

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and Division 00 and 01, apply to this Section.

1.2 SUMMARY

- A. This section includes general and supplementary conditions specifically applicable to Division 23, in addition to Division 01.
- B. This Section includes the following basic mechanical materials and methods to complement other Division 23 Sections.
 - 1. Submittals.
 - 2. Coordination Drawings.
 - 3. Record Documents.
 - 4. Maintenance Manuals.
 - 5. Piping materials and installation instructions common to most piping systems.
 - 6. Concrete base construction requirements.
 - 7. Escutcheons.
 - 8. Dielectric fittings.
 - 9. Flexible connectors.
 - 10. Mechanical sleeve seals.
 - 11. Nonshrink grout for equipment installations.
 - 12. Field-fabricated metal equipment supports.
 - 13. Installation requirements common to equipment specification sections.
 - 14. Rough-ins.
 - 15. Mechanical demolition.
 - 16. Mechanical Installations.
 - 17. Cutting and patching.
 - 18. Touchup painting and finishing.

1.3 GENERAL REQUIREMENTS

- A. Intent:
 - 1. The intent of the Contract Documents is for the Contractor to include all work necessary for the complete mechanical systems, tested and ready for operation.
 - 2. By submitting a proposal, the Contractor represents that it has made a thorough examination of the site, of the work, and all existing conditions and limitations, and that it has examined the Contract Documents in complete detail and has determined beyond doubt that the drawings, specifications, and existing conditions are sufficient, adequate and satisfactory for the construction of the work under the Contract.
 - 3. Where minor adjustments of the work are necessary for purposes of fabrication or installation of items, or resolution of conflicts between items within the intent of the Contract Documents, the Contractor shall make such adjustments with no added compensation. Where such adjustments affect functional or aesthetic design of the work, they shall first be submitted to the Architect for review and approval.
- B. Conditions:

1. Conform to all Bidding Requirements, General Conditions and Amendments to the General Conditions, Supplementary Conditions and Special Conditions and General Requirements, Division 01, which govern the work specified herein.
 2. The Contractor is obligated to comply with the above in addition to the requirements of this Section.
 3. Modifications by this Section do not nullify any other portions of the above referenced conditions.
- C. Make complete mechanical installation, connecting to all equipment shown on the plans, or called for in the specifications. Mechanical contractor to provide any additional extra dampers and valves not shown on plans to obtain design criteria as required by the balancing contractor.
- D. Plans and Specifications: Plans and specifications shall be taken together.
1. Contractor shall provide all equipment, materials and work shown on the plans and/or called for in these specifications.
 2. Provide work specified and not indicated on plans, or work indicated on plans and not specified, as though mentioned in both.
 3. When discrepancies or conflicts occur within the documents, the Architect shall determine which takes precedence and the Contractor shall perform the selected requirement without additional cost.
- E. Mechanical Drawings:
1. Mechanical drawings do not attempt to show all aspects of building construction, which will affect the installation of mechanical systems. The mechanical drawings are diagrammatic and do not intend to show all offsets and fittings that may be required for a complete installation. Locations of equipment, pipes, valves, traps, ductwork, etc. shown on the drawings, shall be followed as closely as conditions will permit. Review all project drawings, including, but not limited to, architectural, structural and electrical drawings; and coordinate with all trades involved so there is no conflict with work of other trades and so Owner secures best arrangement of work consistent with use of space.
 2. Verify exact distances between points shown of drawings by actual measurement at site, as no extra cost will be allowed for differences between actual measurements and scaled measurements.
 3. Changes in design, configuration, or location of equipment, piping, or ductwork, advisable in the opinion of Contractor, shall be submitted to Architect for approval before proceeding with work, with written assurance from other trades that such changes will not interfere with their installation, nor cause any extra cost on their part. Such changes shall be made at no additional cost to Owner.
 4. Check location of all work of all trades and avoid interferences. Special attention is called to the following items; conflicts shall be reported to Architect for decision and direction:
 - a. Exact location of outlets shown on architectural details.
 - b. Location of suspended ceilings.
 - c. Location of ducts, grilles, pipes, and other mechanical equipment so electrical outlets are clear of these items and in proper relation to same.

1.4 DEFINITIONS AND ABBREVIATIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include spaces above hard or lay-in type ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. Domestic Water Piping: Piping inside building that conveys potable cold and hot water to fixtures and equipment throughout the building.
- G. Non-Potable Water Piping: Piping inside building that conveys non-potable water to fixtures and equipment throughout the building.
- H. The word "provide," as used in these specifications, means "furnish and install."
- I. The word "approved," as used in these specifications, means acceptance by the Architect.
- J. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the drawings, or other paragraphs or schedules in the specifications, and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the reader locate the reference. Location is not limited.
- K. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted," mean directed by the Architect, requested by the Architect, and similar phrases.
- L. Mechanical Systems - Including but not limited to:
 - 1. Heating, Ventilation and Air Conditioning Systems.
 - 2. Temperature Controls System.
- M. Abbreviations:
 - 1. AMCA Air Moving and Conditioning Association
 - 2. ANSI American National Standards Institute
 - 3. ARI Air Conditioning and Refrigeration Institute
 - 4. ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers
 - 5. ASME American Society of Mechanical Engineers
 - 6. ASTM American Society of Testing Materials
 - 7. AWWA American Water Works Association
 - 8. AWS American Welding Society
 - 9. CISPI Cast Iron Soil Pipe Institute

10. FM Factory Mutual Engineering Corporation
11. IBC International Building Code
12. IMC International Mechanical Code
13. NEBB National Environmental Balancing Bureau
14. NEC National Electric Code
15. NEMA National Electrical Manufacturers Association
16. NFPA National Fire Protection Association
17. NREC Washington State Non-Residential Energy Code
18. OSHA Occupational Safety and Health Administration
19. SMACNA Sheet Metal and Air Conditioning Contractors National Association, Inc.
20. UPC Uniform Plumbing Code
21. UL Underwriters Laboratories

1.5 CODES, PERMITS AND INSPECTIONS

- A. Codes: Work shall be installed as a minimum in conformity with applicable local ordinances and statutes. Standards and sizes, which exceed preceding requirements, shall be installed as drawn or specified. Nothing in the specifications shall be construed to permit deviation to less than the requirements of governing codes. Contractor is not relieved from furnishing and installing work shown or specified which may be beyond requirements of ordinances, laws, regulations, and codes.
- B. Codes and Standards: Applicable codes and standards shall include, but not necessarily be limited to and shall be the current version adopted by the Authority Having Jurisdiction:
 1. Uniform Plumbing Code, by International Association of Plumbing and Mechanical Officials.
 2. International Mechanical Code, by International Code Council.
 3. International Building Code, by International Code Council.
 4. Requirements of OSHA, EPA and WISHA.
 5. National Fire Protection Association Codes.
 6. ASME codes for boiler and pressure vessels.
 7. SMACNA HVAC Duct Construction Standards, latest edition.
 8. All local and state amendments.
 9. Requirements of all agencies have jurisdictional authority over installation of mechanical systems.
- C. Permits, Fees and Inspections:
 1. Contractor shall arrange and pay for all permits, fees and inspections required in connection with this installation. The Contractor shall present the Owner with properly signed certificates of final inspection before the work will be accepted.
 2. Contractor shall call for all inspections by local building official(s) when they become due, and shall not cover any work until approved by these governing authorities.
 3. Contractor shall make all arrangements with utility companies for water, steam, gas and drainage services, etc., associated with the work and include required payments for meters, piping, services, connection charges and materials furnished and installed by utility companies. Work and materials shall be in strict accordance with rules of respective authorities.
- D. Underwriters Laboratory Approval: Where Underwriters Laboratories (UL) standards exist, all items of electrical equipment or items partially composed of electrical equipment shall carry Underwriters Laboratories (UL) label either for the entire unit or for the electrical portion of the

equipment. If UL standards do not exist, equipment shall be provided that has been labeled by an independent testing agency that is recognized by the authority having jurisdiction.

- E. ASME Code Stamp: ASME code stamp required on all pressure vessels and relief valves. Certificate required from the Boiler Inspector showing approval of the equipment and its installation.

1.6 WORK INCLUDED

- A. Work under this division shall include providing all materials, labor, equipment, tools, appliances, hoisting, scaffolding, supervision and overhead for the proper execution and completion of the mechanical work.
- B. Should these specifications or references made therein fail to specify adequately an item of equipment or material required for proper completion of the work in accordance with present day practice, this deficiency shall not relieve Contractor from furnishing and installing same. Call such omissions to attention of Architect and use such equipment or material as approved by Architect.
- C. All new equipment and products as noted in Part 2 of each section shall be installed as per manufacturer's recommendations.
- D. Provide all additional piping, ducts, caps and valves not shown on drawings, to maintain fully operational systems during the project at no additional cost to the owner.

1.7 WORKMANSHIP

- A. This Contractor shall provide completed systems with a neat and finished appearance. If, in the judgment of the Architect, any portion of the work has not been performed in a workmanlike manner or is left in a rough, unfinished state, this Contractor will be required to remove, reinstall or replace same and patch and paint surrounding surfaces in a manner acceptable to the Architect, without increase in cost to the Owner.

1.8 SUBMITTALS, GENERAL REQUIREMENTS

- A. General: Follow the procedures for submittals or as described herein and specified in Division 01.
- B. General Requirements for Submittals: Provide the following submittals as indicated in each section. Additional submittal requirements may be included in the individual sections.
 - 1. Product Data: Submit manufacturer's product data for the items listed in the individual sections. Product data shall demonstrate compliance with all specified features and requirements. Submittals for equipment shall include, but not be limited to, data indicating equipment capacity meets the indicated values at specified conditions, equipment drawings indicating all dimensions, connection information, service space requirements, recommended piping and/or wiring diagrams, installation details and extended warranties either offered by equipment manufacturer or required by specifications.
 - 2. Shop Drawings: Submit Contractor prepared drawings of Contractor fabricated mechanical systems. Drawings shall be prepared at 1/4" scale using Computer Aided Design (CAD) software unless indicated otherwise. Drawings shall show exact location of

equipment, piping and ductwork, each section of shop fabricated duct or pipe and location of field joints, supports and building attachments, and seismic restraint locations.

3. Reports and Certificates: Indicate and interpret test results for compliance with performance requirements. Provide performance certificates.
 4. Operation and Maintenance Data: Submit proposed Operation and Maintenance materials for approval prior to inclusion in the comprehensive final bound edition. See Article in this section on Operation and Maintenance Manuals for materials required to be included.
- C. Format: Provide submittals arranged with numerical index and bookmarks in PDF electronic format containing the total volume of material. All product data shall be submitted complete by system, partial submittals are not acceptable and may be returned unreviewed. Systems are defined here as HVAC system, and HVAC control system (Division 23). Reference submittals, including title and location of project, Architect, Contractor, submission date, and specification paragraph number to indicate clearly the location, service, equipment identification numbers as shown on drawings, and function of each particular item. Where manufacturers' catalogs, pamphlets, or data sheets are submitted in lieu of prepared shop drawings, such submissions shall indicate specifically the item for which approval is required in red ink, and submissions showing general information only are not acceptable.
- D. Submittals not in conformance to above paragraphs will be returned unreviewed.

1.9 SUBMITTALS, BASIC MECHANICAL MATERIALS

- A. General: See Article in this section, Submittals, General Requirements for general requirements of Product Data, Shop Drawings, Reports and Certificates, and Operation and Maintenance data submittals.
- B. Product Data: Provide submittals of the following:
1. Dielectric Flanges
 2. Dielectric Couplings
 3. Dielectric Nipples
 4. Braided Flexible Hose Connectors
 5. Rubber Flexible Connectors
 6. Flexible Expansion Loops
- C. Shop Drawings: None required.
- D. Reports and Certificates: None required.

1.10 COORDINATION DRAWINGS

- A. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
1. Planned piping layout, including valve and specialty locations and valve-stem movement.
 2. Planned duct layout, including fan, coil, filter, duct silencer, and damper location.
 3. Clearances for installing and maintaining insulation.

4. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
5. Equipment and accessory service connections and support details.
6. Other systems installed in same space as mechanical systems.
7. Exterior wall and foundation penetrations.
8. Fire-rated wall and floor penetrations.
9. Ceiling and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
10. Sizes and location of required concrete pads and bases.
11. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
12. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
13. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.

1.11 SUBSTITUTIONS

- A. [Substitutions will only be considered after project award. No substitutions will be considered during bid and/or negotiation periods.]
- B. In all cases in this specification where an article is followed by the words "or equal," the Engineer is the sole judge of the quality of the proposed substitution.
- C. When the Engineer approves a substitution, the approval is given with the understanding that the Contractor guarantees the article or material substituted to be equal to or better in every respect than the article or material specified. The Contractor shall also assume complete responsibility that the article or material will fit the job as far as space, access and servicing requirements.
- D. Where several materials are specified by name for one use, select for use any of those so specified subject to compliance with specified requirements.
- E. Whenever item or class of material is specified exclusively by detail specification, trade name, manufacturer's name or by catalog reference, use only such item, unless written approval is given. Submit written requests in accordance with Division 01 substitution requirements.
- F. Make no substitutions for materials, articles or process required under contract unless written approval is obtained. See the Division 01 for project substitution requirements.

1.12 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 01. In addition to the requirements specified in Division 01, indicate the following installed conditions:
 1. Ductwork mains and branches, size and location, for both exterior and interior, locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
 2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams,

- complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
3. Record drawings shall incorporate all accepted change orders and RFIs; reference number on drawings is not acceptable.
 4. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 5. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
 6. Contract Modifications, actual equipment and materials installed.
 7. Record the locations and invert elevations of underground installations.

1.13 OPERATION AND MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 01 and the following requirements. Manuals shall be hard cover, 3-post binder, and indexed by systems. Pages shall be same size, with exception of allowable foldout pages for control and flow diagrams. Cover shall be inscribed with name of project, Owner, description of contents, Architect, General Contractor, Mechanical Contractor, and date. In addition to the requirements specified in Division 01, include the following information in Division 23 materials:
 1. Manufacturer's Equipment Installation and Start-Up Manuals for all equipment provided by the project. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 2. Manufacturer's Equipment Service Manuals for all equipment provided by the project, including parts list, troubleshooting list and maintenance procedures for routine preventative maintenance. Include disassembly, repair, and reassembly; aligning and adjusting instructions; servicing instructions and lubrication charts and schedules
 3. Reports and Certificates of all systems and equipment as required by specifications.
 4. Material Safety Data Sheets (MSDS) for all applicable materials used for all specified installations.
 5. Warranty Certificates for all equipment where extended warranties are either offered or required; provide supplier contact information.
- B. Product Data of all equipment provided by the project as indicated in submittal requirements.

1.14 QUALITY ASSURANCE

- A. Equipment Selection: Equipment allowed by the specifications but with different electrical characteristics, physical dimensions, capacities, and/or ratings than what is shown on the drawings may be furnished, provided such proposed equipment is approved in writing and connecting mechanical and electrical services, such as pipe and/or duct connection sizes, circuit breakers, conduit, motors, bases, and equipment spaces are revised to accommodate such equipment. All expenses shall be borne by the Contractor. Specified minimum energy ratings and/or equipment efficiencies must meet design and commissioning requirements.
- B. Soldered Lead Free End Connections: Copper alloys with silicone content greater than 0.005% are not allowed.

1.15 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored mechanical equipment, ducts, pipes and tubes and other materials from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Pipes, ducts, mechanical equipment, and other materials that are damaged due to improper storage shall be replaced at the Contractor's expense.

1.16 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Some equipment may require temporary installation during one phase and require relocation to final location under another phase. Provide all associated labor and materials to accommodate this phasing.
- F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 08.
- H. Use of the building HVAC systems, including those being provided under this contract, for temporary heating, ventilation or cooling during construction is prohibited. When system installation is complete and ready for start-up, approval to operate the system shall be obtained from the Owner or designated Owner's representative.

1.17 COMMISSIONING SUPPORT

- A. Provide the following support for project commissioning:
 - 1. Attend commissioning scoping meetings. At a minimum, the Mechanical, TAB, and Controls Contractors shall participate. Equipment vendor representatives shall also attend upon request of the Commissioning Agent and Test Engineer. These meetings shall further define the testing requirements and participation of each contractor and sub-contractors for each commissioning activity.

2. Provide Commissioning Authority and Test Engineer additional requested data, prior to normal O&M Manual submittal, in a timely manner for the development of the startup plan and the functional performance testing procedures.
3. Provide startup forms and clearly document all completed startup activities. The DDC system startup forms shall include detailed checkout forms with descriptions for each controlled device. All forms shall be submitted for review by the Test Engineer and Commissioning Authority prior to use.
4. During the normal submittal processes, provide an additional copy of all equipment submittals, startup forms, field static testing reports (duct static pressure test reports, pipe static pressure test reports, chemical treatment reports, etc.), and TAB reports to the Commissioning Authority and Test Engineer for review.
5. Provide skilled technicians, including equipment vendor representatives, equipment, and materials to perform startup and execute functional performance tests. DDC system sub-contractor shall provide skilled technicians, familiar with the project, for both startup (Owner-witnessed point-to-point testing) and functional performance testing. Commissioning functional performance testing participation from the controls contractor shall be required in addition to the point-to-point testing.
6. Submit startup documentation to General Contractor, Test Engineer, and Commissioning Authority to verify functional testing prerequisite requirements are fulfilled before functional testing for the associated equipment or system is scheduled to start. [Refer to Division 23 for commissioning procedure]. Startup documentation (point-to-point testing) shall also be required from the controls contractor as a prerequisite to functional performance testing.
7. Correct deficiencies found during startup and functional performance testing in a timely manner to facilitate retesting activities within the commissioning schedule.
8. TAB sub-contractor shall report any deficiencies found in a timely manner. These deficiencies shall be corrected in a timely manner to facilitate functional performance testing within the commissioning schedule.
9. TAB sub-contractor shall coordinate all setpoint value requirements for input into the controls system, including minimum outside air damper positions, return/supply fan VFD speed mapping, pumping loop differential pressure setpoints, duct system static pressure setpoints, air terminal unit flow sensor calibration factors, etc.

PART 2 – PRODUCTS

2.1 BASIC, COMMON FEATURES

- A. Lead free products and materials shall be used for Domestic Water Piping Systems.

2.2 PIPE AND PIPE FITTINGS

- A. Refer to individual piping Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- C. Soldered Lead Free End Connections: Copper alloys with silicone content greater than 0.005% are not allowed.

2.3 JOINING MATERIALS

- A. Refer to individual piping Sections for special joining materials not listed below.

- B. Pipe-Flange Gasket Materials: Suitable for fluid type, temperature and pressure of piping system.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless indicated otherwise.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32.
 - 1. Alloy Sn95 or Alloy Sn94: Approximately 95 percent tin and 5 percent silver. Solder shall be labeled as "LEAD FREE".
 - 2. Alloy E: Approximately 95 percent tin and 5 percent copper. Solder shall be labeled as "LEAD FREE".
- D. Brazing Filler Metals: AWS A5.8.
 - 1. BCuP Series: Copper-phosphorus alloys.
 - 2. BAg1: Silver alloy.
- E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.
- G. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
 - 1. Sleeve: ASTM A 126, Class B, gray iron.
 - 2. Followers: ASTM A 47 malleable iron or ASTM A 536 ductile iron.
 - 3. Gaskets: Rubber.
 - 4. Bolts and Nuts: AWWA C111.
 - 5. Finish: Enamel paint.

2.4 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Dielectric Flanges:
 - 1) Capitol Manufacturing Co.
 - 2) Central Plastics Co.
 - 3) Epco Sales Inc.
 - 4) Watts Industries, Inc.; Water Products Div.
 - 5) Or Approved Equal.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dielectric Couplings:
 - 1) Calpico, Inc.
 - 2) Lochinvar Corp.
 - 3) Or Approved Equal.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dielectric Nipples:
 - 1) Grinnell Corp.; Grinnell Supply Sales Co.
 - 2) Victaulic Co. of America.
 - 3) Or Approved Equal.

2.5 FLEXIBLE CONNECTORS

- A. Braided Hose Flexible Connectors: Stainless steel bellows with woven, flexible, wire-reinforcing protective jacket; 150-psig minimum working pressure and 250 deg F maximum operating temperature. Connectors shall have flanged or threaded-end connections to match equipment connected and shall be capable of 3/4-inch misalignment. Bronze braiding for copper tubing applications and stainless steel braiding for steel pipe applications.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Braided Hose Flexible Connectors:
 - 1) Flex-Hose Co, Inc.
 - 2) Hyspan Precision Products, Inc.
 - 3) Mason.
 - 4) Mercer Rubber Co.
 - 5) Metraflex Co.

- 6) Or Approved Equal.
- B. Rubber Flexible Connectors: Mason SFU for ¾ to 2-inch NPS or equal by other specified manufacturers; Mason SFDEJ for 2-1/2-inch NPS and larger or equal by other specified manufacturers. Fiber-reinforced EPDM rubber body; capable of handling operating temperatures up to 250 deg F and pressures up to 150 psig. Joint type to match system specification.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Rubber Flexible Connectors:
 - 1) General Rubber Corp.
 - 2) Flex-Hose Co., Inc.
 - 3) Mercer Rubber Co.
 - 4) Metraflex Co.
 - 5) Mason.
 - 6) Or Approved Equal.
- C. Flexible Expansion Loops: Stainless steel flexible hose and braid consisting of two flexible sections, two 90 degree elbows and one 180 degree return bend. Pipe connection material and joint type to match system specification, see application section of individual sections. Bronze braiding for copper tubing applications and stainless steel braiding for steel pipe applications. Provide pipe guides as recommended by manufacturer. Loops installed hanging down shall have a drain plug. Units shall be [single][double] braided. Movement and/or loop lengths are indicated.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Flexible Expansion Loops:
 - 1) Metraflex Co.
 - 2) Flex-Hose.
 - 3) Or Approved Equal.
- D. Flexible Expansion Loops: Three equal length sections of annular corrugated stainless steel hose and braid, Provide with four 90 degree elbows and support per manufacturer's recommendations. Ends flanged, screwed, welded, sweat, or grooved. Suitable for operating temperatures up to 850 F. Designed for pressure testing to 1.5 times their maximum rated working pressure with a minimum 4 to 1 (burst to working) safety factor. Factory tested using air-under-water and hydrostatic pressure. Manufacturer: Flex-Hose Company.

2.6 MECHANICAL SLEEVE SEALS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Mechanical Sleeve Seals:

- a. Calpico, Inc.
- b. Metraflex Co.
- c. Thunderline/Link-Seal.
- d. Innerlynx
- e. Or Approved Equal.

- B. Description: Modular design, with interlocking EPDM rubber links shaped to continuously fill annular space between pipe and sleeve. Stainless steel connecting bolts and composite pressure plates.

2.7 PIPING SPECIALTIES

- A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
 - 1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
 - 2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 - 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
 - 4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set screws.
- B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
 - 1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
 - 2. OD: Completely cover opening.
 - 3. Cast Brass: One piece, with set screw.
 - a. Finish: Rough brass.
 - b. Finish: Polished chrome-plate.
 - 4. Cast-Iron Floor Plate: One-piece casting.

2.8 GROUT

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
 - 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psig, 28-day compressive strength.

2.9 ELECTRICAL SHORT CIRCUIT CURRENT RATING FOR MECHANICAL EQUIPMENT

- A. General: Provide control panels for mechanical equipment with a minimum short-circuit current rating as indicated in the Mechanical drawings, or greater than the available fault current at the panel per the values shown on the Electrical drawings, whichever value is greater. Minimum interrupting ratings shall be 14,000 (RMS Symmetrical) at 480/277V and 10,000 (RMS Symmetrical) at 208/120V. Short circuit current rating shall be included on the equipment nameplate.

PART 3 – EXECUTION

3.1 GENERAL MECHANICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
1. Coordinate mechanical systems, equipment, and materials installation with other building components.
 2. Verify all dimensions by field measurements.
 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
 8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
 9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
 11. Install access panel or doors where units are concealed behind finished surfaces. Notify General Contractor on the number, location and size of access panels or doors.
 12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
 13. Replace all air filters with new filters upon Owner taking occupancy of the building or at a time mutually agreed upon between the Owner and Contractor.
 14. Do not install ductwork in elevator machine rooms, electrical and/or communication rooms unless it directly services that room.
- B. Locate wall, floor and ceiling fire ratings from architectural drawings for appropriate hourly rating of combination fire/smoke dampers or fire dampers shown on mechanical drawings.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install piping as described below, unless piping Sections specify otherwise. Individual piping Sections specify unique piping installation requirements.
- B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements

were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.

- C. Lead free products and materials shall be used for Domestic Water Piping Systems.
- D. Install piping at indicated slope.
- E. Install components with pressure rating equal to or greater than system operating pressure.
- F. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- G. Install piping free of sags and bends.
- H. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- I. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- J. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- K. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- L. Install flexible connectors according to manufacturer's written instructions where indicated and specified in other piping sections.
- M. Install flexible expansion loops according to manufacturer's written instructions where indicated and specified in other piping sections.
- N. Install fittings for changes in direction and branch connections.
- O. Install couplings according to manufacturer's written instructions.
- P. Install Portable Instrument Connections in all piping systems where DDC temperature and/or pressure sensors and thermometers and/or pressure gauges are located.
- Q. Do not route piping through elevator equipment rooms, unless specifically allowed by local authority.
- R. Do not route piping over electrical panels, transformers, switchgear or other electrical equipment.
- S. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
 - 1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish. Use split-casting escutcheons if required, for existing piping.
 - 2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
 - 3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
 - 4. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.

5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.
- T. Sleeves are not required for core drilled holes.
- U. Permanent sleeves are not required for holes formed by PE removable sleeves.
- V. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 2. Build sleeves into new walls and slabs as work progresses.
 3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS.
 - b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with nonshrink, nonmetallic grout.
 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.
- W. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
 3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- X. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for manufacturer's recommended clear space between pipe and sleeve.
 1. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
 2. Caulk exterior side of annular space once the mechanical sleeve seal is in place using an elastomeric joint sealant.

- Y. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- Z. Verify final equipment locations for roughing-in.
- AA. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- BB. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
 - 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - 3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
 - 4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 - c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - e. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
 - 6. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators.
 - 7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench to recommended torque values.
- CC. Piping Connections: Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
 - 2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.3 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.
- B. Install equipment according to approved submittal data.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- E. Install equipment giving right of way to piping installed at required slope.

3.4 PAINTING AND FINISHING

- A. Refer to Division 09 for paint materials, surface preparation, and application of paint.
- B. Apply paint to exposed piping, ductwork and supports according to the following, unless otherwise indicated:
 1. Interior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer. Paint not required on interior galvanized supports.
 2. Exterior, Ferrous Piping and ductwork: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
 3. Exterior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
- C. Do not paint piping specialties with factory-applied finish.
- D. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.5 CONCRETE HOUSEKEEPING PADS

- A. Construct concrete housekeeping pads of dimensions indicated, but not less than 4 inches larger in both directions for all floor-supported units. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Concrete and reinforcement as specified in Division 03.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

3.7 DEMOLITION

- A. Perform all demolition or interface work required in the existing building for the removal of, or interface with, existing mechanical equipment, ductwork, tubing, or piping. Relocate or modify the existing piping, tubing and ductwork as required by any general construction alterations or by the installation of new ductwork, tubing, or piping in the existing building.
- B. Existing Materials, Removal and Disposition:
 - 1. Scope: For mechanical items that remain the property of the Owner, refer to drawings.
 - 2. In coordination with the Owner's Representatives, these materials shall be made available for their inspection and decision as to whether the Owner will retain possession. Items selected for retention shall be delivered to a location on the premises selected by the Owner and turned over to them. Take reasonable care to avoid damage to this material.
 - 3. All material not selected for retention by the Owner and debris shall be disposed of by the Contractor.
- C. If pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
- D. Work Abandoned in Place: Cut and remove underground pipe a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.
- E. Reuse of Materials: Reuse of materials is prohibited unless specifically indicated or approved by Architect.
- F. Notify Architect in discovery of any hazardous materials.
- G. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.8 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 01. In addition to the requirements specified in Division 01, the following requirements apply:
 - 1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
- B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
 - 1. Uncover Work to provide for installation of ill-timed Work.
 - 2. Remove and replace defective Work.
 - 3. Remove and replace Work not conforming to requirements of the Contract Documents.
 - 4. Remove samples of installed Work as specified for testing.
 - 5. Install equipment and materials in existing structures.
 - 6. Upon written instructions from the Architect, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.
- C. Cut, remove and legally dispose off-site of selected mechanical equipment, components, and materials, including but not limited to removal of mechanical piping, heating units, and other mechanical items made obsolete by the new Work.

- D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- E. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
- F. Repair cut surfaces to match adjacent surfaces.

3.9 GROUTING

- A. Install nonmetallic, nonshrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placing of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete housekeeping pads to provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's written instructions.

3.10 EARTHWORK

- A. General: Perform earthwork required for installation of mechanical work below grade in accordance with Division 2.
- B. Excavate trenches to uniform widths to provide a working clearance on each side of the pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated. Grade trench bottoms to provide uniform bearing and support for each section of pipe. Form holes and depressions for joints after trench bottom has been graded. Provide temporary pumping equipment to keep excavation free from water. Install pipe bedding in rock excavation consisting of not less than 6 inch of sand or equivalent material.
- C. Provide bracing and shoring as necessary.
- D. Backfill trenches only after completion of pressure tests and inspection. Carefully compact material under pipe and bring backfill evenly up on both sides and along the full length of piping or conduit. Cover to 12-inch thickness over top of pipe. Fill and tamp remainder of backfill material in 6-inch layers. Provide backfill materials generally consisting of clean earth or sand relatively free of clods or stones. For sewer and water piping, use pea gravel. For gas piping, use sand. Backfill under, around, and to 6 inch above top of piping. [In addition, wherever paving or future paving is indicated over backfill, provide remainder of backfill with satisfactory soil, ASTM D 2487 soil classification groups GW, GP, GM, SW, SP and SM or a combination of these.]

- E. Compact soil to 6-inch layer (maximum) loose thickness of backfill. Where roadway or parking area surfaces will be placed over backfill, provide moisture conditions, which will produce compacted density of 95 percent of maximum density. Elsewhere, 90 percent. Test in accordance with Divisions 1 and 2.
- F. Take special care in compacting under services where they enter building to prevent settling. Contractor fully responsible for damage to piping and property as a result of settling around service piping.
- G. Dispose surplus materials off-site in a suitable location.
- H. Place and maintain barricades, construction signs, torches, lanterns, and guards as required during periods of open excavation to protect persons from injury and to avoid property damage.
- I. Leave premises thoroughly clean at completion of earthwork.
- J. Wherever piping is to be installed in areas, which have been excavated below pipe inverts, for any purpose, install piping to prevent subsequent settlement. Do not install piping until backfill is to full compaction, completed to minimum 18 inch above installed pipe. Install piping in re-excavated trenches and backfill as previously specified.

END OF SECTION