

DIVISION 33 - UTILITIES

SECTION 33 63 13 – UNDERGROUND STEAM AND CONDENSATE DISTRIBUTION PIPING

PART 1: GENERAL

1.01 Scope of Standard

- A. This standard provides general guidance concerning the specific preferences of Texas State University-San Marcos for Steam Distribution.
- B. Texas State University-San Marcos recognizes that project conditions and requirements vary, thus precluding the absolute adherence to the items identified herein in all cases. However, unless there is adequate written justification, it is expected that these guidelines will govern the design and specifications for Texas State University-San Marcos projects.

1.02 System Description

- A. Steam Distribution System: Steam is the primary heat source for a variety of heating functions throughout the University. Saturated steam is generated at the Co-Generation Facility and distributed via a loop piping system, which operates at 60 psig (308F). (Design conditions for piping are 135 psig and 400F. The distribution system serves all sections of Central Campus as well as West Campus.
- B. Condensate Return System: The condensate return system operates with 180oF condensate at 20 psig. Design conditions for piping are 100 psig and (212 F.).

1.03 Code Compliance and Standards:

Use current edition in effect at time of design and construction.

- A. American Society of Mechanical Engineers (ASME) - Boiler and Pressure Vessel Code.
- B. American National Standards Institute (ANSI) - B31.1 Power Piping.
- C. Expansion Joint Manufacturers Association (EJMA) – Standards.
- D. Texas Department of Transportation – Standards.

1.04 Quality Assurance

- A. All materials shall be certified new from factory. Pipe, fittings, and valves shall meet or exceed ANSI/ASME standards and be suitably stamped.
- B. Welder Qualifications: Welder(s) shall be qualified in accordance with ASME Section VIII, Pressure Vessels, ASME Section IX, Welding and Brazing
- C. Qualifications. Welders shall be thoroughly familiar with ANSI B31.1 requirements.

- D. The Contractor shall furnish to the Project Manager all applicable welding procedures and welder certification and procedure qualification records. All documentation shall be signed and dated by the appropriate Contractor personnel.

1.05 Submittals

- A. **Manufacturer's Data:** Manufacturer's standard drawings, catalog cuts, specifications, and data sheets for all materials and equipment (piping, valves, expansion joints, insulation, etc.) shall be submitted to the Project Manager for approval.
- B. **Shop Drawings:** Manufacturer's shop drawings for underground piping or conduit systems, including anchors, guides, supports, vault penetrations and trenches shall be submitted to the Project Manager for approval.
- C. **Welder's Performance Qualifications:** Welder's performance qualification records shall be submitted to the Project Manager for approval prior to beginning work.

1.06 Delivery, Storage, and Handling

- A. **Delivery and Storage:**
 - 1. Contractor shall be responsible for inspecting materials delivered to site for damage.
 - 2. Materials shall be stored on-site in enclosures or under protective coverings. Materials shall not be stored directly on ground.
 - 3. Insulation, expansion joints, joint materials, fittings, valves, and gaskets shall be stored under cover out of direct sunlight.
- B. **Handling:**
 - 1. Pipe, conduit sections, fittings, valves and other accessories shall be handled in such a manner as to ensure delivery to the trench in sound, undamaged condition.
 - 2. Special care shall be taken to avoid injury to coatings and linings on pipe and fittings. Damaged coatings and linings shall be repaired by the Contractor to the satisfaction of the Project Manager.

PART 2: PRODUCTS

2.01 Pipe and Fittings.

- A. **Pipe:**
 - 1. ASTM A-106 (seamless), Grade B, black carbon steel.
 - 2. Condensate lines: all sizes to be Schedule 80.
 - 3. Steam lines:
 - a. 2 inch and smaller: Schedule 80,

- b. 2.5 inch through 10 inch: Schedule 40,
- c. 12 inch through 14-inch, 0.375-inch wall,

B. Fittings:

1. Threaded or socket weld (2 inches and smaller): ANSI B16.11 forged carbon steel, ASTM A105, 2000# class.
2. Butt-Welded (2.5 inch and larger): ANSI B16.9, ASTM A234 WPB, schedule to match pipe.
3. Flanged (2.5 inch and larger): ANSI B16.5, ASTM A105 forged steel, 150 or 300 pound class, weld-neck flanges shall be used to match equipment.
4. Unions (2 inches and smaller): ANSI B16.11 forged carbon steel, 800 # class.
5. Dielectric flange sets shall be rated for the service intended.
6. All buried pipe fittings shall be butt welded for all sizes.

2.02 Valves.

- A. General: Valves shall be threaded for 2 inch and smaller piping, flanged for 2.5 inch and larger. Socket weld or butt weld valves shall only be used if specified on the Contract Drawings. Acceptable valve manufacturers for steam or condensate service are provided below, no substitutions unless approved by the Project Manager.

1. No cast iron due to vulnerability to fracture from water hammer.

B. Gate Valves:

1. Threaded (2 inch and smaller): ANSI B16.34, 800 pound class, forged steel, bolted bonnet, conventional port gate valve Walworth, Vogt, Crane, or Edwards.
2. Flanged (2.5 inch and larger): ANSI B16.34, 150 pound class, A216 WCB cast steel body, bolted bonnet, stainless steel trim; Walworth, Crane, Velan or Stockham.
3. Butt weld (2.5 inch and larger): ANSI B16.34, 150 pound class, A216 WCB cast steel body, bolted bonnet, stainless steel trim, Walworth, Crane, Velan or Stockham.
4. Warm up lines: All gate valves 4 inches and larger shall have bypass lines with appropriately sized warm up valves.

C. Globe Valves:

1. Threaded (2 inch and smaller): ANSI B16.34, 800 pound class, forged steel body, stainless steel seat ring and plug, bolted bonnet, rising steam; Walworth, Vogt, or Edwards.
2. Flanged (2.5 inch and larger): ANSI B16.34, 150 pound class, A216 WCB cast steel body, stainless steel trim, Walworth, Crane, or Stockham.

D. Ball Valves:

1. Threaded (2 inches and smaller): 150-pound class, steam-rated, cast steel/stainless steel, Nibco or Walworth.
- E. Check Valves (condensate systems only):
1. Threaded (for steam trap discharge): 800 pound class, forged steel, stainless steel disc, swing check, Vogt, Edwards, or Walworth.
 2. Flanged (2.5 inch and larger): ANSI B16.34, 150 pound class, A216 WCB cast steel body, bolted flange cover, swing check; Walworth or Stockham.
 3. Vertical lift check valves: threaded, 150/200-pound class, for steam powered condensate pump, Stockham, United, Walworth. F. Rotary Valves: 1. 150-pound class, carbon steel, flanged, Adams or Keystone Vanessa.

2.03 Piping Specialties

- A. Gaskets: Non-asbestos containing Mica Graphite Spiral Wound to be used with Standard ASME B 16.5 flanges, suitable for the fluids and temperatures encountered.
- B. Bolting: ASTM A193, Grade B7, for bolts and studs, and ASTM A194, Grade 2H for nuts.
- C. Sleeves: Sleeves for foundation wall penetrations shall be fabricated of one-eighth inch (1/8") thick steel, with two inch (2") wide collar welded in place, and the assembly hot-dip galvanized.
- D. Wall Penetration Seals: High temperature elastomeric link type mechanical seals compressed with corrosion-protected bolts and compression plates, Thunderline Link-Seal, no substitution.
- E. Expansion Joints:
1. Expansion joints shall be slip tube type or externally pressurized bellows type as designed for the specific location. They shall be 150-psig steam rating, flanged, and shall conform to the Standards of the Expansion Joint Manufacturers Association.
 2. Bellows type joints shall have 316 ss bellows, and may be single or double bellows style as required for the intended service: Hyspan, Pathway or Senior Flexonics.
 3. Slip-tube type shall have external and internal high performance guides rated for 500oF and designed for packing under pressure, Yarway or Hyspan.
 4. Slip-tube joints shall be single or double type with center take-off taps as required for the given service.
- F. Steam Traps for main line or building- Install test valve downstream of trap and before check valve. Armstrong, Spirex Sarco, or Hoffman.
- G. Automatic Air Vents (for high points on condensate systems): 3/4 inch thread-o-let with 3/4 inch gate isolation valve is required upstream of air vent. Air vent shall be 3/4 inch 150 # rating, Sarco 13W or approved equal. Discharge of condensate air vents in vaults shall be routed to the floor.
- H. Strainers (for use on steam trap stations): Y-type with cast or forged steel body, 1/16 inch mesh monel strainer elements, threaded for 2 inch and smaller piping; C.M. Bailey or Spirax Sarco IT.

- I. Pipe Hangers and Supports: Pipe hangers and supports shall be designed, and located per the requirements of B31.1 and the recommendations of the powder insulation or prefabricated conduit system vendor.
- J. Pressure gauges: 4.5 inch dial, bourdon tube, 0 to 200 psig on steam mains, 0 to 50 psig on condensate mains, Ashcroft. Include isolation valve and pigtail coil on steam gauges.
- K. No vents on steam side.
- L. Insulation:
 - 1. In manholes, pipe 2.5 inch and greater shall be insulated with ASTM C533, Type I, calcium silicate; 2.5 to 6 inch steam (3 inches thick), 8 to 12 inch steam (4 inches thick), 2.5 to 6 inch condensate (2 inches thick).
 - 2. In manholes, tunnels, and exterior installations: pipe and fitting insulation shall be covered with 0.016-inch smooth aluminum jackets with integral moisture barrier. Stainless steel band on 12-inch center shall hold the insulation to the pipe.
 - 3. Valves and equipment shall be insulated with removable shop-fabricated fiberglass padding rated for 500oF, with thin wire mesh lining, and covered with 18 ounce high-temperature fiberglass cloth with Velcro straps.

2.04 Manholes

- A. General:
 - 1. All structures shall be of reinforced concrete. Main line junctions and service connections shall be in vaults, which require two openings. Minor assemblies such as drip legs, can be in pits, which require only one opening.
 - 2. Prefabricated or field-constructed manholes shall be provided with walls, floors, and roofs not less than 8 inches thick and reinforced with steel bars. Floors shall drain to sump hole.
 - 3. Prefabricated concrete manholes shall conform to TX Dot Standard Specifications.
 - 4. Concrete shall be 2500 psi minimum compressive strength after twenty-eight (28) days, for both prefabricated and field-constructed manholes.
 - 5. Waterproofing shall be provided according to TX Dot Standard Specifications.
 - 6. Ladders shall be provided according to TX Dot Standard Specifications. Covers and openings shall be vehicular traffic rated (H-20). One minimum 40 inch solid lid and marked STEAM.

2.05 Buried Conduit Systems

- A. The condensate return piping shall not be in the same conduit as the steam piping.
- B. Steel or Corrugated Steel Casing to meet engineers' specs. Fiberglass Conduit Casing: No fiberglass casing shall be used.

- C. Conduit End Seals: Conduit end seals shall be fixed type where there is no thermal pipe expansion through the end seal, and shall be slip type where there is thermal pipe expansion through the end seal. One-half inch (1/2") threaded pipe ports at top and bottom of each end seal shall be provided for draining, venting, and pressure testing of conduit casings.
- D. Insulation: ASTM C533, Type I, calcium silicate, mineral fiber, or C552 cellular glass three inch (3") for steam, and two inch (2") for condensate shall be used on the steel pipe within the casing.
- E. Expansion Loops and L-Bends:
 - 1. ANSI B31.1, factory fabricated, with weld testing per design. Casing, couplings, insulation, and piping shall be identical to those used for straight runs and designed to ensure complete drainage. Fabricated materials shall be shipped to the job site in maximum feasible size sections to minimize number of field joints.
 - 2. Loop casings shall be sized to contain pipe movement without crushing the insulation or causing other damage. Eccentric reducers and increasers or welding collars designed to serve the same purpose shall be used to allow free drainage through the loop.
 - 3. Pipe supports shall be slotted to permit unrestricted lateral movement of piping, and shall be otherwise identical to pipe supports specified for straight runs.
- F. Pipe Supports: Anchors shall be located outside vaults. Inside vaults, vent and drain holes shall be provided at the top and bottom of casing closure plates.

PART 3: EXECUTION

3.01 Trenching, Backfilling, and Compacting

- A. Refer to Excavation and Fill Standards
- B. Trenching: Stanford may limit the amount of trench to be opened at any time.
- C. Bedding:
 - 1. Pre-insulated conduit systems: Ditch bedding shall be accurately graded with a minimum of six inches (6") of sand. Sand shall pass a ¼-inch screen with not more than fifteen percent (15%) passing a No.200 sieve. Sand shall be backfilled to a minimum of six inches (6") above the pipe casing. Bedding shall be laid to firmly support the piping along its entire length.
 - 2. Steel pipe and powder insulation system: The steel pipes shall be top hung or bottom supported to allow a bedding of powder insulation underneath (in accordance with manufacturer's specifications). The powder insulation shall be placed to the minimum thickness shown on the Contract Drawings. The insulation shall be installed and compacted (per the manufacturer specifications) to firmly support the piping along its entire length.
- D. Backfilling: Backfilling of trenches shall progress as rapidly as construction, testing, and acceptance of work permits.

- E. Damage Repair: Utilities, walls, piping, and other improvements damaged during the course of work shall be repaired to their original condition or replaced by the Contractor.
- F. Excess Material: Excess material and debris shall be removed and disposed of, at an approved disposal site, within one week after final approval of installation.

3.02 Piping Installation

A. General:

1. Piping and pipe systems shall be fabricated, assembled, welded, installed and tested in accordance with ANSI B31.1.
2. Piping shall be cut accurately to field measurements and worked into place without springing or forcing, except where cold-springing is specified. Piping shall not be buried, concealed, or insulated until it has been inspected, tested, and approved in accordance with Article 3.07, Field Quality Control (below).
3. Materials and equipment shall be protected from the weather during construction.
4. Pipe runs underground between vaults shall be welded. Flanged and threaded joints shall not be buried.
5. Gaskets, packing, and thread compounds shall be suitable for the service. Joint compound or thread tape shall be applied to male threads only.
6. Arrangement of all piping shall be shown on the drawings. During installation, care shall be taken to avoid interference with other piping, conduit, and equipment. Lines shall be trapped only where shown on the drawings.
7. Reducing fittings shall be used for changes in pipe sizes. Bushings shall not be used.
8. In horizontal lines two inches (2") and larger, reducing fittings of the eccentric type shall be used to maintain the bottoms of the lines in the same plane for steam, and the tops of the lines in the same plane for condensate.
9. Pipe shall be adequately supported and anchored so that strain from weight and thermal movement of piping is not imposed on piping, equipment, or structures.

B. Cleaning:

1. Each section of pipe, fittings, and valves shall be thoroughly cleaned free of all foreign matter before erection. Interior of piping shall be cleaned thoroughly as described in Article 3.07 (below) before final connections are made.
2. Open ends of mains shall be plugged or capped during shutdown periods. Lines shall not be left open at any place where foreign matter might accidentally enter pipe.

- C. Pipe Expansion: Expansion of pipes shall be accommodated by expansion loops, L-bends, Z-bends in buried locations, or by slip or bellows expansion joints in manholes, tunnels and

buildings. Expansion joints shall be set to ensure proper function and movement during system operation.

- D. Connections: Locations of capped or plugged outlets for future connections shall be shown on the Drawings. Weld-o-lets or welding fittings shall be used for tapping existing systems.
- E. Steam Line Drainage: Steam lines shall be pitched according to engineering specifications to allow for condensate drainage to the low point steam pots. For steam pipes in tunnels sloped down in the direction of steam flow, a minimum of three inches per one-hundred feet (3" per 100') of length is required. Where counter flow of condensate must be accommodated in steam tunnels, lines shall be pitched up in the direction of steam flow six inches per one hundred (6" per 100') feet of length. Buried steam lines shall be pitched according to engineering specifications to accommodate the worst case of 6" per 100 feet. Steam lines may be peaked with lines pitched as above. Final pipe elevations must be recorded on the as-built drawings.
- F. Welding:
 - 1. Responsibilities of Contractor for Electric Fusion Welding:
 - a. Contractor shall be responsible for the quality of all welding.
 - b. Contractor shall be capable of performing all welding operations required for construction of the steam distribution and condensate return systems.
 - c. Contractor shall determine the suitability of welding procedures used to ensure that welds meet the requirements specified herein.
 - 2. Beveling: Field bevels and shop bevels shall be done by mechanical means or by flame cutting. Where beveling is done after flame cutting, surfaces shall be ground and thoroughly cleaned of scale and oxidation just prior to welding. Beveling shall conform to ANSI standards.
 - 3. Butt welds: All butt welds shall be open root, multi-pass welds, 6010 or 6011 root with 6010 filler caps (SMAW welding process).
 - 4. Electrodes shall be stored in a dry, warm area and kept free of moisture during fabrication operations. Electrodes that have lost part of their coatings shall be discarded.
 - 5. Welds shall be inspected in accordance with ANSI B31.1 requirements.
 - 6. If any welds are found to be defective, the Contractor is responsible for full 100% testing of all the welds. Repair of defective welds by adding weld material over the defect, or by peening shall not be permitted. Welders responsible for defective welds shall be re-qualified before performing more welding on the job.
- G. Anchor Blocks:
 - 1. Anchor Blocks: Concrete anchor blocks shall be provided for pipe anchorage not less than five feet (5') from building or manhole walls (except where metal anchor at the vault wall is shown on the Contract Drawings). Size and position of anchor blocks shall be as shown on Standard Drawings. Anchor blocks shall be cast against undisturbed earth using concrete

- that conforms to ASTM C-94 and has a minimum compressive strength of 2,500 psi at twenty-eight (28) days.
2. Fabricated Structural Anchors: Fabricated structural anchors shall be provided if necessary in vaults, tunnels, and mechanical rooms as described in the Contract Drawings.
- H. Wall Penetrations: Galvanized steel sleeves shall be provided for penetrations in concrete walls six inches (6") or less in thickness, and masonry walls. Existing concrete walls thicker than six inches (6") shall be core drilled or equipped with galvanized steel sleeves. High temperature elastomeric link type seals shall be acceptable for use in all locations.
- I. Insulation and Jackets:
1. Insulation shall be continuous through pipe hangers with calcium silicate inserts to prevent crushing of insulation.
 2. Steam and condensate valves and equipment in manholes and buildings shall be insulated and covered with removable jackets. Insulation shall stop short of bolts/studs at flanges to allow their removal without damage of permanent insulation.
 3. Trap sections between unions in steam trap manifolds shall not be insulated.
 4. No exposed insulation will be permitted. Aluminum or PVC end caps that match the insulation jackets shall be used to cover the ends of insulation runs.
 5. Steam and condensate lines in manholes, tunnels, and buildings shall be color coded as follows, or as otherwise directed by the Project Manager:
High-pressure steam - RED (darker shade)
Reduced pressure steam - RED (lighter shade)

Condensate Return (building) - Orange (lighter shade)
Condensate Return (steam system traps) - Orange (darker shade)

3.03 Valve Installation

- A. Valves shall be installed in accordance with ANSI B31.1 and ASME Section VIII.
- B. Valves shall be installed as shown on the drawings and as required for proper functioning of the system.
- C. Valve hand wheels shall be installed in locations accessible from floor level, preferably with vertical stems, for operation and repair.
- D. All flange bolts shall be lubricated with a high temperature bolt lubricant approved by the Project Manager. Flanged bolt torque shall be in an incremental staggered pattern to assure even compression of the gasket.

3.04 Piping Specialties Installation

- A. Traps and Manifolds: Steam drip and mud legs, guard and blow down valves, and piping shall be as shown on Standard Drawing. Traps stations shall be installed at all mud legs unless otherwise

indicated on the drawings. Multiple trap manifolds at one location shall be in the same horizontal plane.

B. Hangers and Supports:

1. Hangers shall be sized to allow for continuous pipe insulation through the hangers. Hangers shall not be permitted to touch steam pipe.
2. Expansion bolts shall be acceptable for use in wall or ceiling construction.

3.05 Buried Conduit Installation

A. Conduit Field Joints:

1. Conduit sections shall be joined after leak testing of carrier pipe. Conduit joining materials provided or specified by the system manufacturer shall be used.
2. Pipe shall be insulated and casing joined to provide field joint equal to factory-fabricated section on conduit system. Connections to existing conduit systems of a different manufacturer or type shall be made only in manholes or buildings and never in buried locations.

- B. Conduit End Seals: Conduit end seals in manholes or tunnels shall be provided with gooseneck vents on the top and drain valves on the bottom. In buildings, conduit end seals shall be provided with threaded brass plugs.

3.06 Field Quality Control

- A. General: The Project Manager or his representative will conduct field inspections and shall witness all field tests specified in this Section. The Contractor shall perform field tests and provide labor, equipment, and incidentals required for testing. The Contractor shall produce evidence, when required by the Project Manager, that any item of work has been constructed properly in accordance with the Contract Drawings and Specifications.

B. Field Tests:

1. General: All anchor blocks and restraints shall be complete prior to testing. Concrete supports shall be fully cured.
2. Piping Initial Air Leak Tests: Before insulation is applied at field joints, piping shall be pressurized to twenty-five (25) psig air pressure and tested for leaks with soap solution. Leaks shall be repaired and test repeated.
3. Piping Hydrostatic Pressure Tests:
 - a. Test pressure gauges for a specific test shall have dials indicating not less than one and one-half (1-1/2) times nor more than two (2) times the test pressure.
 - b. After installation of insulation, anchor blocks, and backfill, hydrostatic pressure shall be applied to 100 psig and allowed to stabilize to ground temperature while maintaining 100 psig, +/- 10 psi. After stabilization, pressure source shall be removed. Piping must

hold 100 psig, +/- 10 psi, for at least two (2) hours. Leaks shall be repaired and the test repeated if the pressure does not hold.

4. Conduit Casing Pressure Tests: Before backfilling, conduit casing shall be pressurized to fifteen- (15) psig air pressure and allowed to stabilize. After stabilization the pressure source shall be removed. Casing must hold fifteen- (15) psig air pressure, +/- 2 psi, for at least one (1) hours. Pressure test shall be repeated after backfilling. Leaks shall be repaired and the test repeated if the pressure does not hold.
5. Cleaning: After pressure and hydrostatic testing, the pipe system shall be flushed with Steam/Condensate. The Project Manager shall approve the procedure, cleaning solutions, and disposal.
6. Operational Tests: After completion of the work, the system shall be operated for not less than six (6) hours at operational temperatures and pressures to demonstrate satisfactory function. The movement of each expansion joint shall be checked, and each valve shall be operated in both cold and hot conditions.

END OF SECTION 33 63 13