

## **230620S03 Underground and Direct Buried Steam and Condensate Piping**

### **1. GENERAL**

1. Piping shall be new, full weight, and of sizes shown on the drawings. Ends of piping shall be reamed, and where applicable, all threads shall be sharp and true.
2. Piping shall be installed at the locations shown on the construction drawings, properly graded and secured to insure noiseless circulation throughout the system. Supply and Return piping shall be properly erected to prevent the formation of air and water pockets. Any location that tends to trap air or hold water shall have automatic air vents installed at the high points, and manual drain valves installed at the low points. Any location on a steam line that holds water shall have a properly installed dirt leg and steam trap.
3. DIRECT BURY STEAM LINES ARE NOT ALLOWED, unless space constraints eliminate possibility of a tunnel. Consultant should contact the Utilities & Energy Management, Utility Systems Manager to get approval for direct buried piping.

### **2. UNDERGROUND STEAM PIPING**

All underground steam piping should be installed in concrete tunnels, supported by guides, slides, and/or roller hangers, spaced every 10 feet. Tunnels are to be designed to stay dry at all times. Tunnels are to be ventilated with thermostatically controlled fans, with concrete intake and exhaust piping, to keep tunnel temperatures under 85 degrees F and above 40 degrees F. Design of guides, anchors, and piping supports, shall insure that the thermal expansion of piping is in the axial direction. Thermal expansion of the piping must be adequately compensated with conservatively designed expansion compensators rated for twice the anticipated travel. Piping during heat-up and cool-down shall stay centered on rollers, centered through guides, and centered through expansion compensators. Design should take every effort to insure that the piping grows and shrinks without binding through compensators or support systems, and that sufficient anchoring is provided to withstand a hydrostatic test pressure of 450 psig. All steam pipe, fittings, equipment, expansion compensators, etc. must be rated for 300 psig steam working pressure, at a temperature of 500 degree F. All valves, flanges, expansion joints, steam trap lines, drains, vents, etc, must be accessible, by adequately sized manholes and steam pits. Access for maintenance must be provided for all expansion compensators, flanges, and threaded fittings on the steam piping, and this access must not require any excavation. All steam piping to be insulated with mineral wool piping insulation installed to recommended thicknesses, and covered with a protective aluminum jacket.

### **3. UNDERGROUND STEAM CONDENSATE RETURN PIPING**

All underground steam condensate should be installed in concrete tunnels, supported by guides, slides, or roller hangers, spaced every 10 feet. Tunnel must be designed to stay dry at all times and be adequately ventilated. Design of guides, anchors, and piping supports, shall insure that all thermal expansion of piping is in the axial direction. Thermal expansion of the piping must be adequately compensated with conservatively designed expansion compensators rated for twice the anticipated travel. Piping during heat up and cool down shall stay centered on rollers, centered through guides, and centered through expansion compensators. Design should take every effort to insure that the piping grows and shrinks without binding through compensators, support systems or anchors. Adequate space in tunnel must be provided to access and maintain expansion compensators, flanges, and/or threaded fittings, and this access must not require any excavation. All steam condensate return piping shall be Perma-Pipe Poly-Therm pre-insulated piping or equal, consisting of a Schedule 80, seamless, Grade B, A106, black steel carrier pipe, with a spray

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applied 1" of layer polyurethane foam insulation, and jacketed with a filament wound polyester resin/fiberglass reinforcement composite (FRP) directly applied on the insulating foam.

### 4. DIRECT BURIED STEAM PIPING (IF APPROVED)

Direct bury underground steam piping shall be Perma-Pipe Multitherm 500 or equal, pre-insulated piping systems, consisting of an extra strong class, black steel carrier pipe, insulated with Pyrogel® XT-E insulation, contained within a drainable, dryable, pressure tested, Class A, 10 gauge (minimum) steel conduit. All carrier and steel conduit sections are to be welded, no threaded piping allowed in direct bury applications. The conduit is also to be insulated with a 1" layer of polyurethane foam and jacketed with fiberglass (FRP). The fiberglass is to be applied to the urethane foam with a multidirectional filament winding process to eliminate voids and to produce a high strength, high temperature fiberglass jacket, to insure maximum corrosion protection and strength.

CARRIER PIPE THICKNESS (A106, Grade B seamless steel piping)				
PIPE SIZE	WALL THICKNESS	PYROGEL INSULATION THICKNESS	CONDUIT SIZE	GAUGE
2"	.218" sch. 80	.79"	6-5/8"	10
4"	.337" sch. 80	1.1"	8-5/8"	10
6"	.432" sch. 80	1.3"	12-3/4"	10
8"	.500" sch. 80	1.5"	14"	10
10"	.500" sch. 60	1.5"	16"	10
12"	.500"	1.7"	18"	10
14"	.500"	1.7"	20"	10
16"	.500" sch. 40	1.7"	22"	10
18"	.500"	1.9"	24"	10
20"	.500" sch. 30	1.9"	26"	10

Note: Expansion loops and fittings to have oversized conduit and special spacer supports, which allow for movement of the pipe without damaging the piping insulation.

Pipe supports: The service piping within the outer steel conduit is to be supported with spacer support assemblies at no more than 10 foot intervals. These supports are to be designed to allow continuous airflow and drainage of the conduit in place.

The straight supports shall be designed to occupy less than 10% of the annular air space.

Supports shall be of the type where insulation thermally isolates the carrier pipe from the outer conduit. The surface of the insulation shall be protected at the support by a sleeve not less than 12" long, fitted with traverse and rotational arresters.

Service pipe insulation: shall be Pyrogel® XT-E. Split insulation shall be held in place by stainless steel bands and clips installed not more than 18" apart. Insulation shall have passed the boiling test requirements specified in the Federal Agency Guidelines for Class A systems.

Outer Conduit Insulation and Jacket: Conduit insulation shall be spray applied polyurethane foam, having a nominal 2 lb/ft<sup>3</sup> density for all straight lengths and fittings. The insulation thickness shall

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be 1". Factory Quality assurance procedures for the insulation shall include X-ray, infrared, and/or visual checks prior to jacketing of the entire length of the piping to insure that there are no insulation voids. The urethane foam shall have the minimum characteristics of 0.16 K-Factor, density of 2 lb/ft<sup>3</sup> and a closed cell content of 90 to 95%. The outer jacket shall be fiberglass (FRP) and shall be applied directly onto the urethane foam insulation. No PVC or Polyethylene jackets shall be allowed. All straights and fittings shall be factory jacketed.

Installation: The installing contractor shall handle the system in accordance with the directions furnished by the manufacturer and as approved by the Architect or Engineer. The casing shall be air tested to 15 psig, and service pipe shall be hydrostatically tested to 450 psig. The test pressure shall be held without a pressure drop for not less than one hour.

Backfill: A 4" layer of sand shall be placed and tamped in the trench to provide a uniform bedding for the piping system. After the piping is installed, the entire trench shall be evenly backfilled with sand in 6" compacted layers to a minimum height of 6" above the top of the insulated piping system. The remaining trench shall be evenly and continuously backfilled in uniform layers with suitable excavated soil to finished grade level.

### 5. DIRECT BURIED STEAM CONDENSATE PIPING (IF APPROVED)

All underground steam condensate return piping shall be Perma-Pipe Poly-Therm pre-insulated piping or equal, consisting of a Schedule 80, seamless, Grade B, A106, black steel carrier pipe, with a spray applied 1" of layer polyurethane foam insulation, and jacketed with a filament wound polyester resin/fiberglass reinforcement composite (FRP) directly applied on the insulating foam. Thermoplastic casing material, e.g., PVC or Polyethylene jacketing shall not be allowed. The minimum thickness for the FRP jacket shall be 0.55" inches. Field joints are to be installed according to the manufacturer's recommendation and procedures. No underground condensate return piping shall have an internal diameter of less than 2". All underground steam condensate piping is to be welded at each joint.

#### Polyurethane Foam Insulation Thicknesses

2" thru 6"	-	1" thick
8" and above	-	1 ½" thick

Testing: Steam condensate return piping shall be hydrostatically tested to 200 psig, with no leaks for a one hour period.

Backfill: A 4" layer of sand shall be placed and tamped in the trench to provide a uniform bedding for the piping system. After the piping is installed, the entire trench shall be evenly backfilled with sand in 6" compacted layers to a minimum height of 6" above the top of the insulated piping system. The remaining trench shall be evenly and continuously backfilled in uniform layers with suitable excavated soil to finished grade level.