

SECTION 23 22 13
STEAM AND CONDENSATE HEATING PIPING

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. This Section includes steam and condensate piping and specialties for building HVAC and domestic water heating systems, including pipes, fittings, steam traps, special-duty valves, and steam specialties.
- B. Additional Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 23 Section "Common Work Results for HVAC" for general piping materials and installation requirements.
 - 2. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for expansion loops, anchors, and guides applied to steam and steam condensate piping systems.
 - 3. Division 23 Section "Hangers and Supports for HVAC Piping and Equipment" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.
 - 4. Division 23 Section "General-Duty Valves for HVAC Piping" for general-duty valves.
 - 5. Division 23 Section "Meters and Gages for HVAC Piping" for thermometers and pressure gages.
 - 6. Division 23 Section "Identification for HVAC Piping and Equipment" for labeling and identifying steam system piping.
 - 7. Division 23 Section "Instrumentation and Control for HVAC" for temperature-control valves and sensors.

1.3 DEFINITIONS

- A. Low Pressure Systems: Steam system operating at 15 psig or less.

1.4 ACTION SUBMITTALS

- A. Product Data: Including rated capacities where applicable, including piping, fittings, furnished options and accessories, and installation instructions for safety relief valves, pressure-reducing valves, and steam traps.
- B. Steam Trap Schedule: Provide a schedule of all steam traps, including type, make/model, body pressure rating, pressure of the associated steam supply piping, location in the building, application / service, peak steady state condensing rate of the associated equipment, and trap capacity in lbs./hr. at the required design back pressure.

- C. Piping Shop Drawings: Drawings showing the proposed installation of the piping system. 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. Also include control valves, low measuring stations, temperature and pressure sensors, and all other control devices required. Coordinate with the work of the ATC Sub-contractor as described in Division 23 Section "Instrumentation and Control for HVAC".

1.5 INFORMATIONAL SUBMITTALS

- A. Delegated-Design Submittal:
 - 1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
 - 2. Locations of pipe anchors and alignment guides and expansion joints and loops.
 - 3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
 - 4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.
- B. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Other building services.
 - 3. Structural members.
 - 4. Other items required to be included as per the provisions of Division 23 Section "Common Work Results for HVAC".
- C. Field Test Reports: Indicating and interpreting test results relative to compliance with specified requirements.
- D. Welding certificates: Copies of certificates for welding procedures and personnel.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For steam and condensate specialties and special-duty valves to include in the operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. ASME Compliance: Comply with the following provisions:
 - 1. ASME B31.9 "Building Services Piping" and ASME B31.1 "Power Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
 - 2. Welding Standards: Qualify welding processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."
 - a. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

- B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.8 SYSTEM PRESSURE AND TEMPERATURE RATINGS

- A. All components of the low pressure steam and steam condensate system shall be minimum Class 125 construction, and higher where indicated or specified, and shall be suitable for 15 psig saturated steam.

1.9 COORDINATION

- A. Coordinate layout and installation of piping with steam and condensate equipment and with other installations.
- B. Coordinate pipe sleeve installation for foundation and exterior wall penetrations.
- C. Coordinate pipe fitting pressure classes with products specified in related Sections.
- D. Coordinate size and location of concrete housekeeping pads. Cast anchor-bolt inserts into pad. Concrete, reinforcement, and formwork requirements are specified in Division 23 Section "Common Work Results for HVAC".
- E. Coordinate installation of pipe sleeves for penetrations in walls and floor assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Strainers:
 - a. Armstrong
 - b. Eaton / Hayward
 - c. Mueller Steam Specialty
 - d. Nibco
 - e. Keckley Co.
 - f. Spirax Sarco Inc.
 - g. Watson McDaniel Inc.
 - h. Watts
 - i. Or equal as approved by the Professional.
 - 2. Steam Traps:
 - a. ARI Armaturen
 - b. Armstrong International, Inc.
 - c. Barnes & Jones, Inc.
 - d. ITT Hoffman; ITT Fluid Handling Div.
 - e. Spirax Sarco, Inc.
 - f. Sterling, a Division of ACS Group

- g. Watson McDaniel Inc.
 - h. Or equal as approved by the Professional.
3. Thermostatic Air Vents and Vacuum Breakers:
- a. ARI Armaturen
 - b. Armstrong International, Inc.
 - c. Barnes & Jones, Inc.
 - d. ITT Hoffman; ITT Fluid Handling Div.
 - e. Johnson Corp. (The)
 - f. Spirax Sarco, Inc.
 - g. Watson McDaniel Inc.
 - h. Or equal as approved by the Professional.

2.2 PIPE AND TUBING MATERIALS

- A. General: Refer to Part 3 pipe application articles in this Section for identifying where the following materials are used.
- B. Steel Pipe: ASTM A 53, Type ERW or S, Grade B, Schedules 40 and 80, plain ends. Only piping manufactured in the USA or Canada is acceptable.
 - 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, carbon steel, seamless for 2-inch NPS and smaller and electric-resistance welded for 2-1/2-inch NPS and larger. Nipples shall be same type, grade, and thickness schedule as piping system in which it is installed.

2.3 FITTINGS

- A. General: Refer to Part 3 pipe application articles in this Section for identifying where the following materials are used.
- B. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300.
- C. Malleable-Iron Unions: ASME B16.39; Classes 300, ground joint type, with brass to iron seat.
- D. Wrought-Steel Fittings: ASTM A 234, Grade B, with wall thickness to match adjoining pipe.
- E. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, Class 150 including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1 (ASTM A 105).
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.

2.4 JOINING MATERIALS

- A. Welding Materials: Comply with Section II, Part C of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- B. Gasket Material: Provide only metal gaskets of thickness and type suitable for fluid to be handled; and design temperatures and pressures.

2.5 VALVES

- A. Gate, globe, ball, butterfly, and check valves are specified in Division 23 Section "General-Duty Valves for HVAC Piping".
- B. Refer to Part 3 "Valve Applications" Article for specific uses and applications for each valve specified.

2.6 STEAM TRAPS UP TO 125 PSIG

- A. Thermostatic Traps: Class 125, bronze angle-pattern body with integral union tailpiece and screw-in cap; balanced-pressure, stainless-steel or Monel bellows element; and renewable, hardened stainless-steel head and seat.
- B. Float and Thermostatic Traps: ASTM A 126, cast-iron body and bolted cap; renewable, stainless-steel float mechanism with renewable, hardened stainless-steel head and seat; maximum operating pressure of 125 psig; balanced-pressure, stainless-steel or Monel thermostatic bellow element.
 - 1. Thermostatic air vent capable of withstanding 45 deg F of superheat and resisting water hammer without sustaining damage.

2.7 THERMOSTATIC AIR VENTS

- A. Quick Vents: Cast-iron or brass body, with balanced-pressure, stainless-steel or Monel thermostatic bellows, and stainless-steel heads and seats.
- B. Float Vents: Cast-iron or brass body; seamless brass float; balanced-pressure, thermostatic bellows; replaceable stainless-steel seat, float, and head.

2.8 VACUUM BREAKERS

- A. Vacuum Breakers: 150-psig steam working pressure, 365 deg F maximum operating temperature, brass or stainless-steel body, stainless-steel retainer, spring, and ball, with threaded outlet.

2.9 STRAINERS

- A. Low Pressure Y-Pattern Strainers: Minimum 125-psig steam working pressure; Class 125 cast-iron body conforming to ASTM A 278; Type 304 stainless-steel screen, 20 mesh for 2-inch NPS and smaller, and manufacturer recommended perforations for 2-1/2-inch NPS and larger; tapped blowoff plug. Threaded connections for 2-inch NPS and smaller and ANSI Class 150 flanged connections for 2-1/2-inch NPS and larger.
- B. Basket Strainers: Minimum 250-psig steam working pressure; cast- or malleable iron body conforming to ASTM A 278, Class 300; Type 304 stainless-steel screen; bolted cover; flanged connections.

PART 3 - EXECUTION

3.1 LOW PRESSURE PIPING APPLICATIONS

- A. Steam Piping, 2-Inch NPS and Smaller: Use ASTM A 53, Type S or ERW, Grade B, Schedule 40 steel pipe with threaded joints and Class 150 malleable-iron fittings.
- B. Steam Piping, 2-1/2- to 12-Inch NPS: Use ASTM A 53, Type S or ERW, Grade B, Schedule 40 steel pipe with welded joints, Schedule 40 wrought-steel welding fittings, and Class 150 wrought-steel flanges.
- C. Steam Condensate Piping, 2-Inch NPS and Smaller: Use ASTM A 53, Type S or ERW, Grade B, Schedule 80 steel pipe with threaded joints and Class 300 malleable-iron fittings.
- D. Steam Condensate Piping, 2-1/2- to 12-Inch NPS: Use ASTM A 53, Type S or ERW, Grade B, Schedule 80 steel pipe with welded joints, Schedule 80 wrought-steel welding fittings, and Class 150 wrought-steel flanges.

3.2 ANCILLARY PIPING APPLICATIONS

- A. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- B. Steam Condensate Pump Condensate Discharge (i.e. Pumped Condensate) and Receiver Vent Piping: As specified for steam condensate piping.
- C. Vacuum-Breaker Inlet and Outlet Piping: Same as service where installed / to which it is connected.
- D. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.
- E. Miscellaneous Drain Piping: As specified for steam condensate piping.
- F. Miscellaneous Vent Piping: Same as service where installed / to which it is connected.

3.3 VALVE APPLICATIONS

- A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
 - 1. Shutoff Duty: Use gate, ball, and butterfly valves.
 - 2. Throttling Duty: Use globe valves.
- B. Install shut off-duty valves at each branch connection to supply mains, at inlet connection to each steam trap, and elsewhere as indicated.
- C. Vacuum Breakers Less than 15 psig: Class 150 bronze swing check with composition seat.
- D. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.

- E. Install swing check valves as required to control flow direction. Check valves shall not be used as vacuum breakers.
- F. Install dielectric fittings where required by Division 23 Section "Common Work Results for HVAC."

3.4 STEAM-TRAP APPLICATIONS UP TO 125 PSIG

- A. All Applications: Float and Thermostatic Traps
 - 1. Exception: Thermostatic Traps: Convectors, radiators, and finned-tube radiation.

3.5 STEAM TRAP SIZING

- A. Low Pressure Steam: Unless indicated otherwise on the Drawings, size traps as follows:
 - 1. On heat exchangers, heating air coils, domestic water heaters, steam kettles, and similar end uses with modulating steam control valves: For each trap shown, size at 1.5 times the peak, steady-state condensing rate scheduled for the equipment at a differential pressure of 0.5 psig.
 - a. Exception: Float and Thermostatic traps can be sized for 1 times the peak, steady-state condensing rate scheduled at a differential pressure of 0.5 psig.
 - 2. On steam supply piping drips: Size for a minimum capacity listed below at a differential pressure equal to the steam supply distribution pressure minus 7 psig backpressure.
 - a. Piping 8" and Smaller: 200 lbs./hr.
 - b. Piping From 10" to 16": 400 lbs./hr.
 - c. Piping Larger Than 16": 600 lbs./hr.
- B. Minimum PMO Ratings: The PMO (maximum operating pressure) rating of steam traps shall not be less than the operating steam pressure of the lines on which they are installed.
- C. Submit trap selections in the Steam Trap Schedule submittal described elsewhere in this Section.

3.6 PIPING INSTALLATIONS

- A. Install piping according to Division 23 Section "Common Work Results for HVAC."
- B. Pipe Appurtenance Sizing: The size of valves and pipeline specialties that convey the full flow of the connecting piping (e.g. strainer) shall match the size of the pipe in which the valve or specialty is installed, unless otherwise indicated.
- C. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- D. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

- F. Install piping free of sags and bends.
- G. Install safety valves on pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- H. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps
- K. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch NPS ball or glove valve, and short 3/4-inch NPS threaded nipple and cap. The quantity and locations of drains shall be sufficient to completely drain down the system.
- M. Install steam supply piping at a uniform grade (slope) of no less than 0.5 percent (1/16" drop per foot of piping) downward in direction of steam, flow, unless explicitly indicated otherwise on the Drawings. Where condensate is indicated to counterflow against the direction of steam flow, the minimum slope shall be no less than 1.0 percent
- N. Install condensate return piping at a uniform grade (slope) of no less than 1.0 percent downward in direction of flow (1/8" drop per foot of piping), unless a greater slope is indicated on the Drawings.
- O. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
- P. Install branch connections to steam supply mains using 45-degree fittings in main with takeoff out top of main. Use of 90-degree tee fittings is permissible where 45-degree fittings are impractical. Where length of branch takeoff is less than 10 feet, pitch branch line down toward mains at 1.0 percent slope.
- Q. Wrought Steel Fittings, Butt Weld and Flanged: Comply with the following:
 - 1. Install factory-fabricated elbows for changes in direction. Long radius elbows shall be used, and changes in elevation shall be performed with two (2) 22.5 deg elbows in lieu of 45 or 90 degree elbows.
 - 2. Install branch connections to mains using factory-fabricated tee fittings in main.
 - a. Exceptions:
 - 1) The use of "fish-mouth" type fittings for branch connection to mains is permitted, but only when the size of the branch connection is two (2) nominal pipe sizes smaller than the size of the main, and the main is size 5" or larger.
 - 2) The use of weld-o-lets for branch connection to mains is only permitted when the size of the branch connection is three (3) or more nominal pipe sizes smaller than the size of the main pipe. Furthermore, weld-o-lets shall not be used for branches larger than 2".

- R. Threaded Fittings: Comply with the following:
1. Provide regular elbows (45 and 90 deg.) for changes in direction. Street elbows are not acceptable.
 2. Provide long-form reducing couplings for changes in size. Do not use short-form reducing bushings, reducing elbows, or reducing tees where the change in size occurs on the 'straight-through' flow.
 - a. Reducing tees where the change in size only occurs on the branch flow are acceptable.
 3. Crosses and wyes are not acceptable.
- S. Install unions or flanges adjacent to each valve, at final connections of each piece of equipment, and elsewhere as indicated. Unions are not acceptable on piping 2-inch NPS and larger.
- T. Install strainers on supply side of each control valve, pressure-regulating valve, solenoid valve, steam trap, and elsewhere as indicated. Install a 3/4-inch NPS nipple and cap with a full port ball valve in blow-down connection of all strainers. Match the size of strainer blowoff connection for strainers with blowoff connections larger than 3/4-inch NPS.
1. On steam supply piping, Y-strainers shall be installed on horizontal lines only with the strainer basket in the horizontal plane so as to not collect steam condensate.
 2. On steam condensate piping, Locate and orient the strainer so that gravity will assist in retaining the entrapped solids in the screening element (or "leg") or basket so solids can be properly collected and held for disposal.
 - a. Install Y-strainers in vertical downflow lines, and in horizontal lines. Do not install in upflow orientations.
 - b. Install basket strainers horizontally (only).
- U. Anchor and guide piping to ensure proper direction of expansion and contraction. Comply with requirements in Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, swing joints, expansion joints, anchors, and pipe alignment guides.
- V. Swing Connections: Branch piping connections to mains shall be made with swing connections. Swing connections are generally not indicated on the piping floor plans for clarity purposes only.
1. Swing connections shall be made with at least five (5) pipe fittings, including tee in main.
- W. Steam Trap Drip Legs and Steam Main Drip Traps: Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers (regardless of the steam flowing up or down), and ahead of pressure regulators, control valves, isolation valves, pipe bends, and expansion joints.
1. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 150 feet where pipe is pitched down in direction of steam flow and a maximum of 100 feet where pipe is pitched downward in the opposite direction of steam flow.
 2. Size drip legs at vertical riser's full size and extend beyond rise. Size drip legs at other locations same diameter as main, except for steam mains 8-inch NPS and larger, drip legs up to 2 nominal pipe sizes smaller than main, but no smaller than 6-inch NPS, may be provided.

3. Drip legs shall be connected to the steam main using a factory fabricated tee fitting. 'Fish mouth' connections, weld-o-lets, and similar contractor-fabricated fittings are not acceptable.
4. Provide minimum 18-inch-long drip legs for steam mains up to 12-inch NPS. For larger steam mains, provide drip legs with a length 1-1/2 times the nominal steam main pipe diameter.
5. The pipe connecting to the steam trap shall be connected to the side of the drip leg, with its centerline set 4-inches above the bottom of the leg (to function as a dirt pocket).
6. Equip drip leg dirt pockets and strainer blow-downs with shutoff valves to allow removal of dirt and scale.
7. Install steam traps close to drip legs.

3.7 STEAM-TRAP INSTALLATION

- A. Install steam traps in accessible locations close to connected equipment, maximum 48 inches away from the equipment unless explicitly indicated otherwise on the Drawings.
 1. Unless additional appurtenances are indicated on the Drawings, install the following minimum appurtenances at each steam trap: Shutoff valve, strainer, and union upstream from trap; install union, check valve, and shutoff valve downstream from trap.
- B. Install steam traps with sufficient filling head. On heat exchangers, heating air coils, domestic water heaters, steam kettles, and similar end uses with modulating steam control valves, provide no less than 14" elevation change (drop) between the outlet of the equipment and the inlet to the trap.

3.8 TERMINAL EQUIPMENT CONNECTIONS

- A. Piping size for supply and return shall be same size as equipment connections, or the size indicated on the Drawings, whichever is larger. Provide transitions to coil connections as required.
- B. Install traps and control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. Where multiple, parallel control valves are installed, only one bypass is required.
- D. Install vacuum breaker downstream from control valve and control valve bypass, and close to coil inlet connection.
- E. Install thermostatic air vents downstream from control valve and control valve bypass, on the high point of the coil installation. When coil supply header connections are below the top of the coil, the vent shall be installed on the top of the supply header. When coil supply header connections are at the very top of the coil, then the air vent may be installed either on the header or on the connecting supply piping, near to the coil connection.
 1. The discharge of air vents shall be extended to within 12" of the finished floor. Piping shall be sized as per the vent connection size.
- F. Install pressure gage at coil inlet connections.
- G. Pipe outlet from coils to drip leg and trap. No lift in the condensate piping downstream of heating equipment with a modulating control valve is permitted. Condensate drain lines shall pitch

downward from the equipment outlet connection to the gravity condensate system leading to the system condensate pumps.

- H. Air coils shall be pitched to ensure condensate drainage. Air coils operating in parallel shall each have independent / dedicated traps.

3.9 HANGERS AND SUPPORTS

- A. General: Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Conform to requirements below for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal runs 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Thermal-Hanger Shield Inserts: 360-degree insert of high-density, 100-psi minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.
- C. Install hangers for steel steam supply piping with the following maximum spacing, or in accordance with ANSI / MSS-SP-58, whichever is more demanding:
 - 1. NPS 3/4: Maximum span, 9 feet.
 - 2. NPS 1: Maximum span, 9 feet.
 - 3. NPS 1-1/2: Maximum span, 12 feet.
 - 4. NPS 2: Maximum span, 13 feet.
 - 5. NPS 2-1/2: Maximum span, 14 feet.
 - 6. NPS 3 and Larger: Maximum span, 15 feet.
- D. Install hangers for steel condensate piping with the following maximum spacing, or in accordance with ANSI / MSS-SP-58, whichever is more demanding:
 - 1. NPS 3/4: Maximum span, 7 feet.
 - 2. NPS 1: Maximum span, 7 feet.
 - 3. NPS 1-1/2: Maximum span, 9 feet.
 - 4. NPS 2: Maximum span, 10 feet.
 - 5. NPS 2-1/2: Maximum span, 11 feet.
 - 6. NPS 3 and Larger: Maximum span, 12 feet
- E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.
- F. Provide additional hangers at each change of direction of piping and at concentrated equipment loads.

3.10 PIPE JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Common Work Results for HVAC" for joint construction requirements for threaded, welded, and flanged joints.

3.11 HYDROSTATIC PRESSURE TESTING

- A. Hydrostatically test new piping and existing piping systems altered by the Project. The Contractor shall perform pressure tests. Advise the Client Agency and Architect/Engineer no less than 7 days in advance of testing.
- B. Test prior to installing insulation.
- C. Testing Preparation: Prepare steam and condensate piping according to ASME B31.9 ("Building Services Piping") or B31.1 ("Power Piping") as applicable and as follows:
 - 1. Leave joints, including welds, uninsulated 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 so that it is not subjected to test pressure from piping using valves or blinds in flanged joints. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Flanged joints where blinds are inserted to isolate equipment need not be tested.
 - 5. Install relief 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.
- D. Testing: Test steam and condensate piping as follows:
 - 1. Use ambient temperature water as testing medium, except where there is risk of damage due to freezing. Another liquid may be used if it is safe for workers and compatible with piping system components.
 - 2. Use traps installed at the high points of system to release trapped air while filling system. Use drip legs installed at low points for complete removal of liquid.
 - 3. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is water tight.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure, and not less than 100 psig, whichever is greater, however the test pressure shall not exceed maximum pressure for any vessel, heat exchanger, pump, valve, or other component in system under test. Check to verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength."""
 - 5. 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 with new materials as appropriate, and repeat hydrostatic test until there are no leaks. Leak-sealing compounds and preening is not permitted.
 - 6. Prepare written report of testing.
- E. Use of pressurized air for testing of steam system piping is strictly prohibited.

3.12 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

- B. Flush steam and condensate piping with clean water. Remove, clean, and replace strainer screens.

END OF SECTION