

SECTION 23 21 00 - HYDRONIC PIPING AND PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this section apply to the HVAC heating and cooling water systems. Provide pipe, pipe fittings, pumps, and related items required for complete piping system.
- B. Related Work: The requirements of Section 23 05 00, Common HVAC Materials and Methods, also apply to this section.
- C. See 23 08 00 for commissioning requirements.

1.2 QUALITY ASSURANCE

- A. General: ASTM and ANSI Standards are indicated. In addition, special standards are referenced where neither ASTM nor ANSI Standards are applicable.
- B. Labeling: All piping shall be continuously and legibly labeled on each length as required by codes and standards and including as a minimum, country of origin, manufacturers identification marking, wall thickness designation, and applicable standards and approvals. Fittings shall be labeled as required by the referenced standard.
- C. Concealed Plastic Piping: No concealed plastic piping inside the building unless approved by Code or Governing Authorities.
- D. Definitions: Where piping fluid is not indicated in the following paragraphs, provide similar piping materials for similar fluids.
- E. To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be supplied from the same manufacturer as the grooved components.
 - 1. All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.

1.3 STORAGE AND HANDLING

- A. Provide factory-applied end caps on each length of pipe and tube. Maintain end caps through shipping, storage and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.4 SUBMITTALS

- A. Submit catalog data, construction details, performance characteristics for all equipment.
- B. Submit operating and maintenance data.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Black Steel Pipe:
 - 1. Applications:
 - a. Heating water
 - b. Gas
 - c. Snow melt system above grade only.
 - 2. Pipe: Schedule 40, standard black steel pipe ASTM A-106 or A-53.
 - 3. Threaded Fittings: For above ground installations only.
 - a. Banded class 120 cast iron fittings, ANSI B16.4 to 125 psi.
 - 4. Welding Fittings: Beveled ends, seamless fittings of the same type and class of piping above.
 - 5. Flanged Fittings: For above ground installations only.
 - a. Class 125 cast iron fittings, ANSI B16.2 including bolting to 125 psi.
 - b. Facing and Gasketing: Selected for service pressures and temperatures. Full-faced for cast iron and raised face for steel flanges.
 - c. Allowed at pumps, boiler connects, boiler trim items only.
- B. Copper Pipe and Tube:
 - 1. Application:
 - a. Heating water
 - b. Cooling coil condensate drain
 - c. Snow melt system above grade only.
 - 2. Pipe: Type L hard temper copper with soldered joints, ASTM B88.
 - 3. Fittings: Wrought copper solder-joint fittings, ANSI B16.22.
- C. Plastic Pipe:
 - 1. Application:
 - a. Below grade only heating water.
 - b. Heating water above grade where continuously supported per specifications and sizes 1 1/2 " or smaller.
 - c. Snow melt system below grade.
 - 2. Pipe:
 - a. Cross-linked polyethylene (PEX) tubing manufactured by PEX-a or Engel Method for closed loop heating service (with oxygen barrier): Tested/listed to ASTM E84, ASTM F876 and F877, and CSA B137.5 listed certified to NSF standards 14 and 61. Rated for 100 PSI at 180° F. Wirsbo AQUAPEX or approved.
 - 3. Fittings: ASTM F1960 cold expansion fittings. Provide fittings of the type matching piping manufacture and recommended by the piping manufacturer for the service indicated.

2.2 MISCELLANEOUS PIPING MATERIALS/PRODUCTS

- A. Insulating (Dielectric) Fittings: Provide standard products recommended by the manufacturer for use in the service indicated, and which effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and reduce corrosion. Victaulic Style 47 "Clear Flow."
- B. Welding Materials: Provide welding materials as determined by the installer to comply with installation requirements.
- C. Soldering and Brazing Materials: Provide soldering materials as determined by the installer to comply with installation requirements.
 - 1. Tin-Antimony Solder: ASTM B32, Grade 95TA.

2. Lead-Free Solder: ASTM B32, Grade HB. Harris "Bridgit" approved.
3. Silver Solder: ASTM B32, Grade 96.5TS.
- D. Gaskets for Flanged Joints: ANSI B16.21; full-faced for cast-iron flanges; raised-face for steel flanges. Pressure and temperature rating required for the service indicated.
- E. Sleeve Seal: Rubber-link pipe wall and casing closure. Thunderline Link-Seal. For fire rated wall, floor or ceiling penetrations, 3-M "CP-25" caulk, "No. 303" putty and/or "PSS 7904" sealing system.
- F. Strainers: "Y-pattern," ductile iron or bronze body (depending on pipe system) rated for pressures indicated with blow-off connection and 20 mesh stainless steel screen or perforated metal basket with 1/16" or 1/8" openings. Basis of Design: Victaulic Style 732.
- G. Valves up to 12": Model #'s listed are Nibco unless noted otherwise. Approved equal are Watts, Hammond, Appollo, and Victualic.
 1. Ball (to 2") and Smaller:
 - a. Two-piece, cast bronze body, full port, 600 psi WOG, T/S 585-70.
 - b. Two-piece, forged brass body, standard port, 300 psi, Victaulic Series P589.
 2. Gate (to 3"): Bronze body, non-rising stem, 200 psi WOG, T/S-133.
 3. Gate (4" to 12"): Iron body, non-rising stem, solid wedge, bolted bonnet, 200 psi WOG, F-619.
 4. Butterfly (2 1/2" and Larger): Ductile iron body, electroless-nickel coated ductile iron aluminum bronze disc, 300 psi WOG, pressure responsive elastomer seat, and stainless steel stem that is offset from the disc centerline to provide complete 360-degree circumferential seating, suitable for water temperatures to +250 degrees F. Lugged body – LD-2000, Wafer body – WD-2000, Grooved body – Victaulic Vic300 MasterSeal.
 5. Check: Bronze or ductile iron body, spring-assisted swing check, 300 psi WOG, T/S-413B and F-918B, Grooved body – Victaulic Series 716.
 6. Gate valves only allowed at boiler connection per Oregon Boiler Code.

2.3 HEATING WATER SPECIALTIES

- A. Air Vents: Install at all system high points whether shown or not; fabricate of 2" diameter or larger pipe at least 12" long. At the high point of each main install an Armstrong No. 1AV autovent, or equivalent Taco, Bell & Gossett, Armstrong, Dunham-Bush approved substitute.
- B. Circuit Setter and Balancing Valves: Globe style with calibrated handle style balancing fitting with differential pressure taps, brass or bronze body and trim. TA Hydronics STAD series, or equal Nexus, or approved substitute. Valves shall only be used where specifically called out for balance valve, otherwise use flow control valve.
- C. Snow Melt System Headers: 2" copper with formed outlets. Include isolation valve, on each outlet and flow indicator and balancing valve on each loop. Provide with PEX pipe outlet and provide with isolation valve on each main. Uponor or approved.

2.4 EXPANSION JOINT

- A. Stainless steel bellows type with flanged ends, controlled flexing, internal liner rated at a minimum of 28,000 average life cycles. Provide amount of expansion indicated at each joint as shown on Drawings. Carefully align joint and make proper allowance for temperature of pipe at time of installation. Flexonics, Hyspan, or approved substitute.

2.5 HYDRONIC PUMPS

- A. In-Line Circulators: Pipe mounted, in-line arrangement with mechanical seals with ceramic seal seats, suitable for continuous operation at 225 deg. F at head and capacity stated on Drawings. Cast iron impeller casing, stainless steel cartridge with non-metallic impeller. 3250 rpm split capacitor motor. Taco only.
- B. Where existing pump fit with new impellor. Provide parts from original pump manufacture. Trim to diameter noted on drawings.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

- A. General: Install pipe, tube and fittings in accordance with recognized industry practices. Install each run accurately aligned with a minimum of joints and couplings, but with adequate and accessible unions and flanges for disassembly, maintenance and/or replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings.
 - 1. Unions and flanges for disassembly, maintenance and/or replacement of valves and equipment are not required in installations using grooved joint couplings. (The couplings shall serve as disconnect points.)
- B. Piping Runs: Route piping close to and parallel with walls, overhead construction, columns and other structural and permanent-enclosure elements of the building (pitched for drainage). If not otherwise indicated, run piping in the shortest route which does not obstruct usable space or block access for servicing the building or equipment and avoid diagonal runs. Wherever possible in finished and occupied spaces, conceal piping from view. Do not encase horizontal runs in solid partitions.

3.2 PIPING JOINTS

- A. General: Provide joints of the type indicated in each piping system, and where piping and joint as manufactured form a system, utilize only that manufacturer's material.
- B. Ferrous Threaded Piping: Thread pipe in accordance with ANSI 82.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave no more than 3 threads exposed.
- C. Solder Copper Tube and Fitting Joints: In accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in a manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens. "T-Drill" field formed tees may be utilized where the main is at least two pipe sizes larger than the branch.
- D. Braze Copper Tube and Fitting Joints: Where indicated, in accordance with ANSI/ASME B31.5. Pass a slow stream of dry nitrogen gas through the tubing at all times while brazing to eliminate formation of copper oxide. Braze joints 2 1/2 " and larger.
- E. Weld Pipe Joints: In accordance with recognized industry practice and as follows:
 - 1. Weld pipe joints only when ambient temperature is above 0 degrees F.

2. Bevel pipe ends at a 37.5 degree angle, smooth rough cuts, and clean to remove slag, metal particles and dirt.
 4. Use pipe clamps or tack-weld joints with 1" long welds; 4 welds for pipe sizes to 10"; 8 welds for pipe sizes up to 20".
 5. Build up welds with a stringer-bead pass, followed by a hot pass, followed by a cover of filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes and non-metallic inclusion.
 6. Do not weld out piping system imperfections by tack-welding procedures; refabricate to comply with requirements.
 7. Install forged branch-connection fittings wherever branch pipe is indicated, or install regular "T" fitting at Contractor's option.
- F. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gasket.
- G. Insulating (Dielectric) Fittings: Comply with manufacturer's instructions for installing unions or fittings. Install in a manner which will prevent galvanic action and stop corrosion where the "joining of ferrous and non-ferrous piping" is indicated. Use brass valve or nipple with diameter to length ratio of 1:8 or greater in place of dielectric unions for copper to ferrous pipe.
- H. Changes in Direction: Use fittings for all changes in direction. Run lines parallel with building surfaces.
- I. Line Grades: Pitch hydronic piping 1" to 40' minimum to low point drips or drains.
- J. Unions and Flanges: At all equipment to permit dismantling and elsewhere as consistent with good installation practice.
- K. Expansion: Provide loops, swing joints, anchors, runouts and spring pieces to prevent damage to piping or equipment.

3.3 MISCELLANEOUS PIPING EQUIPMENT

- A. Floor, Wall and Ceiling Plates: Chrome plated pressed steel or brass screw locked split plates on all pipe penetrations in finished spaces.
- B. Strainers: Install in a manner to permit access for cleaning and screen removal and with blow-off valve.
- C. Sleeves: At all penetrations of concrete or masonry construction. PVC, 24 gauge galvanized steel or Schedule 40 galvanized steel pipe. Use steel pipe sleeves through beams, footings, girders or columns and for all penetrations of walls or floors below grade. Where floor finish is ceramic tile, terrazzo, or similar material extend standard steel pipe sleeves 1-1/2" above finished floor. Fabricate sleeves 1" diameter larger than pipe or insulation. PVC and sheet metal sleeves at non-structural penetrations only.
- D. Sleeve Caulking: Grout uninsulated pipe with cement mortar or approved waterproof mastic. All caulking or grouting shall extend full depth of sleeve. Install UL sealing caulk, putty and/or system at all penetrations of fire rated walls, floors and ceiling.
- E. Valves: Install valves in accordance with Section 23 0500. Install control valves specified in other division 23 sections.

3.4 EQUIPMENT INSTALLATION

- A. Installation and Arrangement: Install and arrange as shown on the Drawings. Comply with manufacturer's recommendations for installation connections and start-up.
- B. Lubrication: Lubricate all moving and rotating parts in accordance with the manufacturer's recommendations prior to start-up.
- C. Expansion Joint and Compensator Installation: Carefully align joint or compensator and make proper allowance for temperature of pipe at time of installation.
- D. Air Vents: Conduct 1/4" copper tubing from high end of air chambers to accessible locations and terminate with screwdriver cock. Conduct 1/4" copper tubing from outlets of automatic air vents to floor drains indicated or to the outside when approved by Governing Authorities.
- E. Pumps: Mount in a manner to allow disassembly of pump and motor without disturbing piping.
- F. Mechanical contractor and balancing contractor shall be trained on installation, connection, and balancing procedures by certified representative of differential pressure control valves.

3.5 CLEANING

- A. General: Clean all dirt and construction dust and debris from all mechanical piping systems and equipment and leave in a new condition. Touch up paint where necessary.
- B. Heating Water Piping Systems:
 - 1. Add cleaning chemical in proper concentration to clean system of manufacturing and installation contamination and residue.
 - 2. Fill, vent and circulate the system with this solution at design operating temperature. After circulating for four hours, bleed out cleaning solution by the addition of fresh water to the system.
 - 3. Test for pH and add sufficient amount of the cleaning chemical to obtain a pH between 7 and 8.
 - 4. Clean all strainers and remove start-up strainers (from suction diffusers) after the system has operated for one week.

3.6 TEST

- A. General:
 - 1. Minimum duration of two hours or longer, as directed for all tests. Furnish report of test observation signed by qualified inspector. Make all tests before applying insulation, backfilling, or otherwise concealing piping or connecting fixtures or equipment. Where part of the system must be tested to avoid concealment before the entire system is complete, test that portion separately, same as for entire system.
 - 2. Provide all necessary temporary equipment for testing, including pump and gauges. Remove control devices before testing and do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for the indicated pressure and time.
 - 3. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.
 - 4. Allow Bend Maintenance personnel to witness test (s).
- B. Repair:

1. Repair piping system sections which fail the required piping test by disassembly and re-installation, using new materials to the extent required to overcome leakage. Do not use chemical stop-leak compounds, solder, mastics, or other temporary repair methods.
 2. Drain test water from piping systems after testing and repair work has been completed.
- C. Heating Water Piping: 75 psig hydrostatic for 30 psig systems without loss for four hours.
- D. Tanks and Equipment: Hydrostatic pressure to 1.5 times operating pressure.

END OF SECTION 23 21 00

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