber assemblies and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.
- C. Seismic Snubbing Elements:
 - 1. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
 - 2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

2.7 SEISMIC RESTRAINT SYSTEMS

- A. Manufacturers:
 - 1. Seismic Restraint Systems:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. AFCON, a brand of Anvil International: www.anvilintl.com/#sle.
 - d. Eaton Corporation: www.eaton.com/#sle.
 - 2. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.
- B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.
- C. Cable Restraints:
 - 1. Comply with ASCE 19.
 - 2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
 - 3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
 - 4. Use protective thimbles for cable loops where potential for cable damage exists.
- D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

2.8 VIBRATION-ISOLATED AND/OR SEISMICALLY ENGINEERED ROOF CURBS

- A. Manufacturers:
 - 1. Vibration-Isolated and/or Seismically Engineered Roof Curbs:

- a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. BRD Noise and Vibration Control; Hushcore HIG: www.hushcore.net.
 - c. CDI; Iso Curb: www.cdicurbs.com.
 - d. Thybar; Vibro-Curb III: www.thybar.com.
 - e. Substitutions: See Section 012500 - Substitution Procedures.
 - 2. Source Limitations: Furnish vibration-isolated roof curbs and associated accessories produced by a single manufacturer and obtained from a single supplier.
- B. Vibration Isolation Curbs:
- 1. Seismic Curb:
 - a. Location: Between structure and rooftop equipment.
 - b. Construction: Steel.
 - c. Integral vibration isolation to comply with requirements of this section.
 - d. Snubbers consist of minimum 0.25 inch thick resilient pads to avoid metal-to-metal contact without compromising vibration isolating capabilities.
 - e. Weather exposed components consist of corrosion resistant materials.
- C. Seismic Type Nonisolated Curb and Fabricated Equipment Piers:
- 1. Location: Between structure and rooftop equipment.
 - 2. Construction: Steel.
 - 3. Weather exposed components consist of corrosion resistant materials.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 CODE-REQUIRED SPECIAL INSPECTIONS

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 014533 and statement of special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
 - 1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
 - 2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Seismic special inspections include, but are not limited to:

1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with the certificate of compliance.
 2. Installation and anchorage of piping systems designed to carry hazardous materials and their associated mechanical units for Seismic Design Categories C, D, E, and F; periodic inspection.
 3. Installation and anchorage of ductwork designed to carry hazardous materials for Seismic Design Categories C, D, E and F; periodic inspection.
 4. Installation and anchorage of vibration isolation systems for Seismic Design Categories C, D, E, and F where the approved Contract Documents require a nominal clearance of 1/4 inch or less between equipment support frame and seismic restraint; periodic inspection.
 5. Verification of required clearances between HVAC equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.
- D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.
- E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Field-Welding (where approved by Architect): Comply with Section 055000.
- E. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- F. Vibration Isolation Systems:
1. Vibration-Isolated Equipment Support Bases:
 - a. Provide specified minimum clearance beneath base.
 2. Spring Isolators:
 - a. Position equipment at operating height; provide temporary blocking as required.
 - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
 - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
 3. Isolator Hangers:
 - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
 - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
 4. Thrust Restraints:

- a. Adjust restraint movement under normal operating static pressure.
- 5. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
- 6. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
- 7. Adjust isolators to be free of isolation short circuits during normal operation.
- 8. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.
- G. Seismic Controls:
 - 1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris, or other obstructions.
 - 2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
 - 3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
 - 4. Equipment with Sheet Metal Housings:
 - a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
 - b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
 - c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
 - 5. Concrete Housekeeping Pads:
 - a. Size in accordance with seismic design to meet anchor requirements.
 - b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
 - 6. Seismic Restraint Systems:
 - a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
 - b. Install restraints within permissible angles in accordance with seismic design.
 - c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
 - d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
 - e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4500 - Quality Control, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Provide manufacturer representative or authorized technician services to assist with inspection and testing of vibration isolation systems and seismic controls. Submit a detailed copy of manufacturer recommended inspection, testing, and field report procedures.
- D. Vibration Isolation Systems:

Vibration and Seismic Controls for HVAC

1. Verify isolator static deflections.
 2. Verify required clearance beneath vibration-isolated equipment support bases.
 3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- E. Seismic Controls:
1. Verify snubbing element air gaps.
- F. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.
- G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Labels.

1.2 RELATED REQUIREMENTS

- A. Section 099123 - Interior Painting: Identification painting.

1.3 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2025.

1.4 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Brady Corporation: www.bradycorp.com.
- B. Safety Sign Company: www.safetysignco.com.
- C. Seton Identification Products: www.seton.com/aec.
- D. Substitutions: See Section 012500 - Substitution Procedures.

2.2 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: Black.
 - 2. Letter Height: 1/2 inch.
 - 3. Background Color: Yellow.
 - 4. Plastic: Comply with ASTM D709.

2.3 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: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.4 LABELS

- A. Description: Aluminum, size 1.9 x 0.75 inches, adhesive backed with printed identification.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 099123 for stencil painting.

3.2 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- F. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with 8 x 4 inch plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- G. Identify control panels and major control components outside panels with plastic nameplates.

Identification for HVAC Piping and Equipment

- H. Tag automatic controls, instruments, and relays. Key to control schematic.
- I. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- J. Install ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

HVAC ENCLOSED MOTOR CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manual motor controllers.
- B. Magnetic motor controllers.
- C. Combination magnetic motor controllers and disconnects.

1.2 RELATED REQUIREMENTS

- A. Section 260529 - Hangers and Supports for Electrical Systems.
- B. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- C. Section 262813 - Fuses.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2015.
- B. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC; National Electrical Manufacturers Association; 2008 (R2020).
- C. NEMA IA 10039 - Industrial Control and Systems: Control Circuit and Pilot Devices; National Electrical Manufacturers Association; 2017.
- D. NEMA IA 10030 - Industrial Control and Systems: Enclosures; National Electrical Manufacturers Association; 1993 (R2016).
- E. NEMA BS 31047 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum); National Electrical Manufacturers Association; 2013.
- F. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2017.
- G. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for submittal procedures.

- B. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- C. Test Reports: Indicate field test and inspection procedures and test results.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Maintenance Data: Replacement parts list for controllers.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Eaton Corporation; Cutler-Hammer Product: www.eaton.com.
- B. General Electric Company: www.geindustrial.com.
- C. Schneider Electric; Square D Products: www.schneider-electric.us.
- D. Allen Bradley: www.ab.com.
- E. Substitutions: See Section 012500 - Substitution Procedures.

2.2 MANUAL CONTROLLERS

- A. Manual Motor Controllers: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller with overload element, red pilot light, field reversible auxiliary contact, and push button operator.
- B. Fractional Horsepower Manual Controllers: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light, and push button operator.
- C. Motor Starting Switches: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, with red pilot light and key operator.

- D. Enclosures: NEMA IA 10030, Type as required to meet conditions of installation.

2.3 AUTOMATIC CONTROLLERS

- A. Magnetic Motor Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.
- B. Coil Operating Voltage: 120 volts, 60 Hertz.
- C. Overload Relays: NEMA ICS 2; bimetal.
- D. Enclosures: NEMA IA 10030, Type as required to meet conditions of installation.
- E. For starters above 10 HP at 230 volts or 20 HP at 460 volts, provide soft-start with horsepower rated speed bypass contactor, keypad, and LCD to display starter set-up/status/diagnostics and constant current and current ramp modes.

2.4 ACCESSORIES

- A. Auxiliary Contacts: NEMA ICS 2, 2 field convertible contacts in addition to seal-in contact.
- B. Cover Mounted Pilot Devices: NEMA IA 10039, heavy duty oiltight type.
- C. Pilot Device Contacts: NEMA IA 10039, Form Z, rated A150.
- D. Pushbuttons: Recessed and lockable type.
- E. Indicating Lights: Transformer, LED type.
- F. Selector Switches: Rotary type, HOA. Provided on all automatic controllers.
- G. Relays: NEMA ICS 2.
- H. Control Power Transformers: 120 volt secondary. Provide fused primary, secondary, and bond unfused leg of secondary to enclosure.
- I. Solid-state leg loss protection for 3 phase motors.

2.5 DISCONNECTS (AS APPLICABLE)

- A. Combination Controllers: Combine motor controllers with disconnects in common enclosure. Obtain IEC Class 2 coordinated component protection.
- B. Thermal Magnetic Circuit Breakers: Integral thermal and instantaneous magnetic trip in each pole; UL listed.
- C. Motor Circuit Protector: Circuit breakers with integral instantaneous magnetic trip in each pole; UL listed.
- D. Nonfusible Switch Assemblies: NEMA BS 31047, enclosed knife switch with externally operable handle.

- E. Fusible Switch Assemblies: NEMA BS 31047, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate Class R fuses.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install enclosed controllers where indicated, in accordance with manufacturer's instructions.
- B. Install securely, in a neat and workmanlike manner, as specified in NECA 1.
- C. Provide supports in accordance with Section 260529.
- D. Height: 5 ft. to operating handle.
- E. Provide fuses for fusible switches; refer to Section 262813 for product requirements.
- F. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- G. Identify enclosed controllers in accordance with Section 260553.
- H. All single-phase motors shall have manual or automatic controllers as required by control sequence.
- I. All three phase motors shall have automatic controllers.
- J. All controllers shall be provided with enclosure.

3.2 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 014500.
- B. Inspect and test in accordance with NETA STD ATS, except Section 4.
- C. Perform inspections and tests listed in NETA STD ATS, Section 7.16.1.

END OF SECTION

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Measurement of final operating condition of HVAC systems.
- C. Vibration measurement of equipment operating conditions.
- D. Commissioning activities.

1.2 RELATED REQUIREMENTS

- A. Section 014500 - Quality Control: Employment of testing agency and payment for services.

1.3 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2024, with Errata (2025).

1.4 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for submittal procedures.
- B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Submit to Architect.
 - 2. Submit to the Commissioning Authority and Construction Manager.
 - 3. Submit six weeks prior to starting the testing, adjusting, and balancing work.
 - 4. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
 - 5. Include at least the following in the plan:
 - a. Preface: An explanation of the intended use of the control system.
 - b. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - c. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - d. Identification and types of measurement instruments to be used and their most recent calibration date.

- e. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - f. Final test report forms to be used.
 - g. Detailed step-by-step procedures for TAB work for each system and issue, including:
 - 1) Terminal flow calibration (for each terminal type).
 - 2) Diffuser proportioning.
 - 3) Branch/submain proportioning.
 - 4) Total flow calculations.
 - 5) Rechecking.
 - 6) Diversity issues.
 - h. Expected problems and solutions, etc.
 - i. Criteria for using air flow straighteners or relocating flow stations and sensors; analogous explanations for the water side.
 - j. Details of how TOTAL flow will be determined; for example:
 - 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
 - 2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
 - k. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
 - l. Confirmation of understanding of the outside air ventilation criteria under all conditions.
 - m. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
 - n. Method of checking building static and exhaust fan and/or relief damper capacity.
 - o. Proposed selection points for sound measurements and sound measurement methods.
 - p. Methods for making coil or other system plant capacity measurements, if specified.
 - q. Time schedule for TAB work to be done in phases (by floor, etc.).
 - r. Description of TAB work for areas to be built out later, if any.
 - s. Time schedule for deferred or seasonal TAB work, if specified.
 - t. False loading of systems to complete TAB work, if specified.
 - u. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
 - v. Interstitial cavity differential pressure measurements and calculations, if specified.
 - w. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
 - x. Procedures for formal progress reports, including scope and frequency.
 - y. Procedures for formal deficiency reports, including scope, frequency and distribution.
- D. Field Logs: Submit at least twice a week to the Commissioning Authority.
- E. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

- F. Progress Reports.
- G. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Submit to the the Commissioning Authority within two weeks after completion of testing, adjusting, and balancing.
 - 2. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
 - 4. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
 - 5. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 6. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 7. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.
 - 8. Include the following on the title page of each report:
 - a. Name of Testing, Adjusting, and Balancing Agency.
 - b. Address of Testing, Adjusting, and Balancing Agency.
 - c. Telephone number of Testing, Adjusting, and Balancing Agency.
 - d. Project name.
 - e. Project location.
 - f. Project Architect.
 - g. Project Engineer.
 - h. Project Contractor.
 - i. Project altitude.
 - j. Report date.
- H. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
 - 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Having minimum of three years documented experience.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.
- F. TAB Supervisor Qualifications: Professional Engineer licensed in the State of Washington.
- G. Pre-Qualified TAB Agencies:
 - 1. Northwest Engineering Service, Inc.
 - 2. Air Balancing Specialty.
 - 3. Neudorfer Engineers.
 - 4. Precisionaire Northwest.
 - 5. Accurate Balancing Agency, Inc.
 - 6. Substitutions: See Section 012500 - Substitution Procedures.

3.2 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place.
 - 15. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.

1. Require attendance by all installers whose work will be tested, adjusted, or balanced.
- B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.
- C. Provide additional balancing devices as required.

3.4 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.5 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
 1. Running log of events and issues.
 2. Discrepancies, deficient or uncompleted work by others.
 3. Contract interpretation requests.
 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- H. Check and adjust systems approximately six months after final acceptance and submit report.

3.6 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.
- M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
- N. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.
- O. On fan powered VAV boxes, adjust air flow switches for proper operation.

3.7 SCOPE

- A. Test, adjust, and balance the following:
 - 1. Plumbing Pumps.
 - 2. Air Coils.
 - 3. Packaged Air-to-Air Energy Recovery Units.
 - 4. Packaged Outdoor Rooftop Units.
 - 5. Dedicated Outdoor Air Units.
 - 6. Small Capacity Split-System Air Conditioner.
 - 7. Fans.

8. Air Inlets and Outlets.

3.8 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:
 - 1. Manufacturer.
 - 2. Model/Frame.
 - 3. HP/BHP.
 - 4. Phase, voltage, amperage; nameplate, actual, no load.
 - 5. RPM.
 - 6. Service factor.
 - 7. Starter size, rating, heater elements.
 - 8. Sheave Make/Size/Bore.
- B. V-Belt Drives:
 - 1. Identification/location.
 - 2. Required driven RPM.
 - 3. Driven sheave, diameter and RPM.
 - 4. Belt, size and quantity.
 - 5. Motor sheave diameter and RPM.
 - 6. Center to center distance, maximum, minimum, and actual.
- C. Pumps:
 - 1. Identification/number.
 - 2. Manufacturer.
 - 3. Size/model.
 - 4. Impeller.
 - 5. Service.
 - 6. Design flow rate, pressure drop, BHP.
 - 7. Actual flow rate, pressure drop, BHP.
 - 8. Discharge pressure.
 - 9. Suction pressure.
 - 10. Total operating head pressure.
 - 11. Shut off, discharge and suction pressures.
 - 12. Shut off, total head pressure.
- D. Air Cooled Condensers:
 - 1. Identification/number.
 - 2. Location.
 - 3. Manufacturer.
 - 4. Model number.
 - 5. Serial number.
 - 6. Entering DB air temperature, design and actual.
 - 7. Leaving DB air temperature, design and actual.
 - 8. Number of compressors.
- E. Electric Duct Heaters:
 - 1. Manufacturer.
 - 2. Identification/number.
 - 3. Location.
 - 4. Model number.

5. Design kW.
 6. Number of stages.
 7. Phase, voltage, amperage.
 8. Test voltage (each phase).
 9. Test amperage (each phase).
 10. Air flow, specified and actual.
 11. Temperature rise, specified and actual.
- F. Air Moving Equipment:
1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Arrangement/Class/Discharge.
 6. Air flow, specified and actual.
 7. Return air flow, specified and actual.
 8. Outside air flow, specified and actual.
 9. Total static pressure (total external), specified and actual.
 10. Inlet pressure.
 11. Discharge pressure.
 12. Sheave Make/Size/Bore.
 13. Number of Belts/Make/Size.
 14. Fan RPM.
- G. Return Air/Outside Air:
1. Identification/location.
 2. Design air flow.
 3. Actual air flow.
 4. Design return air flow.
 5. Actual return air flow.
 6. Design outside air flow.
 7. Actual outside air flow.
 8. Return air temperature.
 9. Outside air temperature.
 10. Required mixed air temperature.
 11. Actual mixed air temperature.
 12. Design outside/return air ratio.
 13. Actual outside/return air ratio.
- H. Exhaust Fans:
1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Air flow, specified and actual.
 6. Total static pressure (total external), specified and actual.
 7. Inlet pressure.
 8. Discharge pressure.
 9. Sheave Make/Size/Bore.
 10. Number of Belts/Make/Size.
 11. Fan RPM.

- I. Duct Traverses:
 - 1. System zone/branch.
 - 2. Duct size.
 - 3. Area.
 - 4. Design velocity.
 - 5. Design air flow.
 - 6. Test velocity.
 - 7. Test air flow.
 - 8. Duct static pressure.
 - 9. Air temperature.
 - 10. Air correction factor.

END OF SECTION

DUCT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Duct insulation.
- B. Duct liner.
- C. Jacketing and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 099113 - Exterior Painting: Painting insulation jackets.
- C. Section 099123 - Interior Painting: Painting insulation jackets.
- D. Section 230553 - Identification for HVAC Piping and Equipment.
- E. Section 233100 - HVAC Ducts and Casings: Kitchen hood ductwork.

1.3 REFERENCE STANDARDS

- A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- E. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- F. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2025.
- G. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.
- H. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2025.

- I. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2025.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- K. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- L. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2026.
- M. ASTM E2336 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems; 2025.
- N. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- O. NAIMA - North American Insulation Manufacturers Association; Current Edition.
- P. NFPA - National Fire Protection Association; Current Edition.
- Q. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.
- R. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2027.
- S. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- T. UL (Environmental) - Underwriter's Laboratories Environmental; Current Edition.
- U. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.
- V. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.
- W. UL 2824 - GREENGUARD Certification Program Method for Measuring Microbial Resistance from Various Sources Using Static Environmental Chambers; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section and approved by manufacturer.
- C. Surface-Burning Characteristics: For insulation and related materials, UL/ULC Classified per UL 723 or meeting ASTM E84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
- D. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
- E. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- F. Formaldehyde Free: Third party certified with UL Environment Validation.
- G. Biosoluble: As determined by research conducted by the International Agency for Research on Cancer (IARC) and supported by revised reports from the National Toxicology Program (NTP) and the California Office of Environmental Health Hazard Assessment. Certified by European Certification Board for Mineral Wool Products (EUCB).
- H. Recycled Content: A minimum of 50 percent recycled glass content.
- I. 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 (GGG) UL GREENGUARD Gold Certification.
- J. Living Building Challenge-Declare Red List Free.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

1.8 DEFINITIONS

- A. Thermal Conductivity (K value): Units of Btu-inch/hour per square foot per degree F.

- B. ASJ+: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film layer leaving no paper exposed.
- C. ASJ: All Service Jacket (no outer film).
- D. SSL+: Self-Sealing Lap with Advanced Closure System.
- E. SSL: Self-Sealing Lap.
- F. FSK: Foil Scrim Kraft; jacketing.
- G. PSK: Poly Scrim Kraft; jacketing.
- H. PVC: PolyVinyl Chloride.
- I. Glass Mineral Wool: Interchangeable with fiber glass, but replacing the term in the attempt to disassociate and differentiate Glass Mineral Wool from the potential health and safety of special purpose or reinforcement products that do not meet the bio solubility criteria of insulation made from glass. Rock Mineral Wool will replace the traditional Mineral Wool label. Both are used in lieu of the Mineral Mineral Wool label.
- J. ECOSE Technology: a revolutionary new binder system based on rapidly renewable bio-based materials; rather than petroleum-based chemicals commonly used in other glass mineral wool insulation materials. ECOSE Technology reduces the binder embodied energy by up to 70 percent and does not contain phenol, formaldehyde, acrylics or artificial colors.
- K. Polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE fire retardants: have been linked to adverse health effects after exposure in low concentrations.
- L. UL Classified: UL has tested and evaluated samples of the product with respect to certain properties of the product. UL Classifies products to:
 - 1. Applicable UL requirements.
 - 2. Standards for safety.
 - 3. Standards of other National and International organizations.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 DUCT WRAP, FLEXIBLE

- A. Manufacturer:
 - 1. Johns Manville; Microlite FSK: www.jm.com/#sle.
 - 2. Knauf Insulation; Atmosphere Duct Wrap: www.knaufinsulation.com/#sle.
 - 3. Owens Corning Corporation; SOFTR or EcoTouch: www.ocbuildingspec.com/#sle.
 - 4. Substitutions: See Section 012500 - Substitution Procedures.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.

Duct Insulation

1. K value: .29 at 75 degrees F, when tested in accordance with ASTM C177.
 2. Maximum Service Temperature: 250 degrees F.
 3. Maximum Water Vapor Absorption: <5.0 percent by weight per ASTM C1104/C1104M.
- C. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 3. Secure with pressure-sensitive tape.
- D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.
- E. Outdoor Vapor Barrier Mastic:
1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- F. Tie Wire: Annealed steel, 16 gauge.

2.3 GLASS FIBER, RIGID

- A. Manufacturer:
1. CertainTeed Corporation; ToughGard® Rigid Liner Board: www.certainteed.com/#sle.
 2. Johns Manville; Permacote Linacoustic R-300: www.jm.com/#sle.
 3. Knauf Insulation; Rigid Plenum Liner: www.knaufinsulation.com/#sle.
 4. Substitutions: See Section 012500 - Substitution Procedures.
- B. Insulation: ASTM C612; rigid, noncombustible blanket.
1. ASTM C1071, Type II.
 2. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
 3. Maximum Service Temperature: 450 degrees F.
 4. Maximum Water Vapor Absorption: 5.0 percent.
 5. Maximum Density: 8.0 pcf.
- C. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 3. Secure with pressure-sensitive tape.
- D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.
- E. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
 2. Vinyl emulsion type acrylic, compatible with insulation, black color.
- F. UL/ULC Classified per UL 723. Comply with ASTM C1071 Type I and Type II, NFPA 90A, and NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard." UL

GREENGUARD Certified does not support the growth of mold, fungi, or bacteria per ASTM C1338 and meets UL Environment GREENGUARD Microbial Resistance Listing per UL 2824-“GREENGUARD Certification Program Method for Measuring Microbial Resistance “. UL/E validated to be formaldehyde free. DecaBDP Free.

2.4 JACKETING AND ACCESSORIES

- A. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
 - 1. Lagging Adhesive:
 - a. Compatible with insulation.
- B. Mineral Fiber (Outdoor) Jacket: Asphalt impregnated and coated sheet, 50 lb/square.
- C. Aluminum Jacket:
 - 1. Comply with ASTM B209/B209M.
 - 2. Thickness: 0.020 inch sheet.
 - 3. Finish: Embossed.
 - 4. Joining: Longitudinal slip joints and 2 inch laps.
 - 5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
 - 6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
 - 7. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

2.5 DUCT LINER

- A. Manufacturers:
 - 1. CertainTeed Corporation; ToughGard® Duct Liner: www.certainteed.com/#sle.
 - 2. Johns Manville; Linacoustic RC: www.jm.com/#sle.
 - 3. Knauf Insulation: www.knaufinsulation.com/#sle.
 - 4. Owens Corning Corporation; QuietR Rotary Duct Insulation: www.ocbuildingspec.com/#sle.
 - 5. Substitutions: See Section 012500 - Substitution Procedures.
- B. Insulation: Non-corrosive, incombustible glass mineral wool complying with ASTM C1071; mat faced air stream surface and edges coated with acrylic polymer.
 - 1. Fungal Resistance: No growth when tested according to ASTM G21.
 - 2. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.
 - 3. Service Temperature: Up to 250 degrees F.
 - 4. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm, minimum.
 - 5. Minimum Noise Reduction Coefficients:
 - a. 1/2 inch Thickness: 0.45.
 - b. 1 inch Thickness: 0.70.
 - c. 1-1/2 inches Thickness: 0.80.
 - d. 2 inch Thickness: 0.85.
- C. Liner Fasteners: Galvanized steel.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Test ductwork for design pressure prior to applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Insulated Ducts Conveying Air Below Ambient Temperature:
 - 1. Provide insulation with vapor barrier jackets.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. Insulated Ducts Conveying Air Above Ambient Temperature:
 - 1. Provide with or without standard vapor barrier jacket.
 - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with canvas jacket sized for finish painting.
- F. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with with calked aluminum jacket with seams located on bottom side of horizontal duct section.
- G. Slope exterior ductwork to shed water.
- H. External Duct Insulation Blanket or Board Application:
 - 1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
 - 2. Secure board insulation without vapor barrier with mechanical fasteners (pins and speed washers).
 - 3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
 - 4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive or FSK tape made for duct wrap or FSK board.
 - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- I. Duct and Plenum Liner Application:
 - 1. Adhere insulation with adhesive for 100 percent coverage.
 - 2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
 - 3. Seal and smooth joints. Seal and coat transverse joints.

Duct Insulation

4. Seal liner surface penetrations with adhesive.
 5. Duct dimensions indicated are net inside dimensions required for air-flow. Increase duct size to allow for insulation thickness.
 6. Refer to SMACNA publication for transverse edges for velocities over 2500 fpm.
- J. Install fire wrap per manufacturer's instructions.

3.3 SCHEDULES

- A. Combustion Air Duct:
1. Flexible Glass Fiber Duct Insulation: Minimum 2 inches thick or R-value of 7.
- B. Exhaust Ducts Within 10 ft of Exterior Openings:
1. Flexible Glass Mineral Wool Duct Insulation: Minimum 2 inches thick or R-Value of 8.
- C. Outside Air Intake Ducts:
1. Flexible Glass Mineral Wool Duct Insulation: Minimum 2 inches thick or R-Value of 8.
- D. Supply Ducts:
1. Flexible Glass Mineral Wool Duct Insulation: Minimum 1.5 inches thick or R-Value of 5.
- E. Ducts Exposed to Outdoors:
1. Flexible or Rigid Glass Mineral Wool Duct Insulation: Minimum 2 inches thick or R-Value of 8.

END OF SECTION

HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal ductwork.
- B. Casing and plenums.
- C. Kitchen hood ductwork.
- D. Duct cleaning.
- E. Duct systems have been designed for metal duct.

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 099113 - Paints and Coatings: Weld priming, weather resistant, paint or coating.
- C. Section 099123 - Paints and Coatings: Weld priming, weather resistant, paint or coating.
- D. Section 230548 - Vibration Isolation and Sound and Seismic Controls for HVAC Piping and Equipment.
- E. Section 230593 - Testing, Adjusting, and Balancing for HVAC.
- F. Section 230713 - Duct Insulation: External insulation and duct liner, kitchen grease duct fire wrap.
- G. Section 233300 - Air Duct Accessories.
- H. Section 233700 - Air Outlets and Inlets.

1.3 REFERENCE STANDARDS

- A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- D. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

- 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; 2021a.
- F. 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; 2018a.
- G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- I. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.
- J. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.
- K. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.
- L. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2016.
- M. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- N. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2021.
- O. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2021.
- P. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2021.
- Q. SMACNA (FGD) - Fibrous Glass Duct Construction Standards; 2021.
- R. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines; 2001.
- S. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- T. UL 1978 - Grease Ducts; Current Edition, Including All Revisions.
- U. UL 2221 - Tests of Fire Resistive Grease Duct Enclosure Assemblies; Current Edition, Including All Revisions.

1.4 COORDINATION

- A. The Drawings do not attempt to show exact details of all ductwork. No extra payment will be allowed for obstruction by work of other trades or local obstructions to the work which

require offsets. Where diagrams have been made to show duct connections, the Contractor is cautioned that these diagrams must not be used for obtaining material quantities.

- B. Changes in location of equipment or ductwork, advisable in the opinion of the Contractor, shall be submitted to the Engineer for review before proceeding with the work. All measurements and dimensions shall be verified at the site.
- C. Duct sizes shown on the Drawings represent the nominal free area required for that service. Where changes in duct dimensions are necessary to coordinate the installation, the contractor is allowed, with prior permission from the project engineer, to use alternative equivalent sized ducts.
- D. Coordination with Existing Conditions and with other Trades:
 - 1. Coordinate the installation of ductwork with existing conditions and the work of other trades to allow the installation of ductwork and the proper operation of dampers and operators.
 - 2. Where existing thread rod, strut material, miscellaneous supports, conduit, or piping under 1-inch diameter obstructs the passage of the ductwork, they shall be relocated by the Contractor at no additional cost to the Owner. Coordinate the work with other trades.

1.5 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data for duct materials, duct liner, duct connections, and duct fittings.
- C. Shop Drawings: Submit duct fabrication drawings, drawn to scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as Contract Documents, indicating:
 - 1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
 - 2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust duct systems, indicate classification of materials handled as defined in this section.
 - 3. Fittings.
 - 4. Reinforcing details and spacing.
 - 5. Seam and joint construction details.
 - 6. Penetrations through fire rated and other walls.
 - 7. Terminal unit, coil, and humidifier installations.
 - 8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
- D. Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.
- E. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meet or exceed recommended fabrication and installation requirements.
- F. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A, NFPA 90B, and NFPA 96 standards.

1.8 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.
- B. Un-Galvanized Steel for Ducts: ASTM A1008/A1008M, Designation CS, cold-rolled commercial steel.
- C. Aluminum for Ducts: ASTM B209/B209M; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.
- D. Stainless Steel for Ducts: ASTM A666/A666M, Type 304.
- E. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - 1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - 2. VOC Content: Not more than 250 g/L, excluding water.
 - 3. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E84.
 - 4. For Use With Flexible Ducts: UL labeled.
 - 5. Manufacturers:
 - a. Duro-Dyne; Model DSW: www.durodyne.com.
 - b. Hard Cast; Model RTA 50 : www.hardcast.com.
 - c. Hard Cas; Model "Versa-Grip" 102: www.hardcast.com.
 - d. Sika; Model "Sikaflex": www.sika.com.
 - e. Substitutions: See Section 012500 - Substitution Procedures.

- F. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
- G. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
 - 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 - 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 - 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 - 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 - 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
 - 6. Other Types: As required.
 - 7. Manufacturers:
 - a. Powers Fasteners, Inc.: www.powers.com.
 - b. Substitutions: See Section 012500 - Substitution Procedures.
- H. All Ducts: G90 Galvanized steel, unless otherwise indicated. Provide SMACNA pressure class as indicated or at a minimum meet or exceed the pressure rating of the connected fan. In no case less than 1/2 inch w.g. permitted.
- I. General Exhaust: Minimum 1/2 inch w.g. pressure class, galvanized steel. Use Aluminum in wet areas, like shower rooms.
- J. Kitchen Cooking Hood Exhaust: 1 inch w.g. stainless steel or un-galvanized steel.
 - 1. Construct of 16 gage, 0.0598 inch sheet steel using continuous external welded joints in hidden rectangular sections where duct is concealed from kitchen view.
 - 2. Construct of 18 gage, 0.0500 inch stainless steel using continuous external welded joints in exposed rectangular sections where duct is exposed in kitchen.
- K. Dishwasher Exhaust: Minimum 1/2 inch w.g. pressure class.
 - 1. Construct of 18 gage, 0.0500 inch stainless steel using continuous external welded joints in rectangular sections.
- L. Grease Exhaust: 1.0 inch pressure class, stainless steel or un-galvanized steel.
 - 1. Construct of ASTM A1011/A1011M 16 gage un-galvanized steel in hidden areas.
 - 2. Construct of 18 gage, 0.0500 inch stainless steel in exposed areas.
 - 3. Construction:
 - a. Liquid tight with continuous external weld for all seams and joints.
 - b. Where ducts are not self draining back to equipment, provide low point drain pocket with copper drain pipe to sanitary sewer.
 - 4. Access Doors:
 - a. Provide for duct cleaning inside horizontal duct at drain pockets, every 20 feet and at each change of direction.
 - b. Use same material and thickness as duct with gaskets and sealants rated 1500 degrees F for grease tight construction.
- M. Outside Air Intake: Minimum 1/2 inch w.g. pressure class, galvanized steel.

2.2 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.
- B. Transfer Air and Sound Boots: 1/2 inch w.g. pressure class, fibrous glass.

- C. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE (FUND) Handbook - Fundamentals.
- D. Duct systems have been designed for metal duct.
- E. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- F. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.
- G. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
- H. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- I. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).
- J. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- K. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.3 DUCT MANUFACTURERS

- A. Streimer Sheet Metal: www.streimer.com.
- B. General Sheet Metal: www.gsmw.com.
- C. Arctic Sheet Metal: www.arcticsheetmetal.com.
- D. CoolSys Sheet Metal: www.coolsys.com.
- E. Robert Lloyd Sheet Metal: www.rlsm.net.
- F. Just Right Heating and Cooling: www.justrightheat.com.

2.4 ROUND SPIRAL SEAM DUCT

- A. Manufacture: Machine made from round spiral lock seam duct in accordance with SMACNA (DCS).
- B. Fittings: Manufacture at least two gages heavier metal than duct.
 - 1. All fittings shall have rolled edges for added strength and rigidity.
 - 2. All takeoffs to be completely separate fitting; direct tabs are not allowed. Saddle fittings are not allowed except for retrofit installations when approved by project engineer.

3. Branch takeoffs are to be 45 degree laterals or conical tees, 90 and 45 degree.
4. Elbows shall be radiused at 1.5 times the diameter. 15, 30 and 60 degree elbows shall be times the diameter.
5. Joints are to be couplings with centering beads and double-lipped, U-profile EPDM rubber gasket. Use flange joints from 26 inch diameter and large. Crimped ends are prohibited except 8 inches and smaller.

2.5 RECTANGULAR HVAC DUCTWORK

- A. Manufacture: Equal or exceed the minimum wall thickness and reinforcing as scheduled in the SMACNA rectangular duct construction schedule to comply with duct pressure classifications specified. Cross break or bead all duct widths over 14 inches and horizontal surfaces to prevent ballooning or breathing.
- B. Fittings: Fabricate for easiest airflow.
 1. Branch tabs are to be 45 degrees entry with $L = 1/4 W$ inches.
- C. Joints:
 1. Longitudinal: Pittsburg lock flooded with mastic. Snaplock is not allowed.
 2. Traverse: Demountable joint such as Ductmate for 36 inch width and above. Seal corners prior to assembly.

2.6 MANUFACTURED DUCTWORK AND FITTINGS

- A. Flexible Ducts: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
 1. Insulation: Fiberglass insulation with polyethylene or aluminized vapor barrier film.
 2. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
 3. Maximum Velocity: 4000 fpm.
 4. Temperature Range: -20 degrees F to 210 degrees F.
 5. Minimum Insulation: R-6
 6. Manufacturers:
 - a. Thermaflex, M-KE.
 - b. Substitutions: See Section 012500 - Substitution Procedures.
- B. Grease Exhaust: Nominal 3 inches thick ceramic fiber insulation between 20 gage, 304 stainless steel liner and 24 gage, aluminized steel outer jacket.
 1. Tested and UL listed for use with commercial cooking equipment in accordance with NFPA 96.
 2. Certified for zero clearance to combustible material in accordance with:
 - a. UL 2221 with a 2 hour rating.
 3. Materials and construction of the modular sections and accessories to be in accordance with the terms of the following listings:
 - a. UL 1978.
 - b. UL 2221.
 4. Manufacturers:
 - a. AMPCO: www.ampcostacks.com.
 - b. Selkirk: www.selkirkcommercial.com.
 - c. CaptiveAire: www.captiveaire.com.
 - d. Substitutions: See Section 01 2500 - Substitution Procedures.

2.7 CASINGS

- A. Fabricate casings in accordance with SMACNA (DCS) and construct for operating pressures indicated.
- B. Mount floor mounted casings on 4 inch high concrete curbs. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, provide liner of galvanized 18 gage, 0.0478 inch expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.
- C. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.
 - 1. Provide clear wire glass observation ports, minimum 6 by 6 inch size.
- D. Fabricate acoustic casings with reinforcing turned inward. Provide 16 gage, 0.0598 inch sheet steel back facing and 22 gage, 0.0299 inch perforated sheet steel front facing with 3/32 inch diameter holes on 5/32 inch centers. Construct panels 3 inches thick packed with 4.5 lb/cu ft minimum glass fiber insulation media, on inverted channels of 16 gage, 0.0598 inch sheet steel.

2.8 KITCHEN HOOD EXHAUST DUCTWORK

- A. Fabricate in accordance with ductwork manufacturer's installation instructions, SMACNA (DCS), SMACNA (KVS), and NFPA 96.
- B. Exhaust: Construct of 16 gage carbon steel or 18 gage stainless steel, using continuous external welded joints.
- C. Vapor Exhaust: Construct of 18 gage stainless steel, using continuous external welded joints.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install in accordance with manufacturer's instructions.
- C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- D. Fibrous Glass Ducts: Install in accordance with SMACNA Fibrous Glass Duct Construction Standards.
- E. Flexible Ducts: Connect to metal ducts with adhesive and draw bands
- F. Use sealant on all lapped round duct joint connections. Seal all ducts in accordance with State Energy Code.
- G. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

- H. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot 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.
- I. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- J. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.
- K. Install duct hangers and supports in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- L. Use double nuts and lock washers on threaded rod supports.
- M. Do not hang ductwork from un-poured metal pan deck without prior approval from project engineer regardless of what is indicated on the drawings.
- N. Connect terminal units supply ducts rigidly without flexible duct.
- O. Connect diffusers or light troffer boots to low pressure ducts with 5 feet maximum length of flexible duct held in place with strap or clamp.
- P. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.
- Q. At exterior wall louvers, seal duct to louver frame.
- R. For exposed ductwork provide escutcheon or flange at wall penetrations.

3.2 CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that could be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- B. 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.

END OF SECTION

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Turning vanes.
- B. Air extractors.
- C. Backdraft dampers - metal.
- D. Backdraft dampers - fabric.
- E. Duct access doors.
- F. Duct test holes.
- G. Flexible duct connectors.
- H. Volume control dampers.
- I. Barometric relief dampers.

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 230548 - Vibration and Seismic Controls for HVAC.
- C. Section 233100 - HVAC Ducts and Casings.
- D. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

- A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.
- C. NFPA 92 - Standard for Smoke Control Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2027.
- E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- F. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.

- G. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
- H. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013300 - Submittal procedures, for submittal procedures.
- B. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.
- D. Manufacturer's Installation Instructions: Provide instructions for fire dampers and combination fire and smoke dampers.
- E. Project Record Drawings: Record actual locations of access doors, test holes, fire smoke dampers, and fire dampers.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 TURNING VANES

- A. Manufacturers:
 - 1. Elgen All-Tight.
 - 2. Duro-Dyne Type VR.
 - 3. Or approved equivalent.
- B. Hat channel or embossed vane side rails with shop-fabricated, double-blade turning vanes of galvanized steel aligned in the short dimension. Individually adjustable.

2.2 AIR EXTRACTORS

- A. Manufacturers:
 - 1. Carnes; Type 1250; Style 3.
 - 2. Titus; Type AG-45.
 - 3. Or approved equal

2.3 BACKDRAFT DAMPERS - METAL

- A. Manufacturers:
 - 1. PCI Industries, Inc.; Pottorff Brand Model Series BD60: www.pottorff.com.
 - 2. Cesco; Model BAP-1: www.cescoproducts.com.
 - 3. Greenheck; Model Series EM: www.greenheck.com.
 - 4. Nailor Industries, Inc; Model 1370/1380: www.nailor.com/#sle.
 - 5. Ruskin Company; BD/BDR: www.ruskin.com/#sle.
 - 6. Tamco; Model BDD Series 7000 (aluminum): www.tamco.ca.
 - 7. Substitutions: See Section 012500 - Substitution Procedures.
- B. Gravity Backdraft Dampers, Size 18 by 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.
- C. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.4 BACKDRAFT DAMPERS - FABRIC

- A. Manufacturers:
 - 1. PCI Industries, Inc.; Pottorff Brand Model Series BD60: www.pottorff.com.
 - 2. Cesco; Model BAP-1: www.cescoproducts.com.
 - 3. Greenheck; Model Series EM: www.greenheck.com.
 - 4. Ruskin Company; BD/BDR: www.ruskin.com.
 - 5. Nailor; Model 1370/1380: www.nailor.com.
 - 6. Tamco; Model BDD Series 7000 (aluminum): www.tamco.ca.
 - 7. Substitutions: See Section 012500 - Substitution Procedures.
- B. Fabric Backdraft Dampers: Factory-fabricated.
 - 1. Frame: Galvanized steel, 18 gauge, 0.0478 inch minimum base sheet thickness.
 - 2. Blades: Neoprene coated fabric material.
 - 3. Birdscreen: 1/2 inch nominal mesh of galvanized steel or aluminum.
 - 4. Maximum Velocity: 1000 fpm (5 mps) face velocity.

2.5 DUCT ACCESS DOORS

- A. Manufacturers:
 - 1. Cesco; Model Series HF: www.cescoproducts.com.
 - 2. Greenheck; Model Series HAD/CAD: www.greenheck.com.
 - 3. Ruskin Company: www.ruskin.com/#sle.
 - 4. Substitutions: See Section 012500 - Substitution Procedures.
- B. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch thick insulation with sheet metal cover.
 - 1. Less Than 12 inches Square: Secure with sash locks.
 - 2. Up to 18 inches Square: Provide two hinges and two sash locks.
 - 3. Up to 24 by 48 inches: Three hinges and two compression latches with outside and inside handles.

4. Larger Sizes: Provide an additional hinge.

C. Access doors with sheet metal screw fasteners are not acceptable.

2.6 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.7 FLEXIBLE DUCT CONNECTORS

A. Manufacturers:

1. Ventfabrics Ventlon.
2. Duro-Dyne Durolon.
3. Carlisle HVAC Products; Dynair Connector Plus G90 Steel Offset Seam Neoprene Fabric: www.carlislehvac.com/#sle.
4. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
5. Substitutions: See Section 012500 - Substitution Procedures.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Flexible Duct Connections: Fabric crimped into metal edging strip.

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz/sq yd.
 - a. Net Fabric Width: Approximately 3 inches wide.
2. Metal: 3 inches wide, 24 gauge, 0.0239 inch thick galvanized steel.

D. Leaded Vinyl Sheet: Minimum 0.55 inch thick, 0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

E. Maximum Installed Length: 14 inch.

2.8 VOLUME CONTROL DAMPERS

A. Manufacturers:

1. Cesco; Model Series MGF/MGG: www.cescoproducts.com.
2. Greenheck; Model Series MBD/MBDR: www.greenheck.com.
3. Nailor Industries, Inc; Model 1110/1120 galvanized: www.nailor.com/#sle.
4. Tamco: Series 1000 (aluminum): www.tamco.com.
5. Substitutions: See Section 012500 - Substitution Procedures.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Splitter Dampers:

1. Material: Same gauge as duct to 24 inches size in either direction, and two gauges heavier for sizes over 24 inches.
2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.

3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.
 4. Manufacturers:
 - a. Krueger.
 - b. Substitutions: See Section 012500 - Substitution Procedures.
- D. Single Blade Dampers:
1. Fabricate for duct sizes up to 6 by 30 inch.
 2. Blade: 24 gauge, 0.0239 inch, minimum.
 3. Manufacturers:
 - a. Greenheck MBD-10 or approved equal.
 - b. Substitutions: See Section 012500 - Substitution Procedures.
- E. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
1. Blade: 18 gauge, 0.0478 inch, minimum.
 2. Manufacturers:
 - a. Greenheck MBD-15 or approved equal for 2-inch pressure.
 - b. Substitutions: See Section 012500 - Substitution Procedures.
- F. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.
1. Product: 515A.
 2. Manufacturers:
 - a. Young Regulator.
 - b. Substitutions: See Section 012500 - Substitution Procedures.
- G. Quadrants:
1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 3. Where rod lengths exceed 30 inches provide regulator at both ends.
 4. Manufacturers:
 - a. 443 Valcalox Regulator manufactured by Young Regulator.
 - b. Substitutions: See Section 012500 - Substitution Procedures.

2.9 BAROMETRIC RELIEF DAMPERS

- A. Manufacturers:
1. Greenheck: BR Series. www.greenheck.com.
 2. Nailor; Model BDD 1370CB: www.nailor.com.
- B. Dampers shall consist of: 16 ga. insert mount galvanized steel hat channel frame with 5 in. depth; blades from 0.063 in. thick formed aluminum, eccentrically pivoted, 3/8 in. square plated steel axles with galvanized steel press-fit ball bearings; damper shall be equipped with pressure activated vinyl blade seals; and internal plated steel blade-to-blade linkage with blade mounted counterbalance weights.

- C. Damper manufacturer's printed application and performance data including pressure, velocity and temperature limitations shall be submitted for approval showing damper suitable for pressures to 2 in. wg, velocities to 2000 fpm and temperatures to 180 degrees F. Testing and ratings to be in accordance with AMCA 500-D.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 233100 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96 Provide minimum 8 by 8 inch size for hand access, size for shoulder access, and as indicated. Provide 4 by 4 inch for balancing dampers only. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
- G. Demonstrate re-setting of fire dampers to Owner's representative.
- H. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- I. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
 - 1. See Section 230548.
- J. For fans developing static pressures of 5.0 inches and over, cover flexible connections with leaded vinyl sheet, held in place with metal straps.
- K. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- L. Use splitter dampers only where indicated.

- M. Provide balancing dampers on high velocity systems where indicated. See Section 233600 - Air Terminal Units.
- N. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

HVAC POWER VENTILATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Roof exhausters.
- B. Inline centrifugal fans and blowers.

1.2 RELATED REQUIREMENTS

- A. Section 230548 - Vibration and Seismic Controls for HVAC.
- B. Section 233300 - Air Duct Accessories: Backdraft dampers.
- C. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

- A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
- B. AMCA 99 - Standards Handbook; 2025.
- C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.
- D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2025.
- E. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.
- G. NEMA MG 00001 - Motors and Generators; 2024.
- H. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2027.
- I. UL 705 - Power Ventilators; Current Edition, Including All Revisions.
- J. UL 762 - Outline of Investigation for Power Roof Ventilators for Restaurant Exhaust Appliances; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data on fans and accessories, including fan curves with specified operating point plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.

- C. Manufacturer's Instructions: Indicate installation instructions.
- D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Fan Belts: Two sets for each individual fan.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 POWER VENTILATORS - GENERAL

- A. Static and Dynamically Balanced: Comply with AMCA 204 - Balance Quality and Vibration Levels for Fans.
- B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.
- C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.
- D. Fabrication: Comply with AMCA 99.
- E. UL Compliance: UL 705, listed, labeled, designed, manufactured, and tested.
- F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- G. Kitchen Hood Exhaust Fans: Comply with requirements of NFPA 96 and UL 762.

2.2 ROOF EXHAUSTERS

- A. Manufacturers:
 - 1. Carnes, a division of Carnes Company Inc; Model Series VE: www.carnes.com/#sle.
 - 2. Greenheck Fan Corporation; Model G or GB: www.greenheck.com/#sle.
 - 3. Loren Cook Company; Model Series AC: www.lorencook.com.
 - 4. JenCoFan; Model RED or DB: www.jencofan.com.
 - 5. PennBarry; Model Domex: www.pennbarry.com.
 - 6. Twin City Fan & Blower: DCRD/BCRD or DRCU/BCRU: www.tcf.com/#sle.
 - 7. Acme; Model PV or PRN. www.acmefan.com.
 - 8. Substitutions: See Section 012500 - Substitution Procedures.

- B. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.
- C. Roof Curb: 12 inch high self-flashing of galvanized steel with continuously welded seams, built-in cant strips, insulation and curb bottom, interior baffle with acoustic insulation, curb bottom, and factory installed nailer strip.
- D. Disconnect Switch: Factory wired, nonfusible, in housing for thermal overload protected motor and wall mounted multiple speed switch.
- E. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.
- F. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm gets attained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.3 ROOF EXHAUSTERS (KITCHEN KEF-1,2)

- A. Manufacturers:
 - 1. Greenheck; Model CUE/CUBE: www.greenheck.com.
 - 2. Carnes; Model Series VR: www.carnes.com.
 - 3. Loren Cook Company; Model Series ACRU: www.lorencook.com.
 - 4. JenCoFan; Model NBRTD: www.jencofan.com.
 - 5. PennBarry; Model Fumex: www.pennbarry.com.
 - 6. Twin City Fan Company; Model DCRUR/BCRUR: www.tcf.com.
 - 7. Acme; Model PDURF/PNURF: www.acmefan.com.
 - 8. Substitutions: See Section 012500 - Substitution Procedures.
- B. Product Requirements:
 - 1. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.
 - 2. Sound Rating: AMCA 301, tested to AMCA 300, and bearing AMCA Certified Sound Rating Seal.
 - 3. Fabrication: Conform to AMCA 99.
 - 4. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
- C. Performance:
 - 1. Air Flow: As indicated in the Drawing Schedule.
 - 2. Electrical Characteristics:
 - a. Refer to Division 26.
 - 3. Motor: NEMA MG 00001, 2026.
- D. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.

- E. Roof Curb: 12 inch high self-flashing of galvanized steel with continuously welded seams, built in cant strips, insulation and curb bottom, interior baffle with acoustic insulation, curb bottom, ventilated double wall, hinged curb adapter, and factory installed nailer strip.
- F. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor and wall mounted multiple speed switch.
- G. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.
- H. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.4 INLINE CENTRIFUGAL FANS (BI WHEEL WITH HIGH VOL/STATIC EF-1)

- A. Manufacturers:
 - 1. Greenheck Fan Corporation; Model Series SQ/BSQ: www.greenheck.com/#sle.
 - 2. Carnes; Model Series VIDK/VIBK: www.carnes.com.
 - 3. Loren Cook Company; Model Series SQN: www.lorencook.com/#sle.
 - 4. JenCoFan; Model Series JID/JIB: www.jencofan.com.
 - 5. PennBarry, Division of Air System Components; Model Centrex Inliner: www.pennbarry.com/#sle.
 - 6. Twin City Fan & Blower; DSI & BSI: www.tcf.com/#sle.
 - 7. Acme; Model Series XD/XB: www.acmefan.com..
 - 8. Substitutions: See Section 012500 - Substitution Procedures.
- B. Centrifugal Fan Unit: V-belt or direct driven, with galvanized steel housing lined with 1/2 inch acoustic insulation, resiliently-mounted motor, gravity backdraft damper in discharge.
- C. Disconnect Switch: Cord and plug-in housing for thermal overload protected motor and wall mounted switch.
- D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm gets reached with sheaves set at mid-position; fan shaft with self-aligning prelubricated ball bearings.
- E. Performance Ratings: As indicated on drawings.
- F. Electrical Characteristics and Components:
 - 1. Electrical Characteristics: In accordance with Division 26.
 - 2. Motors: In accordance with Sections 220513 and 230513. Type: NEMA MG 00001.
 - 3. Controls: See Section 230993.
 - 4. Disconnect Switch: Factory mount disconnect switch on equipment.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.
- C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.
- D. Hung Cabinet Fans:
 - 1. Install fans with resilient mountings and flexible electrical leads, see Section 230548.
 - 2. Install flexible connections specified in Section 233300 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- E. Provide sheaves required for final air balance.
- F. Install backdraft dampers on inlet to roof and wall exhausters.
- G. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

END OF SECTION

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Diffusers:
 - 1. Square plaque faced diffusers.
 - 2. Rectangular ceiling diffusers.
- B. Registers/grilles:
 - 1. Ceiling-mounted, egg crate exhaust and return register/grilles.
 - 2. Ceiling-mounted, exhaust and return register/grilles.
- C. Louvers.

1.2 RELATED REQUIREMENTS

- A. Section 099123 - Interior Painting: Painting of ducts visible behind outlets and inlets.

1.3 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2023.
- B. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets; 2023.
- C. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2026.
- D. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact); 1993 (Reapproved 2024).
- E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

1.4 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
- C. Project Record Documents: Record actual locations of air outlets and inlets.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Carnes, a division of Carnes Company Inc: www.carnes.com/#sle.
- B. Krueger-HVAC: www.krueger-hvac.com/#sle.
- C. Metalaire, a brand of Metal Industries Inc: www.metalair.com/#sle.
- D. Greenheck: www.greenheck.com.
- E. Price Industries: www.price-hvac.com/#sle.
- F. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com/#sle.
- G. Nailor: www.nailor.com.
- H. Shoemaker: www.shoemakermfg.com.
- I. Tuttle & Bailey: www.tuttleandbailey.com.
- J. Substitutions: See Section 012500 - Substitution Procedures.

2.2 SQUARE PLAQUE FACE DIFFUSER

- A. Manufacturers:
 - 1. Greenheck: www.greenheck.com.
 - 2. Carnes, a division of Carnes Company Inc: www.carnes.com/#sle.
 - 3. Price Industries; Model SPD: www.price-hvac.com/#sle.
 - 4. Krueger-HVAC: www.krueger-hvac.com/#sle. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com/#sle.
 - 5. Nailor: www.nailor.com.
 - 6. Metalaire, a brand of Metal Industries Inc; Model CDP: www.metalair.com/#sle.
 - 7. Substitutions: See Section 012500 - Substitution Procedures.
- B. Units shall be square with a formed backpan, flat panel face, and a high induction inner core assembly. The face panel of the outlet of the outlet shall project no more than 1/4" below the ceiling grid.
- C. Units shall be square with a formed backpan, flat panel face, and an ultra-low flow inner core assembly. The face panel of the outlet shall project no more than 1/4" below the ceiling grid.
- D. The units shall be the size and quantity as outlined in the plans and specifications.
- E. Inlets shall be drawn into the backpan of the diffuser. Welded inlets are not acceptable. Diffusers shall include seismic tabs drawn into the backpan.
- F. Face panel shall be held in place with hooks secured through the backpan and be removable without the aid of tools. Units with face panels held in place with springs or clips are not acceptable.

- G. Inner core assembly shall be steel and include a gasket between the core and the backpan. The high induction core assembly shall produce a four-way discharge pattern through a series of nozzles to maximize induction and comfort. ADPI for the diffuser shall be a minimum of 97 in typical applications. Units shall be designed to integrate into the specified ceiling system.
- H. Butterfly Damper:
 - 1. Aluminum, round butterfly type dampers shall be provided. Damper shall consist of two butterfly style blades that can be adjusted from full open to full closed. Damper shall be adjusted with a screwdriver slot that can be assessed through the face of the diffuser.
 - 2. Radial Shutter Damper:
 - a. Steel round radial shutter damper shall be provided. Damper shall consist of gang operated radial blades that slide perpendicular to air flow direction. The damper shall be adjusted from full open to full closed. Damper shall be adjusted with a screwdriver slot that can be assessed through the face of the diffuser.
 - 3. Equalizing Grid:
 - a. Aluminum, round equalizing grid shall be provided. Equalizing grid shall consist of 1/2" x 1/2" x 1/2" aluminum cubed core mounting in an aluminum frame.
 - 4. Performance Specification:
 - a. The manufacturer shall provide published performance data. Data shall be tested in accordance to ANSI/ASHRAE Standard 70-2006.
 - 5. Paint Specification:
 - a. Process shall be anodic electrodeposition using an anodic acrylic paint. Units shall undergo pre-treatment including a pressurized spray stage using an alkaline cleaner and a de-ionized water rinse.

2.3 RECTANGULAR CEILING DIFFUSERS

- A. Manufacturers:
 - 1. Greenheck; Model XG-5500S: www.greenheck.com.
 - 2. Carnes, a division of Carnes Company Inc; Model Series SK: www.carnes.com/#sle.
 - 3. Price Industries; Model SMD: www.price-hvac.com/#sle.
 - 4. Krueger-HVAC; Model SHPC: www.krueger-hvac.com/#sle.
 - 5. Titus, a brand of Air Distribution Technologies; Model TDC: www.titus-hvac.com/#sle.
 - 6. Nailor; Model 6500: www.nailor.com.
 - 7. Metalaire, a brand of Metal Industries Inc; 5500S: www.metalair.com/#sle.
 - 8. Substitutions: See Section 012500 - Substitution Procedures.
- B. Type: Provide rectangular and square formed multi-louvered ceiling diffusers constructed to discharge air in indicated pattern.
- C. Frame: Provide surface mount, snap-in, inverted T-bar, and spline type. In plaster ceilings, provide plaster frame and ceiling frame.
- D. Fabrication: Steel with baked enamel finish.
- E. Accessories: Provide radial opposed blade, butterfly, and combination splitter volume control damper; removable core, sectorizing baffle, safety chain, wire guard, equalizing grid, operating rod extension, anti-smudging device, and gaskets for surface mounted diffusers with damper adjustable from diffuser face.

2.4 CEILING EGG CRATE EXHAUST AND RETURN GRILLES

- A. Manufacturers:
 - 1. Greenheck; Model XG-CC5: www.greenheck.com.
 - 2. Carnes, a division of Carnes Company Inc; Model RATB: www.carnes.com/#sle.
 - 3. Price Industries; Model Series 81: www.price-hvac.com/#sle.
 - 4. Krueger-HVAC; EGC5: www.krueger-hvac.com/#sle.
 - 5. Titus, a brand of Air Distribution Technologies; Model 50F: www.titus-hvac.com/#sle.
 - 6. Nailor; Model 61DH: www.nailor.com.
 - 7. Metalaire, a brand of Metal Industries Inc; Model CC5: www.metalair.com/#sle.
 - 8. Substitutions: See Section 012500 - Substitution Procedures.
- B. Type: Egg crate style face consisting of 1/2 by 1/2 by 1/2 inch grid core.
- C. Fabrication: Grid core consists of aluminum with mill aluminum finish.
- D. Frame: 1-1/4 inch margin with countersunk screw mounting.
- E. Frame: Channel lay-in frame for suspended grid ceilings.
- F. Accessories: Provide integral gang and face operated opposed blade damper with removable key operator, operable from face.

2.5 WALL SUPPLY REGISTERS/GRILLES

- A. Manufacturers:
 - 1. Greenheck; Model XG-H4004S: www.greenheck.com.
 - 2. Carnes, a division of Carnes Company Inc; Model Series RTDB: www.carnes.com/#sle.
 - 3. Price Industries; Model Series 520: www.price-hvac.com/#sle.
 - 4. Krueger-HVAC; Model 880: www.krueger-hvac.com/#sle.
 - 5. Titus, a brand of Air Distribution Technologies; Model 300RL: www.titus-hvac.com/#sle.
 - 6. Nailor; Model 6145H: www.nailor.com.
 - 7. Metalaire, a brand of Metal Industries Inc; Model H4004S: www.metalair.com/#sle.
 - 8. Substitutions: See Section 012500 - Substitution Procedures.
- B. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, vertical face, single deflection.
- C. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.
- D. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.
- E. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.
- F. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.6 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Manufacturers:
 - 1. Greenheck; Model XG-SRH: www.greenheck.com.
 - 2. Carnes, a division of Carnes Company Inc; Model RSAB: www.carnes.com/#sle.
 - 3. Price Industries; Model Series 530: www.price-hvac.com/#sle.
 - 4. Krueger-HVAC; Model S80: www.krueger-hvac.com/#sle.
 - 5. Titus, a brand of Air Distribution Technologies; Model 350RL: www.titus-hvac.com/#sle.
 - 6. Nailor; Model 49-241: www.nailor.com.
 - 7. Metalaire, a brand of Metal Industries Inc; Model SRH: www.metalair.com/#sle.
 - 8. Substitutions: See Section 012500 - Substitution Procedures.
- B. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, vertical face.
- C. Frame: 1-1/4 inch margin with countersunk screw mounting.
- D. Fabrication: Steel frames and blades, with factory baked enamel finish.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.
- F. Gymnasiums: Provide heavy gauge steel, welded in place 45 degree blades, 3/8 inch spacing, Titus 33 RL, Price 91, or approved equal.

2.7 LOUVERS

- A. Manufacturers:
 - 1. Greenheck; Model ESK-402.
 - 2. Ruskin Company; Model ELF811SH: www.ruskin.com/#sle.
 - 3. Cesco; Model X4KF.
 - 4. Nailor; Model 1604D: www.nailor.com.
 - 5. Substitutions: See Section 012500 - Substitution Procedures.
- B. Type: 4 inch deep frame with blades on 45 degree slope with center baffle and return bend, heavy channel frame, 1/2 inch square mesh screen over intake or exhaust end.
- C. Fabrication: 12 gauge, 0.1046 inch (2.66 mm) thick extruded aluminum, welded assembly, with factory anodized finish.
- D. Color: To be selected by Architect from manufacturer's standard range.
- E. Mounting: Furnish with flanging and anchors as required for installation. Do not use exterior flange.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

Air Outlets and Inlets

- B. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black, see Section 099123.

END OF SECTION

PACKAGED OUTDOOR ROOFTOP UNITS - SMALL CAPACITY**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Packaged roof top unit.
- B. Roof mounting curb.
- C. Maintenance service.

1.2 RELATED REQUIREMENTS

- A. Section 230548 - Vibration and Seismic Controls for HVAC.
- B. Section 233300 - Air Duct Accessories.
- C. Section 260583 - Wiring Connections.

1.3 REFERENCE STANDARDS

- A. AMCA 500-D - "Laboratory Methods of Testing Dampers for Rating"; 2018.
- B. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; American Society for Testing and Materials, 2019.
- C. NFPA 54 - National Fuel Gas Code; National Fire Protection Association, 2021.
- D. NFPA 58 - Liquefied Petroleum Gas Code; National Fire Protection Association, 2020.

1.4 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
- C. Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
- D. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.
- E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Filters: One set for each unit.
 - 3. Fan Belts: One set for each unit.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum 10 years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from physical damage by storing off site until roof mounting curbs are in place, ready for immediate installation of units.

1.7 WARRANTY

- A. See Section 017700 - Closeout Procedures, for additional warranty requirements.
- B. Provide a five year warranty to include coverage for refrigeration compressors and heat exchangers.

PART 2 PRODUCTS

2.1 ROOFTOP AIR CONDITIONING UNITS (AIR TO AIR HEAT PUMP - RTU-1 THRU RTU-7)

- A. Manufacturers:
 - 1. Daikin; Model DHH.
 - 2. The Trane Company.
 - 3. Aeon Incorporated.
 - 4. Carrier Corp.
 - 5. Johnson Controls.
 - 6. Substitutions: See Section 016000 - Product Requirements.
- B. Product Description: Self-contained, packaged, factory assembled and wired, consisting of roof curb, cabinet, supply fan, refrigerant cooling coil, compressor, refrigeration circuit, condenser, electric air to air heat pump, air filters, mixed air casing, controls, and accessories.
- C. Configuration: As indicated on Drawings.
- D. Roof Mounting Curb: 14 inch high, galvanized steel, channel frame with gaskets, nailer strips. Full perimeter type for mounting under entire unit. For vibration isolated roof curbs, see Section 230548.
- E. Cabinet:
 - 1. Designed for outdoor installation with weatherproof construction.
 - 2. Panels: Constructed of galvanized steel with baked enamel finish meeting salt spray test in accordance with ASTM B117. Furnish access doors or removable access panels.

3. Insulation: Factory applied to exposed vertical and horizontal panels, 1/2-inch thick aluminum foil faced foam or glass fiber with edges protected from erosion.
- F. Supply Fan: Forward curved centrifugal type, resiliently mounted with direct drive (under 3 tons) and V-belt drive or adjustable variable pitch motor pulley (3 tons and over) and high efficiency variable speed motor. Motor permanently lubricated with built-in thermal overload protection.
- G. Evaporator Coil: Constructed of copper tubes expanded onto aluminum fins. Galvanized drain pan with piping connection. Factory leak tested under water.
- H. Compressor: Hermetically sealed, resiliently mounted with positive lubrication, and internal motor overload protection. Furnish vibration isolators and short cycle protection.
- I. Refrigeration circuit: Furnish the following for each circuit: fixed orifice control (under 3 tons) or thermal expansion valve (3 tons and over), filter-drier, suction, discharge, and liquid line service valves with gauge ports, high and low pressure safety controls. Dehydrate and factory charge each circuit with oil and refrigerant.
- J. Condenser:
 1. Coil: Copper tube with aluminum or copper fin coil assembly. Factory leak tested under water.
 2. Condenser Fan: Direct drive propeller fans statically and dynamically balanced. Wired to operate with compressor. Motor permanently lubricated with built-in thermal overload protection. Furnish high efficiency fan motors.
- K. Heating: Heat pump with reversing valve.
 1. Auxiliary Heat:
 - a. Electric heater; heavy duty nickel chromium elements, high temperature limit control, individually fused from factory, NEC approved, UL listed.
- L. Compressor Crankcase
 1. Protect against refrigerant migration that can occur during low ambient operation.
- M. Reversing Valve:
 1. 4-way interchange reversing valve effects a rapid change in direction of refrigerant flow resulting in quick changeover from cooling to heating and vice-versa.
- N. Freez
 1. Protects the evaporator coil from damaging ice build-up due to conditions such as low/no airflow or low refrigerant charge.
- O. Defrost Control:
 1. Provides a defrost cycle, if needed, every 30 or 60 or 90 minutes (adjustable) of compressor on time at outdoor coil temperature below 35°F. Temperature switch mounted on outdoor coil liquid line terminates defrost cycle.
- P. Air Filters: 2 thick glass fiber disposable media in metal frames. 30 percent efficiency based on ASHRAE 52 (MERV 8 based on ASHRAE Std 52.2).
- Q. Mixed Air Casing:

1. Damper Leakage: Furnish Class I motorized dampers with maximum leakage rate of 4 cfm per square foot at 1-inch water column pressure differential when tested in accordance with AMCA 500-D.
2. Economizer: Factory installed fully modulating motorized outside air and return air dampers controlled by dry bulb or enthalpy controller with minimum position setting. Outside air damper normally closed and return air damper normally open. Furnish barometric relief damper capable of closing by gravity (3 tons and under) and barometric relief damper with powered exhaust (above 3 tons). Furnish rain hood with screen.

R. Controls:

1. Refer to Section 230913 - Instrumentation and Control Devices for HVAC.

S. Accessories:

1. Convenience Outlet: Factory installed, 115 volt, 15 amp, GFCI type, internally mounted.
2. Roof Curb Adaptor Package: Furnish duct support hardware to adapt unit to existing roof curb.
3. Factory or Field installed ultraviolet C light located downstream of cooling coil.
4. Powered exhaust.

T. Leak Detection:

1. Unit to have factory furnished and tested leak detection system consisting of refrigeration sensors and controller that initiates mitigation sequence upon detection.

U. Capacity:

1. Refer to Drawing schedules.

2.2 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics: In accordance with Division 26.

B. Disconnect Switch: Factory mounted, non-fused type, interlocked with access door, accessible from outside unit, with power lockout capability.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify that proper power supply is available.

3.2 INSTALLATION

A. Roof Curb:

1. Assemble roof curb.
2. Install roof curb level.
3. Coordinate curb installation and flashing with Architect.

4. Install units on roof curb providing watertight enclosure to protect ductwork and utility services.
 5. Install gasket material between unit base and roof curb.
- B. Check and verify location of thermostats and exposed control sensors with plans and room details before installation. Locate 48 inches above floor. Align with lighting switches.
 - C. Install units on vibration isolators. Refer to Section 230548.
 - D. Connect units to supply and return ductwork with flexible connections. Refer to Section 233300.
 - E. Install condensate piping with trap and route from drain pan to splash block on roof.
 - F. Install components furnished loose for field mounting.
 - G. Install electrical devices furnished loose for field mounting.
 - H. Install control wiring between unit and field installed accessories.
 - I. Remove from roof and dispose off-site panels removed from units during installation of economizer and dampers.
 - J. Locate remote panels as indicated on Drawings.
 - K. Provide fixed sheaves required for final air balance.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Section 014000 - Quality Requirements: Requirements for manufacturer's field services.
- B. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.
- C. Furnish services of factory trained representative for minimum of one day to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.4 CLEANING

- A. Section 017000 - Execution Requirements: Requirements for cleaning.
- B. Vacuum clean coils and inside of unit cabinet.
- C. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.

3.5 DEMONSTRATION

- A. Section 017000 - Execution Requirements: Requirements for demonstration and training.
- B. Demonstrate unit operation and maintenance.

Packaged Outdoor Rooftop Units - Small Capacity

- C. Furnish services of manufacturer's technical representative for one 8 hour day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days notice to Architect/Engineer of training date.

END OF SECTION

DEDICATED OUTDOOR AIR UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Roof mounted DOAS.
- B. Indoor-mounted DOAS.
- C. Packaged make-up air heater.
- D. Controls.

1.2 RELATED REQUIREMENTS

- A. Section 230548 - Vibration and Seismic Controls for HVAC.
- B. Section 230923 - Direct-Digital Control System for HVAC.
- C. Section 233300 - Air Duct Accessories: Flexible duct connections.
- D. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2026.
- B. AHRI 270 (SI/I-P) - Sound Performance Rating of Outdoor Unitary Equipment; 2025.
- C. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
- D. AHRI 1060 (I-P) - Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment; 2023.
- E. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant; 2019.
- F. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2026.
- H. NEMA MG 00001 - Motors and Generators; 2024.
- I. NFPA 54 - National Fuel Gas Code; 2024.

- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.
- L. UL (DIR) - Online Certifications Directory; Current Edition.
- M. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.
- N. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data with dimensions, duct and service connections, accessories, controls, electrical nameplate data, and wiring diagrams.
- C. Shop Drawings: Indicate dimensions, duct and service connections, accessories, controls, electrical nameplate data, and wiring diagrams.
- D. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
- E. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.
- F. Operation And Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- G. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- H. Project Record Documents: Record actual locations of components.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements for additional provisions.
 - 2. Extra Filters: One set of each type and size.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to NFPA 70.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriter's Laboratories, Inc., as suitable for the purpose specified and indicated.

1.7 WARRANTY

- A. See Section 017700 - Closeout Procedures for additional warranty requirements.
- B. Provide five year manufacturers warranty for compressor/condenser unit.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Oxygen 8 Model Oxygen 8 Ventum (indoor); Ventum+ (outdoor).
- B. Renewaire: www.renewaire.com.
- C. Greenheck: www.greenheck.com/#sle.
- D. Substitutions: See Section 012500 - Substitution Procedures.

2.2 OUTDOOR-MOUNTED DOAS UNIT (DOAS-1)

- A. DOAS Units:
 - 1. DOAS units shall be factory assembled and tested. Units shall include insulated steel cabinet, sensible plate heat exchanger, electric preheat, fan and motor assembly, filter rack, and integral controls. Unit shall have a single circuit power connection.
- B. Cabinet:
 - 1. Cabinet shall be nominal 2-inch double wall panel with R13 thermal insulation. Cabinet exterior shall be 18-gauge galvanized steel on base panels and 24-gauge pre-painted steel on wall and roof panels and meets or exceeds 650-hour salt spray test based on ASTM B117. Liners and other steel components shall be galvanized steel. All seams shall be sealed to provide airtight casing.
 - 2. Doors shall be nominal 2-inch double wall panel with the same construction as cabinet. Doors shall be fitted with hinges and door handles. The doors shall have one lockable handle as standard.
 - 3. The unit will be designed for single side access service and maintenance from the front to allow for a compact installation.
 - 4. All dampers shall have extruded heavy gauge 6063 aluminum frame that includes jamb seals. Dampers shall be leakage Class 1A at 1 in. w.g. (0.25 kPa) static pressure differential, following standard air leakage data certified under the AMCA Certified Ratings Program. Blades shall be airfoil shaped extruded aluminum and include rubber blade seals. Linkage shall be installed in the frame outside of the airstream.
 - 5. All dampers shall include factory mounted, wired and tested actuators. Dampers shall be modulating, or two-position as required. Provide spring return dampers for outdoor air connections.
 - 6. Standing seam roof to provide weather protection for outdoor installation with exhaust air and outdoor air weather hoods with shutoff damper actuator access panels.
- C. Filters:
 - 1. Unit shall include 4-inch filter rack for the outdoor air and return air paths upstream of energy recovery exchanger. Filters shall be accessed through hinged filter access

- door. Supply one set of MERV 13 pleated filters for the outdoor air stream and one set of MERV8 for the return air stream. All filters must be UL approved.
2. Provide factory mounted pressure sensors to measure filter pressure drop across filters. Pressure drop shall be digital feedback to controller for utilization in control and alarm sequencing. Unit controller shall monitor filter pressure level and report when filter changes are required.
- D. Fans:
1. Fans shall be mixed flow plenum type with direct drive motor. Fan and motor assembly shall be factory mounted and balanced. The fans will be capable of operating in ambient temperatures of up to 40°C.
 2. Fan motors shall be permanent magnet, synchronous motor type with integral digital motor controller. Fan bearings shall be serviceable type with an L-10 life of 40,000 hours. Fan motors will be UL approved.
 3. All fans shall be equipped with integral airflow monitoring system connected to the unit controller.
 4. Provide means to easily remove fan-motor assembly for service through standard man doors.
 5. Fans should be designed such that all service can be performed in the field, including replacement of bearings.
 6. Fan motor drives shall be 208/60/3 and be UL approved. Fans will be protected by UL approved motor protection circuit breaker.
- E. Heat Recovery Device:
1. Where indicated, units shall include AHRI 1060 Certified plate type counter flow heat exchanger fabricated from aluminum. Maximum pressure differential shall be 7.2" w.c. Maximum leakage between airstreams shall be 0.5% of nominal airflow.
 2. The heat recovery device shall be installed over a stainless-steel double sloped condensate pan.
 3. Unit shall include a bypass damper with a modulating actuator. Unit controller shall operate bypass dampers to maximize heat transfer without frosting and bypass heat exchanger during economizer mode.
- F. Electric Heating Coil:
1. Provide open coil electric heaters of the size, capacity and performance shown in the equipment schedules.
 2. All duct heaters shall be tested and certified to UL and CSA.
 3. Frame to be corrosion-resistant and made of galvanized steel.
 4. Coils shall be made of high-grade Nickel-Chrome alloy and shall be insulated from the frame by means of non-rotating ceramic bushings.
 5. Heater to come with door mounted disconnect switch and air proving switch
 6. SCR control is time proportioning type that modulates the heater and supplies the exact amount of power to match the demand. Input signal will be 0-10V.
 7. Heaters shall be equipped with a fail-safe automatic reset disc-type thermal cut-out located in the top frame component above the heating element.
 8. Duct heaters shall be non-sensitive to air flow direction for horizontal or vertical ducts without impairing safety.
- G. Controls:
1. Unit shall include an integrated microprocessor-based unit controller. The controls shall be located in the integral control panel. All unit controls shall operate off a transformer

- from the main power supply for single point power connection. All internal controls and sensors shall be factory prewired and tested.
2. The control system will regulate temperatures, airflows and other functions as required. Unit controller shall be pre-programmed with factory tested software for all possible functions.
 3. The controller shall provide the following, refer to sequence of operation for specific unit control sequences;
 - a. Control of fans correcting for both changes in total static pressure and air density in both VAV and constant airflow applications.
 - b. Fan performance monitoring.
 - c. Ventilation airflow monitoring and control.
 - d. Airflow density correction for winter and summer conditions.
 - e. Energy recovery optimization including operation of bypass damper.
 - f. Supplemental heating and cooling when included.
 - g. Frost protection.
 - h. Monitoring alarms, faults and maintenance points including filter changeout.
 - i. Time and date schedules.
 - j. Data logging and trending.
 4. Include wireless capability that will allow the client to access remotely via internal wi-fi network.
 5. Controller shall be BACnet IP and BTL certified and include Modbus communication. Communication shall include monitoring, control, alarms, faults and maintenance information.
 6. Provide factory installed and tested contactors, overloads, fusing, starters motor speed controllers for supply and exhaust. Include all necessary control transformers.
 7. Provide unit mounted non-fused disconnect switch with single point power connection.
 8. Supply all necessary temperature and pressure sensors complete with plug in wiring harnesses for proper option of unit.
 9. Liquid and Gas thermistors are to be mounted to coil and wired to EKEQ kit in the factory.
- H. Plastic Components:
1. All plastic components that are in the airstream, must be of a UL94 rated material.
 2. If gasketing is used to join unit sections together, gasketing must be a UL94 approved compound.

2.3 INDOOR-MOUNTED DOAS FABRICATION REQUIREMENTS (DOAS-2)

- A. DOAS Units:
1. DOAS units shall be factory assembled and tested. Units shall include insulated steel cabinet, sensible plate heat exchanger, electric preheat, fan and motor assembly, filter rack, and integral controls. Unit shall have a single circuit power connection.
- B. Cabinet:
1. Cabinet shall be nominal 1-inch double wall panel with R6.5 thermal insulation. Cabinet exterior shall be 22-gauge pre-painted steel that meets or exceeds 650-hour salt spray test based on ASTM B117. Liners and other steel components shall be galvanized steel. All seams shall be sealed to provide airtight casing.

2. Doors shall be nominal 1-inch double wall panel with the same construction as cabinet. Doors shall be fitted with hinges and door handles. The doors shall have one lockable handle as standard.
3. The unit will be designed for service and maintenance on the bottom side only to allow for a compact installation.
4. All dampers shall have extruded heavy gauge 6063 aluminum frame that includes jamb seals. Blades shall be airfoil shaped extruded aluminum and include rubber blade seals. Linkage shall be installed in the frame outside of the airstream.
5. All dampers shall include factory mounted, wired and tested actuators. Dampers shall be modulating, or two-position as required. Provide spring return dampers for outdoor air connections.

C. Filters:

1. Unit shall include 2-inch filter rack for the outdoor air and return air paths upstream of energy recovery exchanger. Filters shall be accessed through hinged filter access door. Supply one set of MERV 13 pleated filters for the outdoor air stream and one set of MERV 8 for the return air stream. All filters must be UL approved.
2. Provide factory mounted pressure sensors to measure filter pressure drop across filters. Pressure drop shall be digital feedback to controller for utilization in control and alarm sequencing. Unit controller shall monitor filter pressure level and report when filter changes are required.

D. Fans:

1. Fans shall be mixed flow plenum type with direct drive motor. Fan and motor assembly shall be factory mounted and balanced. The fans will be capable of operating in ambient temperatures of up to 40°C.
2. Fan motors shall be permanent magnet, synchronous motor type with integral digital motor controller. Fan bearings shall be serviceable type with an L-10 life of 40,000 hours. Fan motors will be UL approved.
3. All fans shall be equipped with integral airflow monitoring system connected to the unit controller.
4. Provide means to easily remove fan-motor assembly for service through standard doors.
5. Fans should be designed such that all service can be performed in the field, including replacement of bearings.
6. Fan motor drives shall be 460/60/3 depending on unit size and be UL approved. Fans will be protected by UL approved motor protection circuit breaker.

E. Heat Recovery Device:

1. Where indicated, units shall include AHRI 1060 (I-P) Certified plate type counter flow heat exchanger fabricated from aluminum. Maximum pressure differential shall be 7.2" w.c. Maximum leakage between airstreams shall be 0.5% of nominal airflow.
2. The heat recovery device shall be installed over stainless-steel double sloped condensate pan.
3. Unit shall include bypass dampers with modulating actuators. Unit controller shall operate bypass dampers to maximize heat transfer without frosting and bypass heat exchanger during economizer mode.

F. Electric Heating Coil:

1. Provide open coil electric heaters of the size, capacity and performance shown in the equipment schedule.
2. All duct heaters shall be tested and certified to UL and CSA.

3. Frame to be corrosion-resistant and made of galvanized steel.
4. Coils shall be made of high-grade Nickel-Chrome alloy and shall be insulated from the frame by means of non-rotating ceramic bushings.
5. Heater to come with door mounted disconnect switch and air proving switch.
6. SCR control is time proportioning type that modulates the heater and supplies the exact amount of power to match the demand. Input signal will be 0-10V.
7. Heaters shall be equipped with a fail-safe automatic reset disc-type thermal cut-out located in the top frame component above the heating element.
8. Duct heaters shall be nonsensitive to air flow direction and interchangeable for horizontal or vertical ducts without impairing safety.

G. Controls:

1. Unit shall include an integrated microprocessor-based unit controller. The controls shall be located in the externally mounted electrical enclosure. All unit controls shall operate off a transformer from the main power supply for a single point power connection. All internal controls and sensors shall be factory prewired and tested.
2. The control system will regulate temperatures, air flows and other functions as required. Unit controller shall be pre-programmed with factory tested software for all possible functions.
3. The controller shall provide the following, refer to sequence of operation for specific unit control sequences:
 - a. Control of fans correcting for both changes in total static pressure and air density in both VAV and constant airflow applications.
 - b. Fan performance monitoring.
 - c. Ventilation airflow monitoring and control.
 - d. Airflow density correction for winter and summer conditions.
 - e. Energy recovery optimization including operation of bypass damper.
 - f. Supplemental heating and cooling when needed.
 - g. Frost protection.
 - h. Monitoring alarms, faults and maintenance points including filter change-out.
 - i. Time and date schedules.
 - j. Humidity control.
 - k. Data logging and trending.
4. Include wireless capability that will allow the client to access remotely via internal Wi-Fi network.
5. If non factory controls are proposed as an option, a factory witness test is required to show integration and functionality.
6. Controller shall be BACnet IP and BTL certified and include Modbus communication. Communication shall include monitoring, control, alarms, faults and maintenance information.
7. Provide factory installed and tested contractors, overloads, fusing, starters motor speed controllers for supply and exhaust. Include all necessary control transformers.
8. Provide unit mounted non-fused disconnect switch with single point power connection.
9. Supply all necessary temperature and pressure sensors complete with plug in wiring harness for proper option of unit.

H. Plastic Components:

1. All plastic components that are in the airstream must be of a UUL 94 rated material.
2. If gasketing is used to join unit sections together, gasketing must be UL 94 approved compound.

2.4 PACKAGED MAKE-UP AIR HEATERS (MAU-1)

- A. Manufacturers:
 - 1. CaptiveAire.
 - 2. Substitutions: See Section 012500 - Substitution Procedures.
- B. General Assembly:
 - 1. [endif][endif][endif]Unit(s) shall be factory assembled, tested and shipped as a complete packaged assembly, for outdoor mounting, consisting of the following specifications, deliver all capacities scheduled, and conform to design indicated herein.
- C. Cabinet:
 - 1. Unit(s) shall be constructed of minimum 20-gauge G-90 galvanized steel riveted together via structural pop-rivets. All metal shall be CNC bent for precise assembly.
 - a. Base Construction: The base shall be constructed of galvanized steel for improved rigidity. Base shall be structurally reinforced to accommodate the blower assembly.
 - b. Rigging Provisions: The unit shall have a structural base constructed of minimum 14-gauge G-90 galvanized steel, and include lifting points on all four sides.
 - c. Roof Construction: Roof shall be pitched to allow for proper drainage.
 - d. Exterior Wall Construction: All exterior walls shall consist of insulated galvanized steel construction.
 - e. Service Access Doors: All door jambs shall be gasketed around their perimeter. Doors may be mounted via spring actuated, stainless steel hinges with stainless steel rivets, and self-compressing stainless steel pad lockable latches or through removable sliding panels.
 - f. Each compartment shall have removable access panels to allow for ease of service and maintainability. Electrical cabinet doors shall be outfitted with schematic and/or manual pouches formed into the door, along with wiring diagram attached to the interior of the door from the factory.
 - 2. Entire interior and exterior casing shall be constructed of minimum 20-gauge G-90 galvanized steel with no painting, and shall have undergone a salt spray corrosion test as per ASTM B 117.
 - 3. An observation port shall be located on the exterior of the unit for observation of the main flame and pilot flame. All controls, gas valves, modulating controls and electrical components shall be mounted within the burner vestibule. The burner vestibule shall be an integral part of the unit and not extend outside the exterior casing of the unit and not exposed to the main air stream.
 - 4. Entire unit shall be Miami-Dade wind rated up to ± 130 psf per TAS 201, 202 & 203.
- D. Supply Air Blower and Motor:
 - 1. All supply fans shall be direct drive.
 - 2. The blower assembly shall consist of a centrifugal backward inclined, non- overloading wheel secured directly to a heavy-duty, ball bearing type motor via two set screws. The motor and wheel assembly shall be mounted to a heavy gauge galvanized steel frame. The motor shall be controlled by a variable frequency drive, allowing for variable airflow without the need of belts and pulleys.
 - 3. Blower Motor: Motor shall be a premium efficiency motor available as:
 - a. Open Drip Proof (ODP) motor driven by a Variable Frequency Drive.

- b. Totally Enclosed Fan Cooled (TEFC) motor driven by a Variable Frequency Drive.
 - c. Electronically Commutated Motor (ECM).
 - d. Explosion Proof.
 - 4. Fans to be selected at or near efficiency peak. Check fan curves provided with job.
 - 5. Blower and motor assembly shall be dynamically balanced. The entire blower and motor assembly shall be mounted on rubber vibration isolators. Wheels balanced as per AMCA 204-96; Balance Quality and Vibration Levels for fans.
- E. Shafts and Bearings:
 - 1. Shafts shall be precision ground and polished. Heavy duty, pre-lubricated bearings designed for, and individually tested, specifically for use in air handling applications.
- F. Airflow Configurations:
 - 1. Unit shall be configurable for down (vertical) discharge through unit.
 - 2. Damper: Manufacturer shall provide and install on unit, when possible, a two- position, motor-operated damper with internal end switch to energize the blower- starter circuit. Blades shall be a maximum of 6" wide 16-gauge G-90 galvanized steel and shall be made to guarantee the absence of noticeable vibration at design air velocities. Damper blades are to be mounted on friction-free synthetic bearings. Damper edges shall have PVC coated polyester fabric mechanically locked into blade edge. Jamb seals used are flexible metal, compression type. Damper shall exceed AMCA Class 1A standard for low leakage. Damper assembly shall be a single assembly, and outfitted with an integral bird screen and louver/gutter system to divert any drainage through the base of the unit – intake air hood not required.
 - 3. Actuator: A single direct drive damper actuator shall be used with spring return to ensure that the outdoor air section opens when not powered.
 - 4. [endif]Discharge Diffuser Selections: 180° Side Discharge, Three-way down diffusion, Four-way down diffusion, or 45° down diffusion.
- G. Intake:
 - 1. Possible configurations include: No Intake, Evap Cooler, V-Bank, Intake Hood, Screened Intake, and Trunkline.
 - 2. [endif]Optional purchase: Extra set of intake filters.
- H. Curb: (Selectable options)
- I. Full Perimeter Spring Isolation Curb Curb.
- J. Mixing Boxes:
 - 1. [endif]Mixing box to meet scheduled requirements.
- K. [endif]Heating System:
 - 1. [endif]Modulating electric heat module unit section. Coil section to be designed to fit onto common curb with main unit.
 - 2. Casing and roof to be 20-gauge G-90 galvanized construction. Inside of section to be fully insulated with foil back insulation.
- L. Filters:

1. Provide filters as part of unit. All filters shall be furnished and installed to meet the performance requirements set forth in the schedule and as specified under another section of this work.
2. The filters shall be (2") thick, aluminum mesh coated with super-filter adhesive, aluminum mesh with polyester foam or pleated throw away.
3. [endif]Aluminum-mesh filters shall have aluminum frames with media to be layers of slit and expanded aluminum, varying in pattern to obtain maximum depth loading.
4. All filters shall be installed on tracks for easy removal from the unit.
5. Shall be either insulated or non-insulated constructed of G-90 galvanized steel with filters supported by internal slides and with removable access panels.
6. Unit shall have an optional adjustable pressure differential sensor for the filter bank to alert in the event of a clogged filter.

M. Electrical:

1. All controls shall be pre-wired and housed in an insulated electrical cabinet within the unit to protect against risk of condensation.
2. All units shall be provided with single point electrical connection.
3. Unit shall be provided with a door safety switch that de-energizes the supply fan when the door is opened.
4. The electrical cabinet shall be outfitted with the following:
 - a. LED electrical cabinet service light with automatic activation upon door switch.
 - b. Color wiring schematics, laminated to the interior wall of the cabinet doors.
 - c. Factory mounted disconnect with unit bottom knockouts.
 - d. A LED backlit, LCD Human-Machine Interface (HMI) shall be mounted within the unit's control cabinet to allow for all set points configuration and refrigeration system monitoring at the unit.
 - e. Up to 4 additional space mounted HMIs available. Additional HMIs shall allow for full programming capabilities and are outfitted with integral temperature and humidity sensors. Additional HMIs shall be capable of being individually averaged for space temperature/humidity readings. All HMIs shall be wired using standard CAT5/6 cables.
5. Options:
 - a. Convenience outlet.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide unit- or duct-mounted smoke detectors and other NFPA 90A provisions.
- C. Follow NFPA 54 guidelines to provide natural gas system connection; see Section 231123.
- D. Follow NFPA 54 guidelines to provide fuel gas system; see Section 231126.
- E. Install unit on vibration isolator pad or roof curb; see Section 230548.
- F. Provide flexible duct connections on inlet and outlet from unit; see Section 233300.

Dedicated Outdoor Air Units

- G. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote front-end interface; see Section 230923.

3.2 MAINTENANCE

- A. See Section 01 7700 - Closeout Procedures for additional requirements.

END OF SECTION

SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Air-source heat pumps.
- B. Air cooled condensing units.
- C. Indoor air handling (fan and coil) units for ductless systems.
- D. Refrigerant piping.
- E. Refrigerant piping insulation.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Mounting pad for outdoor unit.
- B. Section 221005 - Plumbing Piping: Includes indoor coil condensate drain, water supply for humidifier, and the like.
- C. Section 223000 - Plumbing Equipment: Cooling condensate removal pumps.
- D. Section 230913 - Instrumentation and Control Devices for HVAC: Thermostats, humidistats, time clocks.
- E. Section 233100 - HVAC Ducts and Casings.
- F. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections and installation and wiring of thermostats and other controls components.
- G. Section 312316.13 - Trenching: Excavation and backfill for buried refrigerant lines and electrical conduits.

1.3 REFERENCE STANDARDS

- A. ACGIH - Ultraviolet Radiation: TLV(R) Physical Agents 7th Edition Documentation; 2010.
- B. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2026.
- C. AHRI 270 (SI/I-P) - Sound Performance Rating of Outdoor Unitary Equipment; 2025.
- D. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
- E. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Addendum (2026).

- F. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant; 2019.
- G. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2025.
- H. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. ASHRAE Std 90.2 - High-Performance Energy Design of Residential Buildings; 2024, with Addendum (2026).
- J. ASHRAE Std 103 - Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers; 2022, with Errata (2025).
- K. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- L. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2026.
- M. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2023.
- N. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2026.
- O. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- P. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
- Q. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 2022.
- R. ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces; 2025.
- S. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- T. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- U. 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; 2004 (Reapproved 2012).
- V. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

- W. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.
- X. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- Y. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013 (Reapproved 2021).
- Z. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding.; 2011 and errata.
- AA. NEMA MG 00001 - Motors and Generators; 2024.
- BB. NFPA 54 - National Fuel Gas Code; 2024.
- CC. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.
- DD. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2027.
- EE. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2027.
- FF. UL 153 - Portable Electric Luminaries; Current Edition, Including All Revisions.
- GG. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.
- HH. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.
- II. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- D. Design Data: Indicate refrigerant pipe sizing.
- E. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
- F. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.

- G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- H. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- I. Project Record Documents: Record actual locations of components and connections.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Filters: One for each unit, of each type and size.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years of experience and approved by manufacturer.

1.6 WARRANTY

- A. See Section 017700 - Closeout Procedures, for additional warranty requirements.
- B. Provide three year manufacturers warranty for solid state ignition modules.
- C. Provide five year manufacturers warranty for heat exchangers, condensing units, and compressors.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Daikin: www.daikin.com.
- B. Trane Inc / Mitsubishi: www.trane.com/#sle.
- C. Carrier Corporation / Toshiba: www.carrier.com/#sle.
- D. York International Corporation / Johnson Controls: www.york.com/#sle.
- E. Comfortmaker: www.comformaker.com.
- F. Substitutions: See Section 012500 - Substitution Procedures.

2.2 SYSTEM DESIGN

- A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
 - 1. Heating and Cooling: Air-source electric heat pump located in outdoor unit with evaporator; auxiliary electric heat.

2. Heating: Natural gas fired, Propane gas fired, or Electric resistance heating.
3. Heating: None.
4. Cooling: Outdoor electric condensing unit with evaporator coil in central ducted indoor unit.
5. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.

B. Performance Requirements: See Drawing Schedule for requirements .

C. Electrical Characteristics:

1. Refer to schedule and Division 26.
2. Disconnect Switch: Factory mount disconnect switch on equipment under provisions of Section 260583.

2.3 HIGHWALL INDOOR AIR HANDLING UNITS FOR DUCTLESS SYSTEMS (FCU-1 / HP-1 THRU FCU-2 / HP-2)

- A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.
1. Location: Ceiling or high wall.
 2. Sound Rating: Less than 45 dBA.
 3. Cabinet: High impact plastic.
 - a. Finish: White.
 - b. Provide with zero-position EEV for systems with variable flow/multiple indoor units.
 4. Fan: Line-flow fan direct driven by a single motor.
 5. Filter return air with washable, antioxidant pre-filter and a pleated anti-allergy enzyme filter.
- B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
1. Construction and Ratings: In accordance with AHRI 210/240.
 2. Manufacturer: System manufacturer.

2.4 OUTDOOR UNITS

- A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
1. Comply with AHRI 210/240.
 2. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.
 3. Refrigerant: R-32.
 4. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
 5. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23.1.
 6. Sound Rating: 69 dBA, when measured in accordance with AHRI 270 (SI/I-P).

- B. Compressor: Hermetic, two speed 1800 and 3600 rpm, AHRI 520 resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.
- C. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
 - 1. Condenser Fans: Direct-drive propeller type.
 - 2. Condenser Fan Motor: Enclosed, permanently lubricated.
- D. Coil: Air-cooled, aluminum fins bonded to copper tubes.
- E. Accessories: Filter drier, high-pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
 - 1. Provide thermostatic expansion valves.
 - 2. Provide heat pump reversing valves.
- F. Operating Controls:
 - 1. Control by room thermostat to maintain room temperature setting.
 - 2. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig and off when pressure drops below 140 psig for operation to 0 degrees F.
- G. Mounting Pad: Precast concrete parking bumpers, minimum 4 inches square; minimum of two located under cabinet feet.
 - 1. Grade: Reinforced concrete pad; see Structural.
 - 2. Roof: PHP Systems Designs: www.phpsd.com.

2.5 ACCESSORY EQUIPMENT

- A. Economizer Damper Units: Steel cabinet with baked enamel finish, easily removed and secured access doors, glass fiber insulation.
 - 1. Dampers: Formed steel with nylon bearings and gaskets.
 - 2. Damper Operator: 24 volt, modulating spring return motor with adjustable minimum position switch.
 - 3. Control Wiring: Provide wiring harness consisting of control board with relays, wiring harness, transformer, and hardware.
 - 4. Controls: Discharge air thermostat, adjustable outdoor air "enthalpy" control, return air "enthalpy" sensor position dampers, and interface to room thermostat.
- B. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage; with following features:
 - 1. System selector switch (heat-off-cool) and fan control switch (auto-on).
 - 2. Automatic switching from heating to cooling.
 - 3. Preferential rate control to minimize overshoot and deviation from setpoint.
 - 4. Set-up for four separate temperatures per day.
 - 5. Instant override of setpoint for continuous or timed period from one hour to 31 days.
 - 6. Short cycle protection.
 - 7. Programming based on every day of the week.
 - 8. Selection features including degree F or degree C display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.

9. Battery replacement without program loss.
10. Thermostat Display:
 - a. Time of day.
 - b. Actual room temperature.
 - c. Programmed temperature.
 - d. Programmed time.
 - e. Duration of timed override.
 - f. Day of week.
 - g. System Mode Indication: Heating, Cooling, Fan Auto, Off, and On, Auto or On, Off.
11. Manufacturers:
 - a. Carrier Corporation: www.carrier.com/#sle.
 - b. Trane Inc: www.trane.com/#sle.
 - c. York International Corporation / Johnson Controls: www.york.com/#sle.
 - d. Honeywell: www.honeywell.com.
 - e. Substitutions: See Section 012500 - Substitution Procedures.

2.6 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
 1. AP Armacell LLC; Armaflex Black LapSeal: www.armacell.us/#sle.
 2. K-Flex USA LLC; Insul-Lock DS: www.kflexusa.com/#sle.
 3. Haldstead; Model "Insul-Tube".
 4. Substitutions: See Section 012500 - Substitution Procedures.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
 1. Minimum Service Temperature: Minus 40 degrees F.
 2. Maximum Service Temperature: 180 degrees F.
 3. Connection: Waterproof vapor barrier adhesive.
- C. Application: Refrigerant piping.
- D. Tape: AP Armaflex Black Lap Seal, 2 inch width, self adhesive for secondary seam security for butt seams.
- E. Fittings: AP Armaflex prefabricated fittings. 3-piece elbows and tees, as intended by manufacturer for straight or grooved piping. Field fabricated fittings are not acceptable.
- F. Support: Armaflex Eco Light insulated support with load bearing PET core to protect insulation from damage. Provide with PVC foil cladding.

2.7 ENGINEERED WALL OUTLET SEALS AND REFRIGERANT PIPING INSULATION PROTECTION

- A. Manufacturers:
 1. Airex Manufacturing, Inc: www.airexmfg.com/#sle.
 2. Substitutions: See Section 012500 - Substitution Procedures.
- B. Basis of Design: Airex Manufacturing, Inc; www.airexmfg.com/#sle.
 1. Pipe Penetration Wall Seal: Airex Titan Outlet.

2. Refrigeration Pipe Insulation Protection System: Airex E-Flex Guard.
 3. Pipe Penetration Wall Seal and Insulation Protection System: Airex Pro-System Kit.
- C. Pipe Penetration Wall Seal: Seals HVAC piping wall penetrations with compression gasket wall mounted rigid plastic outlet cover.
1. Wall Outlet Size, Stucco and Masonry Applications: 7-1/2 inch wide by 10 inch high.
 - a. Elastomeric Sleeve Diameter: 1-11/16 inch minimum.
 2. Wall Outlet Size, Siding and Compact Applications: 6-7/8 inch wide by 3-7/8 inch high.
 - a. Elastomeric Sleeve Diameter: 1-11/16 inch minimum.
 3. Outlet Cover Color: Gray.
 4. Water Penetration: Comply with ASTM E331.
 5. Air Leakage: Comply with ASTM E283.
 6. Air Permeance: Comply with ASTM E2178.
- D. Insulation Protection System: Refrigerant piping insulation PVC protective cover.
1. PVC Insulation Cover Color: Black with full-length velcro fastener.
 2. Weatherization and Ultraviolet Exposure Protection: Comply with ASTM G153.
 3. Water/Vapor Permeability: Comply with ASTM E96/E96M.
 4. Anti-Fungal and Anti-Microbial Resistance: Comply with ASTM G21.
 5. Flame Spread and Smoke Development Rating of 24/450: Comply with ASTM E84.
 6. Carbon Arc Light Exposure: Comply with ASTM G153.
 7. Tensile Strength After UV Exposure and Water Immersion: Comply with ASTM D412.
 8. Water Absorption of Plastics: Comply with ASTM D570.
 9. Adhesive free.

2.8 ACCESSORIES

- A. General Requirements:
1. Provide required accessories in accordance with and subject to the recommendations of the insulation manufacturer.
 2. Furnish compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state.
 3. Comply with ASTM C795 requirements for materials to be used on stainless steel surfaces.
 4. Supply materials that are asbestos free.
- B. Corrosion Inhibitors:
1. Corrosion Control Gel:
 - a. Manufacturers:
 - 1) Polyguard Products; RG2400LT: www.polyguardproducts.com/#sle.
 - 2) Substitutions: See Section 012500 - Substitution Procedures.
 - b. Corrosion Protection: Comply with ASTM B117 and ASTM D610.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.

- B. Verify that proper power supply is available and in correct location.
- C. Verify that proper fuel supply is available for connection.
- D. Verify that water supply is available for humidifier.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.
- B. Install in accordance with NFPA 90A and NFPA 90B.
- C. Install gas fired furnaces in accordance with NFPA 54.
- D. Provide vent connections in accordance with NFPA 211.
- E. Install refrigeration systems in accordance with ASHRAE Std 15.
- F. Mount counterflow furnaces installed on combustible floors on additive base.
- G. Pipe drain from cooling coils and humidifiers to nearest floor drain.
- H. Glue and tape all elastomeric insulation butt seams air tight per manufacturer's recommendations to avoid condensation between pipe and insulation.
- I. Use manufacturer's insulated pipe support to provide continuous insulation through the support.
- J. Fully coat all exterior elastomeric insulated pipe with UV resistant and moisture resistant paint.

END OF SECTION

AIR COILS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electric coils.

1.2 RELATED REQUIREMENTS

- A. Section 230719 - HVAC Piping Insulation.
- B. Section 232300 - Refrigerant Piping.
- C. Section 233100 - HVAC Ducts and Casings: Installation of duct coils.
- D. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

- A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

1.4 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
- C. Shop Drawings: Indicate coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
- D. Certificates: Certify that coil capacities, pressure drops, and selection procedures meet or exceed specified requirements.
- E. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors.
- B. Protect coils from entry of dirt and debris with pipe caps or plugs.

1.7 WARRANTY

- A. See Section 017700 - Closeout Procedures, for additional warranty requirements.

PART 2 PRODUCTS

2.1 ELECTRIC COILS

- A. Manufacturers:
 - 1. INDEECO (Industrial Engineering and Equipment Company): www.indeeco.com/#sle.
 - 2. Warren Technology: www.warrenhvac.com/#sle.
 - 3. Substitutions: See Section 012500 - Substitution Procedures.
- B. Assembly: UL listed and labelled, with terminal control box and hinged cover, splice box, coil, casing, and controls.
- C. Coil: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material.
- D. Casing: Die formed channel frame of 16 gauge, 0.0598 inch galvanized steel with 3/8 inch mounting holes on 3 inch centers. Provide tube supports for coils longer than 36 inches.
- E. Controls: Automatic reset thermal cut-out, built-in magnetic contactors, control circuit transformer and fuse, manual reset thermal cut-out, air flow proving device, fused disconnect, load fuses.
- F. Electrical Characteristics:
 - 1. Refer to Division 26.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Install in ducts and casings in accordance with SMACNA (DCS).
 - 1. Support coil sections independent of piping on steel channel or double angle frames and secure to casings.
 - 2. Provide frames for maximum three coil sections.
 - 3. Arrange supports to avoid piercing drain pans.
 - 4. Provide airtight seal between coil and duct or casing.
 - 5. Refer to Section 233100.

- C. Protect coils to prevent damage to fins and flanges. Comb out bent fins.
- D. Install coils level. Install cleanable tube coils with 1:50 pitch.
- E. Make connections to coils with unions and flanges.
- F. Refrigerant Coils: Provide sight glass in liquid line within 12 inches of coil. Refer to Section 232300.
- G. Insulate headers located outside air flow as specified for piping. Refer to Section 230719.
- H. Electric Duct Coils: Wire in accordance with NFPA 70. Refer to Section 260583.

END OF SECTION