

## **SECTION 23 22 13 – STEAM AND STEAM CONDENSATE PIPING**

### **PART 1 - GENERAL**

#### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

#### **1.02 SUMMARY**

- A. Perform all Work required to provide and install steam and condensate pipe, valves and fittings indicated by the Contract Documents with supplementary items necessary for the proper installation of the steam and condensate piping systems.

#### **1.03 REFERENCE STANDARDS**

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references and as noted in this Section:
  - 1. ANSI/ASME SEC 9 - Welding and Brazing Qualifications.
  - 2. ANSI/ASME SEC B31.9 - Building Services Piping.
  - 3. ANSI/AWS D10.12 – Guide for Welding Mild Steel Pipe.
  - 4. ASTM A234 – Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

#### **1.04 QUALITY ASSURANCE**

- A. Valve manufacturer's name and pressure rating shall be marked on valve body.
- B. All valves of the same type shall be provided from same manufacturer.
- C. All fittings of the same type (threaded or welding) shall be provided from same manufacturer.
- D. All flanges shall be from same manufacturer.
- E. Welding Materials and Procedures: Conform to Chapter V, ANSI/ASME SEC B31.9 and applicable state labor regulations.
- F. Welders Certification: In accordance with ANSI/AWS D10.12.

#### **1.05 SUBMITTALS**

- A. Product Data:

1. Include data on pipe materials, pipe fittings, valves, and accessories.
- B. Record Documents:
1. Include welder's certification of compliance with ANSI/AWS D10.12 and ANSI/ASME B31.9.
  2. Submittal data for all fittings and flanges shall include a letter signed by an official of the manufacturing company certifying compliance with these Specifications.

## **PART 2 - PRODUCTS**

### **2.01 GENERAL**

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Wall, Floor and Ceiling Plates:
1. Provide chrome-plated brass floor and ceiling plates.
- C. Piping System Classification:
1. Piping systems designed for steam pressure below 25 psig are low-pressure steam systems. Piping systems designed for steam pressures from 25 psig up to and including 125 psig are medium-pressure steam. Systems 126 psig and above are high-pressure steam.
  2. Distribution piping complying with Thermal Energy Cooperative (TECO) requirements is considered high-pressure steam.
- D. Piping Materials:
1. Sizes as scheduled and shown on the Drawings are nominal pipe sizes unless otherwise indicated.
  2. All pipe and fittings shall be manufactured by a domestic company.
  3. All brass and bronze piping components shall have no more than 15 percent zinc content.
- E. Threaded Fittings:
1. All threaded fittings shall be USA factory made wrought carbon or alloy steel threaded fittings conforming to ASTM A234 or malleable iron threaded fittings conforming to ASME/ANSI B16.3.
  2. Manufacturers: Grinnell, Tube Turn, Weld Bend Hackney, Taylor Forge, Ladish Company.
  3. Each fitting shall be stamped as specified by ANSI B16.3.
- F. Welded Fittings:
1. All weld fittings shall be USA factory made wrought carbon steel, butt welded fittings conforming to ASTM A234 or ASME B16.9.

2. Manufacturers: Grinnell, Tube Turn, Weld Burn Hackney, Taylor Forge, Ladish Company.
3. Each fitting shall be stamped as specified by ANSI B31.9.

G. Flanges:

1. All 150 lb. and 300 lb. ANSI flanges shall be weld neck and shall be domestically manufactured, forged carbon steel, conforming to ANSI B16.5 and ASTM A1-191 Grade I or II or A-105 as made by Tube Turn, Hackney or Ladish Company. Slip on flanges shall not be used. Complete test reports may be required for any fitting selected at random.
2. Flanges shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25.
3. Bolts used shall be carbon steel bolts with semi-finished hexagon nuts of American Standard Heavy dimensions. All-thread rods are not an acceptable substitute for flange bolts. Bolts shall have a tensile strength of 60,000 psi and an elastic limit of 30,000 psi.
4. All flanges shall have gaskets. Place gasket between flanges of flanged joints. Gaskets shall fit within the bolt circle on raised face flanges and shall be full face on flat face flanges.

H. Gaskets:

1. Gaskets shall be placed between the flanges of all flange joints. Such gaskets shall be ring form gaskets fitting within the bolt circle of their respective flanges.
2. All gaskets used on steam system shall be Flexitallic Style CG, AP1061 spiral wound 30455 with Grafoil fill as manufactured by Garlock or approved equal, regardless of pipe size and pressure.
3. The inside diameter of such gaskets shall conform to the nominal pipe size and the outside diameter shall be such that the gasket extends outward to the studs or bolts employed in the flanged joint.

2.02 PIPE

A. High Pressure Steam and Trapped Condensate Piping:

1. Pipe 2 inches and smaller: Carbon steel, ASTM A53, Grade B, seamless, Schedule 80.
  - a. Fittings: Forged steel, ASTM A105, socket weld, 300 lb.
  - b. Joints: Socket weld.
  - c. Unions: Forged steel, ASTM A105, socket weld, 3000 lb., stainless steel seats.
  - d. Gaskets: Flexitallic Style CG, API 601 spiral wound 304SS with Grafoil Fill or accepted substitution.
  - e. Cathodic Protection Gaskets: 1/16 inch thick Sealon by Ameriflex. Specify OD and ID of pipe and flanges. Bolt holes to be ¼ inch oversized.
2. Pipe 2-1/2 inches and larger: Carbon steel, ASTM A53, Grade B, seamless; standard weight for steam, Schedule 80 for condensate.

- a. Fittings: Carbon steel, ASTM A234 WPB, seamless welding fittings, standard weight for steam, Schedule 80 for condensate.
- b. Joints: Butt weld.
- c. Flanges: 300 lb., ANSI forged carbon steel, ASTM A181 Class 70, weld neck raised face.
- d. Gaskets: Flexitallic Style CG, API 601 spiral wound 304SS with Grafoil Fill or accepted substitution.
- e. Cathodic Protection Gaskets: 1/8 inch thick Sealon by Ameriflex. Specify OD and ID of pipe and flanges. Bolt holes to be ¼ inch oversized.

**B. Medium Pressure Steam and Trapped Condensate Piping:**

1. Pipe 2 inches and smaller: Carbon steel, ASTM A53, Grade B, seamless, Schedule 80.
  - a. Fittings: 125 lb., cast iron, screwed, conforming to ANSI B16.4. Thread-o-lets may be used when the branch line is 1/3 the main size or less.
  - b. Joints: Screwed.
  - c. Unions: Class 300 malleable iron.
2. Pipe 2-1/2 inches and larger: Carbon steel, ASTM A53, Grade B, seamless, standard weight for steam, Schedule 80 for condensate.
  - a. Fittings: ASTM A234, Grade WPB, ANSI B16.9; butt welding type, standard weight for steam, Schedule 80 for trapped condensate. Thread-o-lets may be used when the branch line is one-third the main size or less.
  - b. Joints: Butt weld.
  - c. Flanges: Class 150, ANSI B16.5, forged carbon steel, raised face. Materials in accord with ASTM A105, Grade II weld neck.

**C. Low Pressure Steam and Trapped Condensate Piping:**

1. Pipe 2 inches and smaller: Carbon steel, ASTM A53, Grade B seamless, Schedule 40 for steam, Schedule 80 for condensate.
  - a. Fittings: 125 pound black cast iron. Thread-o-lets may be used when the branch line is one-third the main size or less.
  - b. Joints: Threaded.
  - c. Unions: Class 300 malleable iron.
2. Pipe 2-1/2 inches and larger: Carbon steel, ASTM A53, Grade B, seamless, standard weight for steam, Schedule 80 for condensate.
  - a. Fittings: Butt weld, conforming to ASTM A234, Grade WPB, ANSI B16.9, standard weight for steam, Schedule 80 for trapped condensate.
  - b. Joints: Butt weld.

- c. Flanges: Class 150, ANSI B16.5, forged steel, raised face. Materials in accord with ASTM A105, Grade II, weld neck.
- D. Condensate Piping (Building) – Return and Pumped Return:
  1. All piping shall be extra strong black steel piping.
  2. Fittings on piping 2-1/2 inches and larger shall be extra heavy butt welding type. Flanges shall be 150 lb. welding neck type. Extra strong Weld-o-lets, Thread-o-lets or shaped nipples may be used only when takeoff is one-third or less nominal size of main.
  3. Screwed fittings around traps and for piping 2 inches and smaller shall be 125 lb. black cast iron (300 lb. for unions).
- E. Condensate and Pumped Return Piping:
  1. Pipe 2 inches and smaller: Carbon steel, ASTM A53, Grade B, seamless, Schedule 80.
    - a. Fittings: Forged steel, ASTM A105, socket weld.
    - b. Joints: Socket weld.
    - c. Flanges: 150 lb. ANSI forged carbon steel, ASTM A181, Class 70, socket weld with Flexitallic Style CG Gasket, API 601 spiral wound 304SS with Grafoil Fill or accepted substitution.
    - d. Cathodic Protection Gaskets: 1/8 inch thick Sealon by Ameriflex. Specify outside diameter (OD) and inside diameter (ID) of pipe and flanges. Bolt holes to be ¼ inch oversized.
  2. Pipe 2-1/2 inches and larger: Carbon steel, ASTM A53, Grade B, seamless, Schedule 80.
    - a. Fittings: 150 lb. ANSI, forged carbon steel, ASTM A181, Class 70, weld neck.
    - b. Joints: Butt weld, beveled.
    - c. Flanges: 150 lb. ANSI, forged carbon steel, ASTM A 181, Class 70, weld neck with Flexitallic Style CG gasket, API 601 spiral wound 304SS with Grafoil Fill or accepted substitution.
    - d. Cathodic Protection Gaskets: Ameriflex. Specify OD and ID of pipe and flanges. Bolt holes to be ¼ inch oversized.
- F. Low and Medium Pressure Clean Untreated Steam (304 Stainless Steel):
  1. Pipe 2 inches and smaller: ASTM A312, TP 304, Schedule 40, seamless stainless steel.
    - a. Fittings: ASTM A182, Gr. F304, ANSI B16.11, 3000 lb. socket-weld.
    - b. Unions: 3000 lb socket-weld, stainless steel ground joint.
  2. Pipe 2-1/2 inches and larger: ASTM A312, TP 304, Schedule 40, seamless stainless steel.
    - a. Fittings: ASTM A403, Gr. WP304/ANSI 16.9, Butt-weld.

- b. Unions: None
- c. Flanges: ASTM A182, Gr. F304, ANSI B16.5, 150 lb. standard with 1/16 inch raised face, serrated face finish and welding neck.
- d. Bolts: Stud bolts, ASTM A193, Gr. B7.
- e. Nuts: ASTM A194, Gr. 2H.

G. Equipment Drain Piping:

- 1. All factory fabricated or field erected steam equipment or apparatus that require drains shall be connected with adequately sloped drain line routed to a floor drain.
- 2. All drain piping shall be one-inch minimum diameter or larger as indicated on the Drawings or required by equipment. Such piping shall be standard weight galvanized steel pipe with galvanized malleable iron screw tees at each change in direction; or Type K, hard drawn copper tubing with threaded joints and fittings.
- 3. Install screw plug in unused openings for access to rod and clean.

2.03 VALVES

A. General:

- 1. All valves used in steam systems (low and medium pressure) shall be Class 150 SWP. Class 300 valves shall be constructed of all ASTM B-61 composition. All gate, globe and angle valves shall be union bonnet design. Metal used in the stems of all bronze gate, globe and angle valves shall conform to ASTM B371 Alloy 694, ASTM B99 Alloy 651 or other corrosion resistant equivalents. Written approval by the Owner must be secured for the use of alternative materials.
- 2. Manufacturers: NIBCO, Crane, Velan, Williams and Vogt.
- 3. All ductile Iron body valves shall have pressure containing parts constructed of ASTM A-395. Ductile iron stem material shall meet ASTM 371 Alloy 876 silicon bronze or its equivalent. Gates and globes shall be bolted bonnet with OS&Y (outside screw and yoke) and rising stem design.
- 4. All cast steel body valves shall have the pressure containing parts constructed of ASTM designation A-216-GR-WCB carbon steel. Gate and globe valves shall be bolted bonnet outside and screw and yoke design with pressure-temperature rating conforming to ANSI B16-34-1977. Stems shall meet ASTM designation A-186-F6 chromium stainless steel. Wedge (gate valves) may be solid or flexible type and shall meet ASTM A-182-F6 chromium stainless steel on valves from 2 inch to 6 inch. Sizes 8 inch and larger may be A-216-WCB with forged rings or overlay equal to 182-F6. Seat ring shall be hard faced carbon steel or 13 percent chromium A-182-F6 stainless. Handwheels shall be A47 Grade 35018 malleable iron or Ductile Iron ASTM A536.
- 5. All forged steel body valves shall have the pressure containing parts constructed of ASTM 105, Grade 2 forged carbon steel. Seat and wedges shall meet ASTM A-182-F6 chromium stainless steel. Seat rings shall be hard faced. Valves shall conform to ANSI B16-34 pressure-temperature rating.

6. All gate valves, globe valves, angle valves and shutoff valves of every character shall have malleable iron hand wheels, except iron body valves 2-1/2 inches and larger which may have either malleable iron or ASTM A-126 Class B, gray iron hand wheels.
7. Packing for all valves shall be free of asbestos fibers and selected for the pressure-temperature service of the valve. It is incumbent upon the manufacturer to select the best quality, standard packing for the intended valve service.
8. Valves 6 inches and larger located with stem in horizontal position shall be drilled and tapped in accordance with MSS-SP-45 to accommodate a drain valve and equalizing bypass valve assembly.
9. Valve Operator: Provide valve chain operator type on all shutoff valves shown on the Drawings that are 7'-6" above finished floor and higher. Chain operator shall be chain wheel of cast iron or malleable iron and designed to provide positive grip on wheel. Provide chain guide to prevent chain from slipping or jumping on wheel. Employ rust-proof chain complete with closing link of sufficient length to operate at 6'-6" above floor level.

B. Gate Valves:

1. High Pressure Steam and Trapped Condensate:
  - a. Socket Welded Pipe: 800 psig forged steel, welded bonnet, bolted gland, outside screw and yoke. Thread ends Vogt Ser. 2801 or socket weld Vogt 2801 SW.
  - b. Welded Pipe: Class 300 OS&Y, bolted flexible wedge disc. Crane Fig. No. 33 welded and flanged.
2. Medium and Low Pressure Steam and Trapped Condensate:
  - a. Threaded Pipe: 150 lb., screwed, bronze gate, rising stem, union bonnet, NIBCO T-134.
  - b. Welded Pipe: 150 lb. flanged OS&Y gate valve ductile iron, NIBCO F-637-31.
3. Building Condensate Return and Pumped Return:
  - a. Threaded Pipe: 150 lb., screwed, bronze gate, rising stem, union bonnet, NIBCO T-134.
  - b. Welded Pipe: 125 lb. flanged OS&Y gate valve ductile iron, NIBCO F-637-31.
4. Pumped Condensate Return:
  - a. Socket Welded Pipe: 800 lb. forged steel, socket weld, Vogt 2801 SW or threaded Vogt 2801.
  - b. Welded Pipe: 150 lb. carbon steel, butt welding ends (flanged ends where designated), OS&Y bolted bonnet, flexible wedge disc. Crane No. 47 ½ XU welded, 47 XU flanged.
5. Clean Steam:

- a. Socket-welded Pipe: Stainless steel body, flanged, stainless steel solid wedge, stellite seats, rising stem, union bonnet, malleable iron handwheel impregnated Teflon packing, Class 150 (150 psi WP steam), Williams Figure S15F6-316.
- b. Welded Pipe: Stainless steel body, flanged, stainless steel solid wedge, stellite seats, impregnated Teflon packing, Class 150 (150 psi WP steam), equal to Williams Figure S15F6-316.
- c. Drain valves: Use gate valve as specified above with hose thread adapter. Provide  $\frac{3}{4}$  inch minimum drain valve size except strainer blowdown valves to be blowdown connection size.

C. Globe Valves:

1. High Pressure Steam and Trapped Condensate:
  - a. Manufacturers: NIBCO, Crane, Williams, Vogt, Velan.
  - b. Socket Welded Pipe: 800 psig forged steel, welded bonnet, bolted gland, outside screw and yoke. Thread ends Vogt Ser. 2821 or socket weld Vogt 2821 SW.
2. Medium Pressure Steam and Trapped Condensate:
  - a. Threaded Pipe: 200 lb., screwed, bronze globe valve, rising stem, with 500 Brinnell hardness plug disc and seat ring. NIBCO T-256-AP.
  - b. Welded Pipe: 150 lb. Flanged OS&Y globe valve ductile iron, NIBCO F-738-31.
3. Low Pressure Steam and Trapped Condensate:
  - a. Threaded Pipe: 200 lb., screwed, bronze globe valve, rising stem, with 500 Brinnell hardness plug disc and seat ring. NIBCO T-256-AP.
  - b. Welded Pipe 150 lb flanged OS&Y globe valve Ductile Iron NIBCO F-738-31.
4. Building Condensate Return and Pumped Return:
  - a. Threaded Pipe: 200 lb., screwed, bronze globe valve, rising stem, with 500 Brinnell hardness plug disc and seat ring. NIBCO T-256-AP.
  - b. Welded Pipe: 150 lb. flanges OS&Y globe valve Ductile Iron NIBCO F-738-31.
5. Clean Steam:
  - a. Socket-welded Pipe: Stainless steel body, flanged, stainless steel disc, stellite seats, impregnated teflon packing, union or screw-over bonnet, malleable iron handwheel Class 150 (150 psi WP steam), Williams Figure S152F6-316.
  - b. Welded Pipe: Stainless steel body, flanged, stainless steel disc, stellite seats, Class 150, (150 psi WP steam), Williams Figure S152F6-316 approved equivalent model by listed manufacturers.

D. Check Valves:

1. High Pressure Steam and Trapped Condensate:



- a. Socket Welded Pipe: 800 lb., forged steel, socket weld, stainless steel seat and disc, swing check. Crane No. 3682X or accepted substitution.
  - b. Welded Pipe: Class 300 carbon steel, bolted cover, weld end (flanged end where designated), stainless steel seat and disc, swing check, 147XU flanged.
  - c. Manufacturers: NIBCO, Crane, Williams, Velan, Vogt.
2. Medium Pressure Steam and Trapped Condensate:
    - a. Threaded Pipe: 150 lb., screwed, horizontal swing check valve with screwed cap. NIBCO T-433-B.
    - b. Welded Pipe: 150 lb. flanged horizontal, swing check valve, ductile iron with bolted cap. NIBCO F938-31.
  3. Low Pressure Steam and Trapped Condensate, and Building Condensate Return, and Pumped Return:
    - a. Threaded Pipe: 150 lb., screwed, horizontal swing check valve with screwed cap NIBCO T-433-B.
    - b. Welded Pipe: 150 lb. flanged horizontal, swing check valve, ductile iron with bolted cap. NIBCO F938-31.
  4. TECO Pumped Condensate Return:
    - a. Socket Welded Pipe: Class 600 steel body, stainless steel swing check. Crane 175-1/2XU.
    - b. Welded Pipe: Class 150 swing check, stainless steel trim. Crane 147-1/2 XU welded, Crane 147 flanged.
  5. Clean Steam:
    - a. Socket-welded Pipe: Stainless steel body, flanged, stainless steel disc, Class 150 (150 psi WP steam), Williams, Powell or Velan equal to Williams Figure S151F6-316.
    - b. Welded Pipe: Stainless steel body, flanged, stainless steel disc, Class 150 (150 psi WP steam), Williams Figure S151F6-316.
- E. Ball Valves:
1. Two-piece bronze body rated at 150 psi steam, TFE seats, stainless steel ball and stem. NIBCO T-585-70-66.
  2. The following manufacturers are acceptable if they comply with the specification: NIBCO, Apollo, or Watts.

### **PART 3 - EXECUTION**

#### **3.01 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

- B. Remove scale and dirt on inside and outside before assembly. All piping shall be clean when it is installed. Before installation it shall be checked, upended, swabbed if necessary, and all rust or dirt from storage or from lying on the ground shall be removed.
- C. Prepare piping connections to equipment with flanges or unions.
- D. After completion, fill, clean and treat systems.

### 3.02 WELDING OF STEAM SYSTEM PIPING

- A. Steam and condensate piping and fittings shall be welded and fabricated in accordance with the latest edition of ASME/ANSI the latest editions of Standards B31.9 for all systems. Machine beveling in shop is preferred. Field beveling may be done by flame cutting to recognized standards.
- B. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Keep inside of fittings free from globules of weld metal. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process. All pipe shall have the ends beveled 37-1/2 degrees and all joints shall be aligned true before welding. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size and the like shall be made with factory-fabricated welding fittings. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction is not permitted.
- C. Align piping and equipment so that no part is offset more than 1/16-inch. Set all fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
- D. No weld shall project into the pipe so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
- E. Remove all split, bent, flattened or otherwise damaged piping from the Project Site.
- F. Remove dirt, scale and other foreign matter from the inside of piping, by swabbing or flushing, prior to the connection of piping sections, fittings, valves or equipment.
- G. Schedule 40 pipe shall be welded with not less than three passes including one stringer/root, one filler and one lacer. Schedule 80 pipe shall be welded with not less than four passes including one stringer/root, two filler and one lacer. In all cases, however, the weld must be filled before the cap weld is added.

### 3.03 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Pipe Installation:
  - 1. Direct connection of a steam exhaust, blowoff or drip pipe shall not be made with the building drainage system. Discharge into the building drainage system shall be at a temperature not higher than 140 degrees F. When higher temperatures exist, approved cooling methods shall be provided.

2. All the various piping systems shall be made up straight and true and routed in an orderly manner, plumb and parallel to the building structure. Install piping to conserve building space. Coordinate location with other trades and do not interfere with use of space for other work.
3. Piping shall follow as closely as possible the routes shown on Drawings, which take into consideration conditions to be met at the Project Site.
4. Should any unforeseen conditions arise, lines shall be changed or rerouted after proper approval has been obtained.
5. All piping shall be installed with due regard to expansion and contraction and to prevent excessive strain and stress in the piping, in connections, or in equipment to which the lines are connected.
6. Group piping whenever practical at common elevations.
7. Slope piping and arrange system to drain at low points. Use eccentric reducers to maintain bottom of pipe level.
8. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
9. Provide clearance for installation of insulation, and access to valves and fittings.
10. Prepare pipe, fittings, supports, and accessories for finish painting.
11. Procedure of Assembling Screw Pipe Fittings:
  - a. All screw joints shall be made with taper threads, properly cut.
  - b. Joints shall be made tight with Teflon-based compound appropriate to the medium, material, and temperature range of the system. Teflon tape is not permitted.
  - c. Compound shall be applied to the pipe threads only and not to fittings.
  - d. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs.
  - e. Before installing pipe that has been cut and threaded, lengths of pipe shall be upended and hammered to remove all shavings and foreign material.

D. Valve Installation:

1. Locate all valves such that the removal of their bonnets is possible. All flanged valves shown in horizontal lines with the valve stem in a horizontal position shall be positioned so the valve stem is inclined one bolt hole above the horizontal position. Screw pattern valves placed in horizontal lines shall be installed with their valve stems at a minimum 30 degree angle above the horizontal position. All valves must be true and straight at the time the system is tested and inspected for final acceptance. Install valves as nearly as possible to the locations indicated in the Drawings. Any change in valve location must be so indicated on the Record Drawings.

2. Equipment, valves, expansion joints, relief devices, strainers, etc., must be removed or isolated during the test if the pressure/force ratings of the devices are not as high as that specified for the test. Piping shall be drained and protected any time ambient temperature is below freezing.
3. Where leaks occur, the pipe shall be repaired and the tests repeated. No leaks shall be corrected by peening. Defective piping and joints shall be removed and replaced.
4. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with architectural drawings.
5. At the end of one year, period spot checks will be made and should the valve packing show signs of hardening or causing stem corrosion, all valves supplied by the manufacturer shall be repacked by the Contractor, at no expense to the Owner, with a packing material selected by the Owner.

### 3.04 CLEANING AND FLUSHING OF STEAM SYSTEMS

#### A. General:

1. Thoroughly clean steam and condensate systems before placing into operation to rid systems of rust, dirt, piping compound, mill scale, oil, grease, any and all other material foreign to water being circulated.
2. Exercise extreme care during construction to prevent dirt and other foreign matter from entering pipe or other parts of systems. Pipe stored on the project shall have open ends capped and equipment shall have openings fully protected. Before erection, each piece of pipe, fitting, or valve shall be visually examined and dirt removed.
3. Chemicals, feeding devices and water technician services shall be furnished by a single reputable manufacturer who will be responsible for the complete cleaning and flushing of the systems. Provide only chemical products that are acceptable under State and local pollution control regulations.
4. Add a temporary line with drain and isolate the building steam and condensate piping from the campus/building distribution piping to allow for proper circulation and cleaning of new piping in the new or modified building system.
5. Clean systems with a chemical compound specifically formulated for the purpose of removing the above listed foreign matter. These chemicals shall be injected to the systems, circulated and completely flushed out. Repeat the process if required. After each flushing, remove and thoroughly clean all strainers. UH representative shall be present for flushing process.
6. Final connection shall not be made to the campus/building loop system until the Chemical Contractor has filed with the Owner's representatives, a report stating that the systems are clean.

#### B. UH Systems:

1. Clean piping systems thoroughly. Purge pipe of construction debris and contamination before placing the systems in service. Provide whatever temporary connections are required for cleaning, purging and circulating.

2. Install temporary strainers in front of pumps, tanks, water still, solenoid valves, control valves and other equipment where permanent strainers are not indicated. Where permanent strainers are indicated, assure that the strainers are installed and screens are in place and are cleaned. Keep temporary strainers in service until the equipment has been tested, then replace straining element with a new strainer and clean and deliver the old straining elements to Owner. Fit strainers with a line size blow-off valve.
3. Circulate a chemical cleaner in steam and condensate piping system to remove mill scale, grease, oil and silt. Circulate chemical cleaner for 48 hours, flush system and replace with clean water. Dispose of chemical solution in accordance with local codes. When the chemical cleaning is complete, remove, clean and reinstall all permanent screens. Notify Owner so that the reinstallation of clean strainer screens may be witnessed.

### 3.05 TESTING

#### A. Weldings:

1. All welds are subject to inspection, visual and/or x-ray, for compliance with Specifications. The Owner will, at the Owner's option, provide employees or employ a testing laboratory for the purposes of performing said inspections and/or x-ray testing. Initial visual and x-ray inspections will be provided by the Owner. Contractor shall be responsible for all labor, material and travel expenses involved in the re-inspection and retesting of any welds found to be unacceptable. In addition, Contractor shall be responsible for the costs involved in any and all additional testing required or recommended by ASME/ANSI Standards B31.9 and B31.3 due to the discovery of poor, unacceptable or rejected welds.
2. Welds lacking penetration, containing excessive porosity or cracks, or are found to be unacceptable for any reason, must be removed and replaced with an original quality weld as specified herein. All qualifying tests, welding and stress relieving procedures shall, moreover, be in accord with Standard Qualification for Welding Procedures, Welders and Welding Operators, Appendix A, Section 6 of the Code, current edition.

#### B. Pipe Pressure:

1. Equipment, valves, vents, expansion joints, pressure reducing stations, etc., must be removed or isolated from test pressure and/or forces if the devices are not rated for the test pressures. All water must be drained from all steam system piping and devices after test completion. Piping shall be drained and protected any time the ambient is below freezing.
2. The following lines shall be tested at the stated pressure for the length of time noted:

Line	Testing Medium	Testing Pressure (psig)	Time in Hours
Steam M.P. & L.P.	Water	150	24
Steam Condensate M.P.	Water	150	24
Steam Condensate H.P. Pumped	Water	150	24

Condensate  
Return

3. Where leaks occur, repair pipe and repeat tests. No leaks shall be corrected by peening. Remove and replace defective piping and joints.
4. Condensate Return to Power Plant:
  - a. Dump condensate until acceptable to UH Power Plant. Fifteen (15) micromhos or less conductivity for the TECO Main Central Plant and 200 micromhos or less conductivity for the Power Plant. UH will test condensate samples and will notify Contractor when condensate is acceptable to return.
  - b. Each time the steam system is cycled, the condensate must again be tested.
  - c. After the above requirements have been met, the building will be scheduled to have steam services turned on.
  - d. Unnecessary cycling or intermittent use of thermal systems will not be permitted.

**END OF SECTION 23 22 13**