

SECTION 23 21 00
HYDRONIC PIPING AND PUMPS

PART 1 - GENERAL

1.01 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.

1.02 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.
- F. See Commissioning specification for additional requirements.

1.03 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.

1.04 SUBMITTALS

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

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

- A. Black Steel Pipe:
 - 1. Applications:
 - a. Heating water

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.
- B. Black Steel Pipe:
1. Applications:
 - a. Heating water above grade
 2. Pipe: Schedule 40, standard black steel pipe ASTM A-106 or A-53.
 3. Fittings: Cold Press Mechanical Joint Fitting shall conform to material requirements of ASTM A420 or ASME B16.3 and performance criteria of IAPMO PS117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have Smart Connect® feature design (leakage path). MegaPress fittings with the Smart Connect feature assure leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.
 4. Pipe Thread: Pipe Threads shall conform to ASTM B16.3.
 5. Hangers and supports: Hangers and supports shall conform to MSS SP 58.
 6. Hanger spacing: In accordance with ASME B 31.1, NFPA54, UPC, IMC other National or local codes.
 7. Source Quality Control:
 - a. Fittings shall be listed and approved for their intended application.
 - b. Manufacture shall be Viega MegaPress or approved.
- C. Black Steel Pipe:
1. Applications:
 - a. ~~Chilled water~~
 - b.a.** Heating water
 2. Pipe: Schedule 40, standard black steel pipe ASTM A-106 or A-53.
 3. Mechanical Couplings for Joining Carbon Steel Pipe.
 - a. Standard Mechanical Couplings, 2 inch (DN50) through 12 inch (DN300):
 Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12. Gaskets shall be pressure responsive synthetic rubber, grade to suit the intended service, conforming to ASTM D-2000. (Gaskets used for potable water applications shall be UL classified in accordance with ANSI/NSF-61 for potable water service.) Mechanical Coupling bolts shall be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to ASTM A-449 and ASTM A-183, minimum tensile strength 110,000 psi (758450 kPa).
 - 1) Rigid Type: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with ANSI B31.1, B31.9, and NFPA 13. Basis of Design: Victaulic Style 07.
 - a) 2" (DN50) through 8" (DN200): Installation ready rigid coupling for direct stab installation without field disassembly. Gasket shall be Grade "EHP" EPDM compound with red color code designed for operating temperatures from -30 deg F (-34 deg C) to +250 deg F (+120 deg C). Basis of Design: Victaulic Style 107H.

- 2) Flexible Type: Use in locations where vibration attenuation and stress relief are required. Flexible couplings may be used in lieu of flexible connectors at equipment connections. Three couplings, for each connector, shall be placed in close proximity to the vibration source. Basis of Design: Victaulic Style 77.
 - a) 2" (DN50) through 8" (DN0200): Installation ready flexible coupling for direct stab installation without field disassembly. Gasket shall be Grade "EHP" EPDM compound with red color code designed for operating temperatures from -30 deg F (-34 deg C) to +250 deg F (+120 deg C). Basis of Design: Victaulic Style 177.
 - b. Flange Adapters: For use with grooved end pipe and fittings, flat faced, for mating to ANSI Class 125 / 150 flanges. Basis of Design: Victaulic Style 741.
 - c. Grooved couplings shall meet the requirements of ASTM F-1476.
 - d. Gasket: Synthetic rubber conforming to steel pipe outside diameter and coupling housing, manufactured of elastomers as designated in ASTM D-2000.
 4. Grooved End Fittings:
 - a. Standard fittings shall be cast of ductile iron conforming to ASTM A-536, Grade 65-45-12, forged steel conforming to ASTM A-234, Grade WPB 0.375" wall (9,53 mm wall), or factory-fabricated from Std. Wt. Carbon Steel pipe conforming to ASTM A-53, Type F, E or S, Grade B. Fittings provided with an alkyd enamel finish or hot dip galvanized to ASTM A-153. Zinc electroplated fittings and couplings conform to ASTM B633.
 - b. Fittings shall be manufactured of ductile iron conforming to ASTM A-536, forged carbon steel conforming to ASTM A-234, or factory fabricated from carbon steel pipe conforming to ASTM A-53. Fittings shall be manufactured to the dimensional standards ASME B16.9. Orange enamel coated or galvanized.
 5. Tooling: Tools shall be manufactured and supplied by pipe fitting manufacturer. Use roll sets or cut groovers compatible with the pipe material and wall thickness per installation instructions.
 6. Approved Manufacturers: Victaulic. For alternate manufacturers, see other end treatments listed above.
- D. Copper Pipe and Tube:
1. Application:
 - a. Heating water in boiler room or mechanical rooms.
 - b. Cooling coil condensate drain
 2. Sizes 2-1/2" and Larger: Rolled groove fittings with UPC approval. Victaulic CTS or approved. For pipe see "F".
- E. Copper Pipe and Tube:
1. Application:
 - a. Heating water in boiler room or mechanical rooms.
 - b. Cooling coil condensate drain
 2. UPC approved copper fitting with EPDM o-ring. For pipe see "F".
 3. Press fit connection.
 4. Viega Pro Press approved.
- F. Copper Pipe and Tube:
1. Application:
 - a. Heating water
 - b. Cooling coil condensate drain
 2. Pipe: Type L hard temper copper with brazed or soldered joints, ASTM B88. Brazing required for 2" and larger lines.
 3. Fittings: Wrought copper solder-joint fittings, ANSI B16.22.
- G. Plastic Pipe:
1. Application:

- a. Boiler condensate drain
 - 2. Pipe:
 - a. Polyvinyl Chloride and Chlorinated Polyvinyl Chloride Plastic Pipe for Water Service: SDR-PR pipe, ASTM D2241; Schedules 40, 80 and 120, ASTM D1785.
 - 3. Fittings: Provide fittings of the type indicated, matching piping manufacture. Where not otherwise indicated, provide fittings produced and recommended by the piping manufacturer for the service indicated.
- H. Plastic Pipe:
- 1. Application:
 - a. Indoor heating water above grade where continuously supported per specifications with manufacturers support channel and concealed.
 - b. Size shall be one nominal pipe size greater than the size on the drawings.
 - 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.
 - 4. Insulate per specification - pre-insulated pipe is not allowed.

2.02 MISCELLANEOUS PIPING MATERIALS/PRODUCTS

- A. Insulating (Dielectric) Fittings: Not allowed. See Section 3.
- 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"):
 - a. Two-piece, cast bronze body, full port, 600 psi WOG, T/S 585-70.
 - 2. Butterfly: 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.

3. Check: Bronze or ductile iron body, spring-assisted swing check, 300 psi WOG, T/S-413B and F-918B, Grooved body – Victaulic Series 716.
4. Gate valves only allowed at boiler connection as required by Oregon Boiler Code.

2.03 HEATING WATER SPECIALTIES

- A. Pressurized Precharged Expansion Tank: Precharged diaphragm type hydropneumatic tank with all necessary air elimination fittings. Install with ball valve on piping connection. Amtrol, Taco, Bell & Gossett, Armstrong, Wheatley, Wessels or approved substitute.
- B. Air Vents: Install at all system high points whether shown or not;
 1. At all locations not in mechanical rooms use manual air vents.
 2. At mechanical rooms 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 Bell & Gossett, Armstrong, Dunham-Bush approved substitute. Route discharge line to over floor sink.
- C. Flow Control Valve:
 1. Install where shown on plans, flow metering fittings complete with quick disconnect, flow meter valves, with safety shut-off valves and with size and series identification tags. Install as recommended by manufacturer, Victaulic, Griswold, Pro-Hydronic Specialties or approved substitute.
 2. Valves shall be dynamic flow limiting devices sized to the nearest 0.5 gpm. Stainless steel cartridge and spring with body and ends to match piping system.
 3. Unless noted otherwise all flow control valves are flow limiting not balancing valves.
- D. Circuit Setter and Balancing Valves: Globe style with calibrated handle style balancing fitting with differential pressure taps, brass or bronze body and trim. TA Hydraulics STAD series, or equal Nexus, Wheatley or approved substitute. Valves shall only be used where specifically called out for balance valve, otherwise use flow control valve.
- E. Differential Pressure Control Valves 1/2" through 2": Maximum differential pressure is 51 psi, maximum temperature is 248°F for use in heating and cooling systems only. NPT threaded valve body and bonnet shall be manufactured of dezincification resistant copper alloy, O-rings, seat seal, and membrane manufactured of HBNR. Shall have adjustable differential control, single pressure temperature port, dead end service shut off capabilities, stainless steel spring, and polyimide handle. Shall be capable of stabilizing ΔP_v ranges of 2.9-11.6 psi for heating water devices and 5.8-23.2 psi for chilled water valves sizes shall be determined by factory representative based on system flows listed on drawings. Supply side valve shall be Tour and Andersson style STAD (or approved equal) with capillary tube, drain kit, and all connection fittings to match.

2.04 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.

PART 3 - EXECUTION

3.01 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.

3.02 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.
- 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.
 - 3. 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".
 - 4. 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.
 - 5. Do not weld out piping system imperfections by tack-welding procedures; refabricate to comply with requirements.
 - 6. 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: Where the "joining of ferrous and non-ferrous piping". Use brass valve or brass nipple with length/nominal dramatic ratio of 8 or greater rather than dielectric fitting.
- 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. Flexible hoses are not allowed.
- L. Press Fittings: MegaPress Cold Press Mechanical Joint Fittings shall be installed in accordance with the manufacturer's installation instructions. The protective corrosion coating shall be removed from the outside of the pipe end. The pipe shall be fully inserted into the fitting and the pipe marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the pipe to assure the pipe is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.

3.03 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 05 00. Install control valves specified in other Division 23 sections.

3.04 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. Mechanical contractor and balancing contractor shall be trained on installation, connection, and balancing procedures by certified representative of differential pressure control valves.
- F. **Replace the factory control interface/control panel of the 4 existing Hydro Therm KN Series boilers. Complete factory start-up document for each boiler and submit in O & M's.**

3.05 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.
- C. See Section 23 25 00 for more requirements.

3.06 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.
- 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 & Chilled 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