

## SECTION 15181 – HVAC PIPING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section includes piping, special-duty valves, and specialties for
  1. Hot water heating
  2. Makeup water for HVAC systems
  3. Blow down drain lines
- B. Installation of PEX tubing shall not be permitted on this project.
- C. Related Sections include the following:
  1. Division 7 Section for materials and methods for sealing pipe penetrations through fire and smoke barriers.
  2. Division 15 Section "Basic Mechanical Materials and Methods" for general piping materials and installation requirements.
  3. Division 15 Section "Hangers and Supports" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.
  4. Division 15 Section "Meters and Gages" for thermometers, flow meters, and pressure gages.
  5. Division 15 Section "Mechanical Identification" for labeling and identifying hydronic piping.
  6. Division 15 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
  7. Division 15 Section "HVAC Instrumentation and Controls" for temperature-control valves and sensors.

## 1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's standard submittal cut sheets. For each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, calibrated balancing valves, and automatic flow-control valves.
- B. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
- C. Welding Certificates: Copies of certificates for welding procedures and personnel.
- D. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
  1. Test procedures used.
  2. Test results that comply with requirements.
  3. Failed test results and corrective action taken to achieve requirements.

- E. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals specified in Division 1.
- F. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

#### 1.4 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

#### 1.5 COORDINATION

- A. Drawings show the general layout of piping and accessories but do not show all required fittings and offsets that may be necessary to connect piping to equipment and to coordinate with other trades. Fabricate piping based on field measurements. Provide all necessary fittings and offsets.
- B. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- C. Coordinate pipe sleeve installations for foundation wall penetrations.
- D. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.
- E. Coordinate pipe fitting pressure classes with products specified in related Sections.
- F. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.
- G. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 for fire and smoke wall and floor assemblies.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Hydronic Calibrated Balancing Valves:
    - a. Griswold Controls.
    - b. ITT Bell & Gossett; ITT Fluid Technology Corp.
    - c. Taco, Inc.
    - d. Tour & Anderson

2. Hydronic Pressure-Reducing Valves:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Conbraco Industries, Inc.
  - d. ITT Bell & Gossett; ITT Fluid Technology Corp.
  - e. Spence Engineering Company, Inc.
  - f. Watts Industries, Inc.; Watts Regulators.
3. Safety Valves:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Conbraco Industries, Inc.
  - d. ITT McDonnell & Miller Div.; ITT Fluid Technology Corp.
  - e. Kunkle Valve Division.
  - f. Spence Engineering Company, Inc.
4. Automatic Flow-Control Valves:
  - a. Flow Design, Inc.
  - b. Griswold Controls.
5. Expansion Tanks, Air Separators, and Hydronic Specialties:
  - a. Amtrol, Inc.
  - b. Woods
  - c. ITT Bell & Gossett; ITT Fluid Technology Corp.
  - d. Taco, Inc.
  - e. Aurora
6. Air Vents and Vacuum Breakers:
  - a. Armstrong International, Inc.
  - b. Barnes & Jones, Inc.
  - c. ITT Hoffman; ITT Fluid Technology Corp.
  - d. Johnson Corp. (The).
  - e. Spirax Sarco, Inc.

## 2.2 PIPING MATERIALS

- A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

## 2.3 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. DWV Copper Tubing: ASTM B 306, Type DWV.
- C. Wrought-Copper Fittings: ASME B16.22.
- D. Wrought-Copper Unions: ASME B16.22.
- E. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.
- F. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).

## 2.4 STEEL PIPE AND FITTINGS

- A. Steel Pipe, NPS 2 and Smaller: ASTM A 53, Type S (seamless) or Type F (furnace-butt welded), Grade B, Schedule 40 and 80, black steel, plain ends.
- B. Steel Pipe, NPS 2-1/2 through NPS 12: ASTM A 53, Type E (electric-resistance welded), Grade B, Schedule 40 and 80, black steel, plain ends.
- C. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250.
- D. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
- E. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
- F. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.
- G. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- H. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
  - 1. Material Group: 1.1.
  - 2. End Connections: Butt-welding.
  - 3. Facings: Raised face.
- I. Mechanical Pipe Couplings and Fittings: May be used, with cut or roll grooved pipe, in water service up to 210 °F in lieu of welded, screwed or flanged connections.
  - 1. Grooved mechanical couplings: Malleable iron, ASTM A47 or ductile iron, ASTM A536, fabricated in two or more parts, securely held together by two or more track-head, square, or oval-neck bolts, ASTM A183.
  - 2. Gaskets: Rubber product recommended by the coupling manufacturer for the intended service.
  - 3. Grooved end fittings: Malleable iron, ASTM A47; ductile iron, ASTM A536; or steel, ASTM A53 or A106, designed to accept grooved mechanical couplings. Tap-in type branch connections are acceptable.
- J. Mechanically formed copper or steel tee connections are not acceptable.
- K. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and thredolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ANSI B16.11 may be used for drain, vent and gage connections.
- L. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- M. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

## 2.5 HYDRONIC VALVES

## A. Gate Valves

1. Threaded Ends 2" and Smaller: Class 125, bronze body, union bonnet, rising stem, solid wedge: Red-White 293, Nibco T-124/134, Stockham B105, Milwaukee 1152 or equal.
2. Flanged Ends 2-1/2" and Larger: Class 125, iron body, bronze mounted, bolted bonnet, rising stem, OS&Y, solid wedge: Red-White 421, Nibco F617-0, Stockham G623, Milwaukee F2885 or equal.
3. Solder Ends 2" and Smaller: Class 125, bronze body, union bonnet, rising stem, solid wedge: Red-White 291, Nibco S-124/134, Stockham B115, Milwaukee 1142 or equal.
4. Comply with the following standards:
  - a. Cast Iron Valves: MSS SP – 70
  - b. Bronze Valves: MSS SP - 80

## B. Ball Valves

1. Threaded Ends 4" and Smaller: 600# W.O.G., forged brass two piece body, hard chrome plated forged brass ball, true adjustable packing nut ("O"-ring only type stem seal not acceptable), blow-out proof stem: Red-White 5044F, Nibco T-585-70, Stockham S216-BR-RT, Apollo 70-Series, or approved equal.
2. Soldered Ends 3" and Smaller: 600# W.O.G., forged brass two piece body, hard chrome plated forged brass ball, true adjustable packing nut ("O"-ring only type stem seal not acceptable), blow-out proof stem: Red-White 5049F, Nibco S-585-70, Stockham S216-BR-RS, Apollo 70-Series, approved or equal.
3. Comply with MSS SP-110.

## C. Butterfly Valves

1. Where butterfly valves are used as shutoff for termination, or equipment removal or repair, provide lug type valves.
2. Provide gear operators on butterfly valves 8" and larger.
3. Valve bodies shall have extended necks to provide for 2-1/4" insulation as needed.
4. Comply with MSS SP-67.
5. Wafer Type 2" and Larger: Rated Working Pressure of 200 psi on sizes 2"-12", cast iron body, lever operated, 10-position throttling handle, memory plate, bronze disc, type 410 stainless steel stem, EPDM seat.
6. Lug Type 2" and Larger: Rated Working Pressure of 200 psi on sizes 2"-12", cast iron, drilled and tapped lug body, lever operated, 10-position throttling handle, memory plate, bronze disc, type 410 stainless steel stem, EPDM seat.

## D. Wafer Check valves:

1. Provide wafer style, butterfly type, spring actuated check valves designed to be installed with gaskets between 2 standard Class 125 flanges. Construct iron body valves with pressure containing parts of valves with materials conforming to ANSI/ASTM A 126, Grade B. Support hanger pin by removable side plug.
2. 2" and Larger: Class 125, cast iron body, stainless steel trim, bronze disc, Buna-N seal: Red-White 442, Nibco W920-W, Stockham WG970, Metraflex C-125 or equal.

## E. Swing check valves:

1. Construct pressure containing parts of Valves as follows:
  - a. Bronze Valves: 125 or 150 psi: ANSI/ASTM B 62
  - b. Iron Body Valves: ANSI/ASTM A-126, Grade B
2. Comply with the following standards for design, workmanship, material and testing:
  - a. Bronze Valves: MSS SP - 80

- b. Cast Iron Valves: MSS SP – 71
  3. Construct valves of pressure casting free of any impregnating materials. Construct disc and hanger as one piece. Support hanger pins by removable side plug.
  4. Threaded Ends 2" and Smaller: Class 125, bronze body, screwed cap, "Y" pattern swing, Teflon disc: Red-White 236T, Nibco T-413Y, Stockham B320T, Milwaukee 509 or approved equal.
  5. Soldered Ends 2" and Smaller: Class 125, bronze body, screwed cap, "Y" pattern swing, Teflon disc: Red-White 237T, Nibco S-413-Y, Stockham B310T, Milwaukee 511 or approved equal.
  6. Flanged Ends 2-1/2" and Larger: Class 125, iron body, bronze mounted, horizontal swing, cast-iron disc: Red-White 435, Nibco F918-B, Stockham G931, Milwaukee F2974 or approved equal.
- F. Check valves at pump discharges shall be non-slam wafer type.
- G. "Circuit setter" calibrated balancing valves, NPS 2-1/2 and Smaller: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.
1. Provide a closed cell polyethylene foam insulation kit with each valve.
- H. Calibrated Balancing Valves, NPS 3 and Larger: Cast-iron or steel body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having flanged or grooved connections. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.
- I. Pressure-Reducing Valves: Diaphragm-operated, bronze or brass body with low inlet pressure check valve, inlet strainer removable without system shutdown, and non-corrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory set at operating pressure and have capability for field adjustment.
- J. Safety Valves: Diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV.

## 2.6 HYDRONIC SPECIALTIES

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig working pressure; 225 deg F operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 discharge connection and NPS 1/2 inlet connection.
- B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS 1/4 discharge connection and NPS 1/2 inlet connection.
- C. Expansion Tanks: Welded carbon steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity by a flexible diaphragm securely sealed into tank. Include drain fitting and taps for pressure gage and air-charging fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Factory fabricate and test tank with taps and

supports installed and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

- D. Tangential-Type Air Separators, Taco or approved equal: Welded black steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature; perforated stainless-steel air collector tube designed to direct released air into expansion tank; tangential inlet and outlet connections; threaded connections for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger; threaded drain connection, top fittings for air vent and makeup water. Provide units in sizes for full-system flow capacity. Removable stainless steel strainer shall have 3/16" diameter perforations and a free area of not less than five times the cross sectional area of the connecting pipe.
- E. In-Line Air Separators: One-piece cast iron with an integral weir designed to decelerate system flow to maximize air separation at a working pressure up to 175 psig and liquid temperature up to 300 deg F.
- F. Air Purgers: Cast-iron body with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal. Maximum working pressure of 150 psig and temperature of 250 deg F.
- G. Y-Pattern Strainers: 125-psig working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 and larger, threaded connections for NPS 2 and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.
- H. Flexible Connectors shall be either of the following:
  - 1. Stainless steel bellows with woven, flexible, bronze, 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.
  - 2. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F and pressures up to 150 psig.

### PART 3 - EXECUTION

#### 3.1 HYDRONIC PIPING APPLICATIONS

- A. Hot Water, NPS 2 and Smaller: Aboveground, use Type L drawn-temper copper tubing with soldered joints or Schedule 40 steel pipe with threaded joints. Belowground or within slabs, use Type K annealed-temper copper tubing with soldered joints. Use the fewest possible joints belowground and within floor slabs.
- B. Hot Water, NPS 2-1/2 and Larger: Schedule 40 steel pipe with welded and flanged joints or grooved mechanical-joint couplings.

#### 3.2 VALVE APPLICATIONS

- A. Hydronic Valve Applications: Unless otherwise indicated, use the following valve types:
  - 1. Shutoff Duty: Gate, ball, and butterfly valves.
  - 2. Throttling Duty: Globe, ball, and butterfly valves.

- B. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
- C. Install calibrated balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction. Install in horizontal position, with hinge pin horizontally perpendicular to centerline of pipe. Install for proper direction of flow.
- E. Install safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves on hot-water generators and elsewhere as required to regulate system pressure.

### 3.3 HYDRONIC PIPING INSTALLATIONS

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation requirements.
- B. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- C. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and hose-end fitting with cap, at low points in piping system mains and elsewhere as required for system drainage.
- D. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- E. Pipe size at connections to equipment shall be distribution main size, not connection size.
- F. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- G. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.
- H. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blow-down connection of strainers NPS 2 and larger. Match size of strainer blow-off connection for strainers smaller than NPS 2.
- I. Anchor piping for proper direction of expansion and contraction.

### 3.4 SAFETY VALVE INSTALLATIONS



- A. Install safety valves according to ASME B31.1. Pipe safety valve discharge without valves to atmosphere outside building. Install drip pan elbow fitting adjacent to safety valve and pipe drain connection to nearest floor drain.
- B. Check the settings and operation of each safety valve. Record settings.

### 3.5 PIPE JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping; and solvent-welded joints for PVC piping.

### 3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install separator in pump suction lines. Install piping to compression tank with a 2 percent upward slope toward tank. Install blow-down piping with gate valve; extend to nearest drain.
- C. Install expansion tanks on floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements.

### 3.7 CONTROL VALVE INSTALLATION

- A. Perform the following as directed by the controls contractor:
  - 1. Installation of immersion wells and pressure tappings, along with associated shut-off cocks.
  - 2. Installation of flow switches.
  - 3. Setting of automatic control valves or other control devices.
- B. Valve submittals shall be coordinated for type, quantity, size, and piping configuration to ensure compatibility with pipe design.
- C. Slip-stem control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position. Ball type control valves shall be installed with the stem in the horizontal position.
- D. Valves shall be installed in accordance with the manufacturer's recommendations.
- E. Control valves shall be installed so that they are accessible and serviceable and so that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.
- F. Isolation valves shall be installed so that the control valve body may be serviced without draining the supply/return side piping system. Unions shall be installed at all connections to screw-type control valves.

### 3.8 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be same as for equipment connections.

- B. Install control valves in accessible locations close to connected equipment.
- C. Arrange piping with offsets to allow for expansion, as well as terminal unit removal.

### 3.9 FIELD QUALITY CONTROL

- A. Prepare piping according to ASME B31.9 and as follows:
  - 1. Leave joints, including welds, un-insulated and exposed for examination during test.
  - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  - 3. Flush system with clean water. Clean strainers.
  - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
  - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on piping:
  - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
  - 2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
  - 3. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
  - 4. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
  - 5. Prepare written report of testing.
- C. Check expansion tanks to determine that they are not air bound and that system is full of water.

### 3.10 ADJUSTING

- A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.
- B. Perform these adjustments before operating the system:
  - 1. Open valves to fully open position.
  - 2. Check pump for proper direction of rotation.
  - 3. Set automatic fill valves for required system pressure.
  - 4. Check air vents at high points of system and determine if all are installed and operating and bleed air completely.
  - 5. Set temperature controls so all coils are calling for full flow.
  - 6. Check operation of automatic bypass valves.
  - 7. Check and set operating temperatures of boilers, and to design requirements.
  - 8. Lubricate motors and bearings.

- C. Mark calibrated nameplates of pump discharge valves after steam and condensate system balancing has been completed, to permanently indicate final balanced position.

3.11 CLEANING

- A. Flush piping systems with clean water.
- B. Remove and clean or replace strainer screens.
- C. After cleaning and flushing hydronic-piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers, and replace with the permanent stainless steel screens.

END OF SECTION 15181