SECTION 23 2213 - STEAM PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following for HP (High Pressure) and LP (Low Pressure) steam and condensate piping:

1. Pipe, fittings, unions and flanges, and joints.
2. Pipe support guides and anchors.
3. Expansion loops.
4. Valves, chainwheels, and certain other specialties for HP steam and condensate systems.
5. Unions, flanges, and joining materials.
6. Isolation, check, and pressure equalization, and drain valves for HP steam and condensate systems.
7. Tracer wire.

B. Related Requirements:

1. Section 23 0000 "Common Work Requirements for HVAC."
2. Section 23 0516 "Expansion Fittings and Loops for HVAC Piping."
3. Section 23 0517 "Sleeves and Sleeve Seals for HVAC Piping."
4. Section 23 0518 "Escutcheons for HVAC Piping."
5. Section 23 0529 "Mechanical Supporting Devices."
6. Section 23 0553 "Mechanical Systems Identification."
7. Section 23 2216 "Steam Piping Specialties."
8. Section 33 6313 "Exterior Underground Steam Distribution System."

1.3 DEFINITIONS AND CAMPUS STEAM SYSTEM INFORMATION

A. HP Steam Systems: High-pressure piping operating at more than 15 psig as required by ASME B31.1.

B. LP Steam Systems: Low-pressure piping operating at 15 psig or less as required by ASME B31.9.

C. For the Evanston campus, central steam is distributed at 150 psig (known as the "Campus Line"), and at 230 psig. These are distinct piping systems but they both originate from the same high pressure header in the CUP. Steam is and needs to be metered and reduced in pressure after entrance of each building as required. On the condensate return side, there is high pressure condensate return and pumped condensate return.

D. For the Chicago campus, central steam is distributed at 170 psig. Steam is and needs to be metered and reduced in pressure after entrance of each building as required.

E. Both campus's utilize direct buried piping and piping run through tunnels.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures:

1. HP Steam and Medium Pressure (MP) Piping: XXX psig and XXXF.
2. LP Steam Piping: 15 psig and 300F.
3. HP and MP Condensate Piping: XXX psig at XXX deg F.
4. LP Condensate Piping: 15 psig at 250 deg F.
5. Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
6. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
7. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. Pipe, fittings, unions and flanges.
2. Pipe support guides and anchors.
3. All valves, and chainwheels.
4. Tracer wire.

B. Shop Drawings ***(For Use Amongst the Contractors and For University Reference, Not for Engineer Approval)***: Detail fabrication of pipe anchors, hangers, pipe, multiple pipes, alignment guides, and expansion loops and their attachment to the building structure. Detail locations of anchors, alignment guides, and expansion loops.

C. Coordination Drawings ***(For Use Amongst the Contractors and For University Reference, Not for Engineer Approval)***: 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. Other building services.
2. Lighting.
3. Structural members.
4. Supports.

D. Welding certificates (For Information).

E. Field quality-control test reports.

F. Operation and Maintenance Data: For valves and expansion joints, to include in emergency, operation, and maintenance manuals.

G. Delegated-Design Submittal ***(For Use Amongst the Contractors and For University Reference, Not for Engineer Approval)***:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion 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 penetration and fire-stopping for fire- and smoke-rated wall and floor and ceiling assemblies.

H. Northwestern Maintenance Requirement Forms, see Division 01.

1.6 QUALITY ASSURANCE

A. Pipe Welding: Qualify processes and operators according to the following:

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

Retain applicable codes in paragraph below: B31.1 for HP steam system and B31.9 for LP steam system.

B. ASME Compliance: Comply with ASME B31.1, "Power Piping" and ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.

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

D. Comply with FM Global requirements for pressure vessels and piping and for pressure relief devices.

E. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.7 DELIVERY, STORAGE AND HANDLING

A. Product Delivery Requirements: Accept valves and accessories on site in shipping containers with labeling in place.

B. Product Storage and Handling Requirements: Protect piping and fittings from soil and debris with temporary and caps and closures. Maintain in place until installation. Provide temporary protective coating on steel valves and specialties.

1.8 SITE CONDITIONS

A. Verify field conditions prior to fabrication.

1.9 SPECIAL WARRANTIES

A. Five (5) years, see Division 01.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials: Piping shall be meet ASTM requirements.

B. Piping shall be routed orthogonally (no diagonal shortcuts).

2.2 TRACER WIRE:

A. All non-electrical pipe installed below grade shall have a 12 AWG copperhead Reinforced Tracer Wire, or equal. Tracer wire to be accessible at each end in manholes, 8 AWG wire to be installed in 1 inch conduit run next to piping. Conduit shall be rigid steel piping with PVC coating.

2.3 HIGH PRESSURE STEAM IN CUP, IN INTERIOR MANHOLES (IF APPLICABLE), AND SHORT SECTIONS JUST ENTERING BUILDING MECHANICAL ROOMS

A. 2½ inches and Smaller:

1. Pipe: ASTM A106, Grade B, extra strong, carbon steel.
2. Fittings: ASTM A105 Grade II/ASME B16.11, 3000 lb. forged steel, socket weld.
3. Unions: Forged steel, 3000 lb., socket well. Refer to Unions and Flanges in this Section.

B. 3 inches and Larger:

1. Pipe: ASTM A106, Grade B, extra strong, carbon steel.
2. Fittings: ASTM A234 Grade WPB/ASME B16.9, extra strong, seamless, carbon steel weld.
3. Flanges: Class 300. Refer to Unions and Flanges in this Section.

2.4 PUMPED CONDENSATE AND STEAM TRAP CONDENSATE IN CUP, IN INTERIOR MANHOLES (IF APPLICABLE), AND SHORT SECTIONS JUST ENTERING BUILDING MECHANICAL ROOMS:

A. 2½ and Smaller:

1. Pipe: ASTM A106, Grade B, extra strong, carbon steel.
2. Fittings: ASTM A105 Grade II/ASME B16.11, 3000 lb. forged steel, socket weld.
3. Unions: Forged steel, 3000 lb., socket weld. Refer to Unions and Flanges in this Section.

B. 3 inches and Larger:

1. Pipe: ASTM A106, Grade B, extra strong, carbon steel.
2. Fittings: ASTM A234 Grade WPB/ASME B16.9, extra strong, seamless, carbon steel weld.
3. Flanges: Class 300. Refer to Unions and Flanges in this Section.

2.5 PUMPED CONDENSATE AND STEAM TRAP CONDENSATE IN INTERIOR MANHOLES (IF APPLICABLE), AND SHORT SECTIONS WITHIN BUILDING MECHANICAL ROOMS:

A. 2½ inches and Smaller:

1. Pipe: ASTM A312, 304L, Schedule 40S, seamless stainless steel.

2. Fittings: ASTM 182, Gr. F304, ASME B16.11, 3000 lb socket-weld.
3. Unions: 3000 lb socket-weld, stainless steel ground joint.

B. 3 inches and Larger:

1. Pipe: ASTM A312, 304L, Schedule 40S, seamless stainless steel.
2. Fittings: ASTM A403, Gr. WP, Class S or Class W, ASME 16.9.
3. Flanges: ASTM A182, GR. F304, ASME B16.5, 150 lb std. with 1/16” raised face, serrated face finish and welding neck.
4. Bolts: Stud bolts, ASTM A193, Gr. B7.
5. Nuts: ASTM A194, Gr. 2H.

2.6 HIGH PRESSURE STEAM AND CONDENSATE (UNDERGROUND) – GENERAL:

A. Same as existing, or same as new as installed by the site utility contractor, and work of this section for this application only meant to cover new piping in from 5'-0" outside of building if the site utility responsibility ends there, refer to their drawings and specs. Contractor fabricated piping and fittings are not allowed. No metal components shall be exposed to earth. Refer to Section 33 6313 for information and requirements on site HP steam and condensate piping systems (including vaults) and also including (but not limited to) pipe support guides, expansion loops, moment guided, elbows and tees, anchors, end seals and gland seals, and field joints.

B. If drainable/dryable type, all straight sections, fittings, anchors and other accessories shall be factory prefabricated to job dimensions, and designed to minimize the number of field welds. The design shall be computer analyzed by the piping system manufacturer to determine stresses and movements of the service pipe and to ensure that the system design is in strict conformance with ANSI B31.1 latest edition, and stamped by a registered professional engineer licensed in the state of Illinois. The analysis shall include piping and structures inside the manholes.

C. The piping manufacturer shall provide minimum of 2 days of on-site technical assistance during installation of the piping. The factory representative shall be a factory trained technician to witness requirements outlined in the installation portion of this specification.

D. Contractor shall perform a computerized pipe stress analysis for the piping systems in the underground steam system. Submit stress analysis report including input data, system graphics, output data including: system forces and moments, system deflections, system stresses, hanger, support and anchor loading summary and other pertinent data. Analysis shall consider actual materials of construction and a system pressure and temperature of 250 PSIG and 450°F, base temperature is 50°F. Analysis output data shall be utilized to select proper supports, guides and anchors to resist actual loads calculated. Pipe stress analysis calculations to be submitted to the Engineer for review along with the re-engineered piping system shop drawings.

2.7 LP STEAM AND CONDENSATE PIPING

A. LP Steam: 2" and smaller: ASTM A53, Grade B, ERW, schedule 40 carbon steel, with screwed joints. Fittings, unions, flanges, and couplings to be ANSI/ASTM B16.3. malleable iron, Class 150.

B. LP Steam: 2-1/2" and larger: ASTM A53, Grade B, ERW, schedule 40, carbon steel, with ANSI/AWS D1.1 butt welded joints. Fittings to be ASTM A234, forged steel, Class 150. Flanges to be Class 150 forged steel slip-on type, or weld-neck flanges for carbon steel.

C. LP Steam Condensate: 2" and smaller: ASTM A53, Grade B, ERW, schedule 80 carbon steel, with screwed joints. Fittings, unions, flanges, and couplings to be ANSI/ASTM B16.3. malleable iron, Class 150.

D. LP Steam Condensate: 2-1/2" and larger: ASTM A53, Grade B, ERW, schedule 80, carbon steel, with ANSI/AWS D1.1 butt welded joints. Fittings to be ASTM A234, forged steel, Class 150. Flanges to be Class 150 forged steel slip-on type, or weld-neck flanges for carbon steel.

E. Pumped Condensate, 2" and smaller: ASTM A53, Grade B, ERW, schedule 80 carbon steel, with screwed joints. Fittings, unions, flanges, and couplings to be ANSI/ASTM B16.3. malleable iron, Class 150.

F. Pumped Condensate, 2-1/2" and larger: ASTM A53, Grade B, ERW, schedule 80, carbon steel, with ANSI/AWS D1.1 butt welded joints. Fittings to be ASTM A234, forged steel, Class 150. Flanges to be Class 150 forged steel slip-on type, or weld-neck flanges for carbon steel.

G. Steel Pipe Nipples: ASTM A733, made of ASTM A 53/A 53M, black steel, of same type, grade, and schedule as pipe in which installed.

2.8 UNIONS AND FLANGES:

A. Unions:

1. 2½ inches and Smaller:

a. Forged steel, ASTM A105 Grade 2, ASME B16.11, socket weld, 3000 lb. WOG with steel to steel seats.

B. Flanges:

1. 3 inches and Larger:

a. ASTM A105, ANSI B16.5, hot forged steel flanges, welding neck pattern. Slip-on pattern flanges are not allowed. Bore dimension of welding neck flange shall match inside diameter of connected pipe. Use raised face flanges for mating with other raised face flanges with self-centering flat ring gaskets. Use flat face flanges for mating with other flat face flanges with full face gaskets.

2. Flange pressure class indicated in respective piping service is minimum required. Mating flange pressure class shall match pressure class of device connected to such as valves and piping specialties. Flanged connection will on be permitted at specialty connections such as at a vessel or specialty valve.

C. Flange Gaskets:

1. Gasket material to be asbestos free and suitable for pressure temperatures and fluid of piping system. Non-metallic gaskets shall be in accordance with ANSI/ASME B16.21 and ASTM F104.
2. Gaskets shall be equal to Flexitallic Style CG, graphite filler, 304 SS winding, carbon steel centering ring, 0.175” thickness.

D. Bolting:

1. For all connections to valves, use bolts studs.
2. Bolts, bolt studs, nuts and washers used on piping systems in CUP, tunnel and manholes shall have zinc plated finish.
3. Thread shall be in accordance with ANSI/ASME B1.1, Class 2A tolerance for external threads and Class 2B tolerance for internal threads. Threads shall be coarse-thread series except that alloy steel bolting 1-1/8" and larger in diameter shall be 8 pitch thread series.
4. Threaded rods are not allowed as fastening elements on steam systems.
5. For Class 150 and Class 300 flanges at 400°F or lower temperature, use carbon steel bolts or stud bolts conforming to ASTM A307, Grade B with nuts conforming to ASTM A307.
6. For Class 300 flanges at 500°F or lower temperature, use alloy steel bolts or stud bolts conforming to ASTM A193, Grade B7 or B16, with nuts conforming to ASTM A194, Grade 2H.

2.9 VALVES – GENERAL:

A. General: Install valves as shown on plans, details and according to the valve manufacturer's installation recommendations.

B. Provide chain operators for manually operated valves 4" and larger, located more than 8'-0" above normal working surface.

2.10 HIGH PRESSURE STEAM, PUMPED CONDENSATE, AND STEAM TRAP CONDENSATE SYSTEM VALVES (100 TO 230 PSIG/450°F):

A. Isolation Valves:

1. High pressure steam and condensate isolation valves shall be ANSI Class 300.

a. Up thru 2½ inches:

1) Description: Ball, full port, carbon steel body, 316 SS ball & stem, "Xtreme" seats & PTFE seals or reinforced PTFE seats & seals, rated for 300 psi at 600°F, threaded end connections, 4" steam extension, Jamesbury: ASTM A193 Grade B7 bolts with ASTM A194 Grade 2H nuts.
2) Manufacturer and Model No.:

a) Apollo 83-540-64-04.
b) Jamesbury 4BX-22236XT-1.

b. 3 inches and Larger:

1) Description: Butterfly ANSI Class 300, rated for 300 psi at 600°F, lugged, carbon steel body as follows:

a) Disc: Stainless steel or carbon steel
b) Seat: laminated Type 321 SS & graphic disc seat, or carbon steel body with a SS welded overlay for the body seat.
c) Shaft: A276 Type 431 stainless steel shaft.
d) Bi-directional dead end.
e) Valve shall be triple offset.
f) Valve shutoff shall be ANSI Class IV.
g) All valves shall have a manual-gear actuator.

h) All valves located more than 8 ft. above the equipment room floor shall have a chain wheel.

2) Manufacturer and Model No:

a) Zwick A1-YZA11AG.

2. Prior to shipment, valves to be hydrostatically and leak tested at the factory. Factory hydrostatic test shall be performed at 300 psig for all valves.

a. NU and Architect/Engineer shall have option to be present to witness factory testing for the first valves that are 2½" and smaller and the first valves that are 3" and larger. Valve manufacturer shall be responsible for providing transportation and accommodations for two (2) NU representatives and one (1) representative of the Architect/Engineer.

B. Swing Check Valves:

1. 2" and Smaller: ASTM B62, cast steel body, threaded ends, regrinding, Y-pattern swing type, renewable TFE seat disc, Class 300 (300 psi WOG), conforming to MSS SP-80.

C. Globe Valves:

1. 2" and Smaller: ANSI Class 600, steel body, stainless steel disc & seat ring, threaded ends.
2. 2½" and Larger: ANSI Class 300, steel body, stainless steel disc & seat ring, butt weld ends, constructed in accordance with ASME B16.34

D. Pressure Equalizing Valves

1. Use 1-1/4" globe valve for use on valves 3" and 4" valves.
2. Use 1½" globe valve for use on valves 6" to 10".
3. Use 2" globe valves for use on valves larger than 12".

E. Drain Valves:

1. Gate valves as specified above with hose thread adapter and cap. Provide 1" minimum drain valve except strainer blowdown valves to be blowdown connection size. Drain valves shall be provided with short threaded nipple and cap.

2.11 VALVES AND SPECIALTIES FOR LP STEAM AND CONDENSATE PIPING

A. See Section 23 2216.

2.12 JOINING MATERIALS

A. Gaskets:

1. Suitable for chemical and thermal conditions of piping system contents.
2. Anti-Seize compound, if required, shall be Loctite C5-A Copper Based or approved equal.
3. High Pressure Steam and Condensate Piping: Flexitallic spiral wound gaskets Class 150, ASME B16.20 with 304 SS metal winding strip and Flexicarb flexible graphite filler material; or approved equal.

4. Low Pressure Steam and Condensate Piping: Flexitallic spiral wound gaskets Class 150, ASME B16.20 with 304 SS metal winding strip and Flexicarb flexible graphite filler material, Graphonic corrugated metal gaskets Class 150 with 316 SS metal core and flexible graphite sealing element; or approved equal.

B. Joint Sealers:

1. Use a pipe compound approved for the type of service.
2. All purpose PTFE soft-set thread sealing compound. Jomar "Gimmie The White Stuff", Rectorseal No. 5, or approved equal.

C. Flange Bolts and Nuts: Unless required otherwise, conform to ASTM A-354 Grade BD and SAE J-429 Grade 8 for steam and condensate application.

D. Welding Filler Metals: Comply with AWS D10.12for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. 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.

2.13 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to valve stems.
3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc coating.
4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim and long enough to reach from particular valve height to 3' from finished floor.

PART 3 - EXECUTION

3.1 STEAM PIPING APPLICATIONS

A. See PART 2 above.

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. Air-Vent Piping:

1. Inlet: Same as service where installed.
2. Outlet: Type Kannealed-temper copper tubing with soldered or flared joints.

C. Vacuum-Breaker Piping: Outlet, same material as service where installed.

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. As detailed on drawings, install manual pressure relief assemblies to allow safer access to system components for servicing. Assemblies to be made up of tees, nipples, ball valves, and strainers with nipple and cap.

3.3 VALVE APPLICATIONS

A. As shown and detailed, and as called out in conjunction with Section 23 2216.

B. First isolation valves off of mains to be high performance, triple offset butterfly valves. Downstream from these points for isolation, non-high performance valves may be used.

3.4 PIPING INSTALLATION

A. Refer to Division 23 Section “Common Work Results for HVAC” for basic installation requirements.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Use indicated piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in mechanical rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless otherwise indicated.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve and trap servicing (minimum 14" unobstructed area around traps).

G. Install piping free of bends and sags.

H. Install fittings for changes in direction and for branch connections.

I. Install piping to allow installation of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, properly rated NPS 3/4 full port ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains an elsewhere as required for system drainage.

M. Install piping, as well as expansion loops, guides and anchors, to allow controlled movement of piping systems and components, and to minimize stresses from same.

N. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.

O. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.

P. Reduce pipe sizes using eccentric reducer fitting installed with level side down.

Q. Install branch connections to mains using tee fittings in main pipe, with the branch connected to top of main pipe, at a 45 degree angle.

R. Install properly rated unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

S. Install properly rated flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

T. Install properly rated strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and full port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blow-off connection for strainers smaller than NPS 2.

U. Strainers ahead of steam pressure regulating and control valves shall be mounted on the side and have blow-off valves.

V. Install properly rated strainers installed ahead of traps on steam main drip legs.

W. Identify piping as specified in Division 23 Section "Mechanical Systems Identification."

X. Install valved steam system warm-up assemblies as shown and as detailed.

Y. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.

1. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 150 feet.
2. Size drip legs same size as main. In steam mains NPS 6and larger, drip leg size can be reduced, but to no less than NPS 4.
3. Install dirt pockets of the drip legs and strainer blow downs with gate valves to remove dirt and scale.

Z. Comply with requirements in ***Section 23 0516 "Expansion Fittings and Loops for HVAC Piping"*** for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.

AA. Comply with requirements of Section 23 0553 "Mechanical Systems Identification" for identifying piping.

BB. Install sleeves for piping penetrations of walls, floors, and ceilings. Comply with requirements for sleeves specified in ***Section 23 0517 "Sleeves and Sleeve Seals for HVAC Piping."***

CC. Install sleeve seals for piping penetrations of concrete walls, floors, and slabs. Comply with requirements for sleeves specified in ***Section 23 0517 "Sleeves and sleeve Seals for HVAC Piping."***

DD. Install escutcheons for piping penetrations of walls, ceilings and floors. Comply with requirements for escutcheons specified in ***Section 23 0518 "Escutcheons for HVAC Piping."***

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Welded Steel Pipe:

1. All welding shall be done in accordance with the ANSI B-31.1 and the ASME welding code.
2. Pipe ends on welded pipe lines shall be suitably beveled to permit butt-welding.
3. All welds shall be of sound metal thoroughly fused to the base metal and penetrating to the bottom of the joints.
4. Use welding bends in changing pipe directions. Mitered joints will not be accepted.
5. Welders shall be experienced in the type of work to be done. Any welder, who, in the opinion of the Architect/Engineer or Construction Representative, is not competent to perform the work required, shall be dismissed from the job. At no time shall any welder not approved by the Architect/Engineer be allowed to weld pipe on the project.
6. All welders shall be certified under the procedure of the ANSI B-31.1 and the ASME Welding Code, Section 9, for the thickness and type of high pressure piping and equipment they work on. Tests shall be conducted by Hartford Insurance Co., or equivalent certifying agency. The Engineer shall be sent a copy of the certification of all welders employed on the project.

3.6 TRACER WIRE:

A. Tracer wire shall be installed on buried pipe.

B. Tracer wires shall terminate in each tunnel and manhole where new utilities penetrate. Tracer wires shall be provided with labels noting what pipe the wire is affixed to (i.e., HP Steam Supply, Pumped Condensate Return, etc.)

C. Test each pipe in the presence of the Owner to confirm that it can be traced.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install traps and control valves in accessible locations close to connected equipment.

C. Install vacuum breakers downstream from control valve, close to coil inlet connection.

D. Install bypass piping with globe valve around control valves. If parallel valves are installed, only one bypass is required.

E. Install a drip leg at coil outlet.

3.8 FIELD QUALITY CONTROL

A. Prepare steam and condensate piping according to ASME B31.1, "Power Piping" and/or ASME B31.9, "Building Services 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 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.

B. Test steam and condensate piping according to ASME B31.1, "Power Piping" and/or ASME B31.9, "Building Services Piping," as applicable, and as follows:

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. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the working 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 90 percent of specified minimum yield strength.
3. 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.

C. Prepare written report of testing.

END OF SECTION 23 2213