

CONSTRUCTION STANDARD SPECIFICATION

SECTION 02558

**PRE-INSULATED UNDERGROUND PIPE FOR STEAM
AND CONDENSATE SERVICE**

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CONSTRUCION STANDARD SPECIFICATION

SECTION 02558

PRE-INSULATED UNDERGROUND PIPE FOR STEAM AND CONDENSATE SERVICE

PART 1 – GENERAL

1.01 SUMMARY

Underground steam and condensate distribution systems including steam, steam trenches, and pre-engineered systems.

1.02 DEFINITIONS

The following definitions are applicable:

- A. **Systems:** A complete underground heat distribution system with total manufactured components including all required components such as carrier piping, steel conduit, insulation, loops, ells, tees, end seals, gland seals, anchors, valves, manholes, cathodic protection (if required), and other appurtenances as specified herein and as recommended by the manufacturer.
- B. **Project Drawings:** The project drawings associated with this specification provide information on:
 - 1. the size of carrier pipes, length, and site location of the system;
 - 2. the elevation of the piping along the path;
 - 3. location of manholes and valve boxes;
 - 4. the obstacles that must be avoided along the path;
 - 5. type of system required – (i.e. multi-therm 500 or poly-therm)
 - 6. other pertinent general information as noted.
- C. **Construction Complete:** The point at which the Project Team determines the requirements of the Construction Phase including the construction contract are fulfilled. This includes the resolution of any open items.

Project Complete: The point at which the Project Team determines that all project activities are completed, closed, and/or approved for normal operations.

1.03 QUALITY ASSURANCE

- A. Contractor shall provide a complete installation with all necessary specialties, materials and equipment fully and properly connected and coordinated. Installation shall be fully operational upon completion of work defined and as phased.
- B. Apply and install materials, equipment and specialties in accordance with manufacturer's instructions. Printed instructions shall be made available by the Contractor at the site during construction.
- C. Materials and workmanship shall conform to applicable local codes, American National Standards Institute, Power Piping Code, publications of the Manufacturers Standardization Society, American Welding Society, National Association of Corrosion Engineers, Federal Specifications, American Society of Testing Materials, current safety standards, all as defined in the section of this specification relating to Applicable Publications.

1.04 SUBMITTALS

Also refer to Section 01330, "Submittal Procedures" for submittal data.

- A. Submittals shall be in the form of descriptive literature, shop drawings, diagrams and catalog cuts, which shall include the manufacturer's name, trade name, catalog model or number, name plate data, size location, layout dimensions, capacity, pressure rating, specification reference' and all other information which will assist in evaluating the materials and equipment for compliance with the plans, specifications and purpose intended.
- B. All items listed under each group shall be submitted simultaneously.
- C. Group I Pre-Engineered Systems:
 - 2.02 The contractor shall, within 30 days after the date of award of the contract, submit 6 copies of the following documents to the Sandia Delegated Representative (SDR) for approval prior to commencing any work:
 - a. A detailed design layout of the system showing the size, type, and location of each component to be used in the system, including (if applicable) the transition point designed to aboveground or other type systems.
- D. Group II Expose Piping (In Manholes):
 - 1. Materials:
 - a. Piping: Shall conform with ANSI B31.1-73 and shall also be as follows:

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- 1) 2" and larger: Shall be schedule 40, black steel, seamless, beveled end, per ASTM A53-GRADE A or equivalent.
- 2) 1-1/2" and smaller: Shall be schedule 40, black steel, seamless, plain end, per ASTM A53-GRADE A or equivalent.

b. Fittings: Shall conform with ANSI B31.1-73, and shall be as follows:

- 1) Flanges 2" and larger: Shall conform to ANSI B16.5-71 for 150
- 2) Pound rated, steel, GRADE I flanges.
- 3) Flanges 1-1/2" and smaller: Shall conform to ANSI B16.5-71 for
- 4) For 150 Pound rated, steel, GRADE I flanges with threads conforming to ANSI B2.1-68.
- 5) Fittings 2" and larger: Shall conform to ANSI B16.9-71 for
- 6) Schedule 40, wrought steel butt-weld fittings.
- 7) Fittings 1-1/2" and smaller: Shall conform to ANSI B16.3-71 for
- 8) 300 pound malleable-iron screwed fittings or 2000 pound forged
- 9) steel socket weld, ANSI B16.11-66.
- 10) Gaskets: Shall be made of 1/16 inch thick compressed asbestos,
- 11) And shall be Flexitallic, Style CG.
- 12) Bolts and Nuts: Bolts shall conform to ASTM A193-71, GRADE
- 13) B7, and nuts shall conform to ASTM A194-72 CLASS 2H.

2. Insulation in Manholes:

a. Insulation for all pipes, valves, and fittings shall be moulded type Fiberglass (mineral wool) pipe insulation having a factory applied 0.016 inch thick embossed aluminum jacketing. The insulation shall have a minimum density rating of 7 pounds per cubic foot, a thermal conductivity (k) of 0.30 at 200 F mean temperature, a temperature rating of 400 F, and shall conform with the other requirements of ASTM C547, and shall be OWENS-CORNING Fiberglass. The thickness of the insulation shall be as follows:

<u>Pipe Size</u>	<u>Insulation Thickness</u>
3 inch and smaller	1-1/2 inches
4 inch and larger	2 inches

When necessary use a moulding cement by Owens-Corning. The installed moulding cement shall be finished with two coats of aluminum colored weather resistant mastic such as Foster 60-65, or approved equal, reinforced with open weave glass fabric.

b. Excluding unions and expansion joints, all pipe, valves, fittings and Flanges in the steam and condensate lines shall be insulated. All threaded valves, unions, traps, strainers, flash tanks, and finned tubes in the manhole condensate drainage system shall not be insulated. insulation shall be applied with the longitudinal lock seam of the metal jacket in the four o'clock position on the pipe to shed water. Butt joints shall be sealed with factory furnished joint scaling strips with integral mastic and secured in place with 1/2 inch aluminum bands tightened to insure weather seal. When pipe hangers or supports occur on exterior of aluminum jacket, a 22 gauge galvanized iron sleeve shall be installed between the aluminum jackets and pipe hangers.

- E. Group IV Pipe Trenches:
 - 1. Trench plans, profiles, sections and details.
 - 2. Pipe and fittings (concealed in trenches).
 - 3. Pipe anchors, supports. Pipe insulation, jackets and wrapping materials.

1.05 PROJECT CONDITIONS:

- A. Phasing of demolition and construction shall be in accordance with the provisions of the Specifications Section 15050, "General Material & Work Requirements, and as indicated on drawings.
- B. Interruption of Existing Service: Arrange, phase and perform work and provide temporary facilities, materials, equipment, and connections to utilities, to assure adequate steam and condensate return service for existing installations at all times. Only such absolutely necessary interruptions as may be required for making connections will be permitted, and only at such times when approval is obtained from SDR. See drawing for additional information.

PART 2 – PRODUCTS

2.01 MATERIALS AND MANUFACTURED PRODUCTS:

- A. All items to be installed must have approval of the SDR prior to installation. SDR has the right to reject any item which is not in compliance with contract requirements.
- B. Manufactured Products: Manufactured products incorporated shall meet following conditions:
 - 1. When two or more units of equipment serve same function, they shall be products of on manufacturer.
 - 2. Manufacturers of equipment assemblies which include components made by others shall assume complete responsibility for final assembled unit.
 - a. All components of an assembled unit need not be products of same manufacturer.
 - b. Constituent parts which are alike shall be products of a single manufacturer.

- c. Components shall be compatible with each other and with the total assembly for intended service.
- C. **Manufacturer's Identification:** Components of equipment shall bear manufacturer's name or trademark and model number on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

2.02 PRE-ENGINEERED SYSTEMS:

- A. **Steam System Requirements:** The system provided shall be approved for Class A groundwater conditions, an operating temperature of 350 degrees F for steam system, 250 degrees F for condensate system and mildly corrosive soil conditions. Design the system for steam and condensate service.
- B. **Valves, Pressure Gages, Steam Traps, Strainers, Ball Joints:** These items must conform to the specifications. Do not furnish these items as part of the "Pre-Engineered Systems".

2.03 STEAM SUPPLY AND CONDENSATE RETURN PIPE AND FITTINGS:

- A. **General:**
 - 1. All underground steam shall be multi-therm 500 and all underground condensate shall be poly-therm as manufactured by Perma-Pipe, Inc. or equivalent. The system supplier shall have fabricated systems of the composition defined herein for at least three years. All straight sections, fittings, anchors and other accessories shall be factory prefabricated to job dimensions and designed to minimize the number of field welds. Each system layout shall be computer analyzed by the piping system manufacturer to determine stresses on the carrier pipe and anticipated thermal movement on the service pipe. The system design shall be in strict conformance with ANSI B31.1, latest edition. Factory trained field technical assistance shall be provided for the critical periods of installation; i.e., unloading, field joint instruction and testing.
- B. **Service Piping:**
 - 1. Internal piping shall be standard weight Schedule 40 carbon steel except for condensate piping which shall be Schedule 80 carbon steel. All joints shall be butt welded for sizes 2-1/2 inches and greater, and socket welded for 2 inches and below. Where possible, straight sections shall be supplied in 40-foot nominal length with 6 inches of piping exposed at each end for field joint fabrication. Steel Pipe: ASTM A53 Grade B or A106 Grade B.

C. Sub-Assemblies:

1. Steam Piping: End seals, gland seals and anchors shall be designed and factory prefabricated to prevent the ingress of moisture into the system. All subassemblies shall be designed to allow for complete draining and drying of the conduit system.
2. Condensate Piping: End seals and anchors shall be designed and factory prefabricated to prevent the ingress of moisture into the system.

D. Insulation:

1. Steam Piping: Carrier pipe insulation shall be calcium silicate or mineral wool. Split insulation shall be held in place by stainless steel bands installed on 18 inch centers. The insulation shall be passed the most recent boiling test and other requirements specified in the Federal Agency Guidelines Specification
2. Condensate Piping: Carrier pipe insulation shall be 2 pound per cubic foot density polyurethane foam for straight sections and preformed polyurethane form for all fittings.
3. Steam and Condensate Piping: Minimum insulation thickness shall be:

<u>Pipe Size (in.)</u>	<u>Insulation Thickness (in.)</u>
Up to 1	1
1 1/2 – 3	1.5
4 – 6	2
8 – 14	2.5
16 – up	3

E. Steel Conduit:

1. Steam Piping: The steel conduit casing shall be smooth wall, welded steel conduit of the thicknesses specified below:

<u>Conduit Size</u>	<u>Conduit Thickness</u>
Up to – 26"	10 Gauge
28" – 36"	6 Gauge
38" – 42"	4 Gauge

Changes in casing size, as required at oversized casing to allow for carrier pipe expansion, shall be accomplished by eccentric and concentric fittings and shall provide for continuous drainage.

2. Condensed Piping: does not apply.

F. Pipe Supports:

1. Steam Piping: All pipes shall be supported at not more than 10 foot intervals. These supports shall be designed to allow for continuous airflow and drainage of the conduit in place. The straight supports shall be designed to occupy not more than 10% of the annular air space. Supports shall be of the type where insulation thermally isolated the carrier pipe from the other conduit. The surface of the insulation shall be protected at the support by a sleeve not less than 12 inches long, fitted with traverse and, where required, rotational arresters.
2. Condensate Piping: does not apply.

G. Steel Conduit Insulation

1. Steam Piping: Conduit insulation shall be spray applied polyurethane foam, having a nominal 2 pound per cubic foot density for all straight lengths and fittings. The insulation thickness shall be 1 inch. Quality assurance procedures for the insulation shall include either a visual check prior to jacketing or infrared, or x-ray of the entire length, to insure there are no insulation voids. The urethane foam shall meet ASTM C591 and have the minimum characteristics of .14K-factor, density of 2 pcf and a closed cell content of 90 to 95%.
2. Condensate Piping: does not apply

H. Protective Jacket:

1. Steam and Condensate Piping: All straight sections of the insulated piping system shall be filament wound, polyester resin/fiberglass reinforcement composite directly applied on the insulating foam. Thermoplastic casing material, e.g. PVC or PE, shall not be allowed.

The minimum thickness for FRP jacket shall be as follows: For jacket diameter up to 15.5 inches – thickness = 0.055 inches, jacket diameter between 15.6 inches and 24.5 inches thickness – 0.085 inches, jacket diameter above 24.6 inches, thickness = .110 inches. All fittings shall be pre-fabricated.

2.04 EXPANSION LOOPS, ELBOWS AND ECCENTRIC FITTINGS:

- A. Steam Piping: Expansion loops and elbows shall be factory manufactured utilizing the same casing thicknesses, material and coating as the straight conduit lengths. Loops and elbows shall be sized to allow carrier pipe thermal movement

without damage to the insulation. Eccentric fittings shall be factory manufactured, coated and utilized whenever changes in casing size are warranted as determined by the manufacturer.

- B. Condensate Piping shall utilize external expansion compensation at loops and elbows as required and recommended by the system manufacture to allow thermal movement.

2.05 FIELD JOINTS, PATCH & REPAIR:

- A. Field joints shall be applied by the insulation contractor utilizing the manufacturer's furnished kit and instructions. Field joints shall not be applied until after carrier pipe has been hydrostatically tested and approved.
- B. Patch and repair existing piping to remain with Dri-Therm installed according to manufacturer's installation instructions.

2.06 FIELD JOINTS:

- A. Field joints shall be applied by the insulation contractor utilizing the manufacturer's furnished kit and instructions. Field joints shall not be applied until after carrier pipe has been hydrostatically tested and approved.

2.07 VALVES:

- A. Gate Valves 2" and Larger: Shall be of cast steel, 150 pound rating, with outside screw and yoke, rising stem, and with flanged ends and shall conform to ANSI B16.10. The trim and stem shall be 316 stainless steel per ASTM A276. Gate valves 2" and larger for steam shall have factory installed globe valve by-pass. The by-pass valve shall be cast steel Y-type globe valve with yoke cast integral with the body. The by-pass shall be 1/2" thru 4" gate valves, 3/4" for 5" thru 8" gate valves, and 1" for 10" or over gate valves. Gate valves shall be walworth 5202F.

2.08 GUIDES

- A. Guides shall be constructed of materials in accordance with ANSI B31.1-73, Section 121.2.1. Prefabricated pipe alignment guides with steel spider and segmented steel cylinder shall be:
 - 1. Flexonics Piping Alignment Guide, or Tube-Turn Series A Guides.

PART 3 – EXECUTION

3.01 INSTALLATION:

- A. The installing contractor shall handle the system in accordance with the directions furnished by the manufacturer and as approved by the SDR. The installing contractor shall be responsible to excavate, string conduit, weld, test, place in trench, backfill or otherwise treat and install the system as per directions furnished by the manufacturer and approved by the Sandia design engineer in accordance with plans and specifications. The conduit shall be air tested at 15 psig and the carrier piping hydrostatically tested to 1 ½ times the working pressure; test pressure shall hold for two hours. Holiday testing of conduit coating shall be the responsibility of the contractor under the directions furnished by the manufacturer. All holidays shall be recoated and retested. A qualified representative of the manufacturer shall be present at the job site during critical periods of the installation such as unloading, commencement of the installation and testing. Backfill shall not commence until approval of tests by the manufacturer's representative. Upon completion of the installation, the manufacturer shall provide a certificate that the installing contractor has accomplished the work in accordance with the manufacturer's directions. Additionally, the installing contractor shall certify that he has complied with the manufacturer's directions.

3.02 BACKFILL:

- A. A 4-inch layer of sand or fine gravel shall be placed and tamped in the trench to provide a uniform bedding for the conduit. The entire trench shall be evenly backfilled with a similar material as the bedding, in 6 inch compacted layers to a minimum height of 6 inches above the top of the insulated piping system. Bedding and backfill materials shall be as recommended by the manufacturer. Refer to Section 02200, "Earthwork" for additional backfill above the pipes.

3.03 GENERAL:

- A. Connecting to Existing Work: Connect new work to existing work in a neat and workmanlike manner. Where an existing structure must be cut or existing utilities interfere, such obstruction shall be bypassed, removed, replaced or relocated, patched and repaired. Work disturbed or damaged shall be replaced to its prior condition.
- B. Coordination: The Contractor shall coordinate the location of all items of equipment and work of all trades. An essential feature of the design is to maintain operability and maintainability of the equipment and systems. Any relocation of equipment or systems to comply with the requirement of operability and maintainability shall be performed by the Contractor at his cost.

- C. Grading: Unless otherwise shown on drawings, steam and condensate lines shall be graded downward not less than 1-inch in 20-feet. Provide eccentric reducing fittings on steam mains and branches (except on vertical piping). Install said fittings to maintain continuity of grade in bottom of pipeline. Install properly dripped and trapped risers on steam lines where shown on drawings and where space restrictions prevent continuous grading.
- D. No excavation shall be initiated without a digging permit. Permits are available through the SDR.

3.04 JOINTS, WELDED:

- A. Welded Joints:
 - 1. Welding material and labor shall be in accordance with welding procedure of ANSI Piping Codes.
 - 2. Branch connections shall be made with welding tees.
 - 3. Mitering of pipe to form tees will not be permitted. All pipe and fittings shall be cleaned before welding and installation in system.
- B. Fittings: All pipe intersections and all changes in direction shall be made with factory-built reinforced fittings. Field-fabricated fittings and miters are not permitted.

3.05 PRE-ENGINEERED SYSTEM:

- A. Contract Requirements: The Contractor, if not the system supplier, shall employ the services of a system supplier who has pre-engineered system for the groundwater conditions, operating temperature, and soil classification specified by SNL. The system supplier shall design and oversee the installation and testing of the system in strict accordance with the requirements specified herein.
- B. Excavation, Trenching, and Backfilling: The Contractor is responsible for excavation, trenching, and backfilling as required by and described in the system supplier's approved brochure and as required by the system supplier's design.
- C. Reports to SDR: The Contractor shall obtain periodic (3-minimum) written reports from the representative of the system supplier. The original report shall be presented to the Contracting Officer on the same day it is prepared, and one copy shall be forwarded to the manufacturer's main office. The report shall be signed by the manufacturer's representative. The report shall state whether or not the condition and quality of the materials used and the installation of the system are in accordance with the plans, specifications, and is satisfactory in all respects. If any work connected with the installation is unsatisfactory, the report shall state what corrective action has been taken or shall contain the system supplier's

recommendations for corrective action. The report shall identify any conditions that could result in an unsatisfactory installation including such items as open conduit ends left in the trench overnight and improper manhole entries. The representative shall take prompt action to return to the factory all damaged or defective material, and shall order prompt replacement of such material. The representative of the system supplier shall be present at the job site to inspect all delivery of materials and all installation work, tests, and backfilling. The Contractor shall not perform any of this work in the absence of the representative of the system supplier. Upon completion of the work and before final acceptance, the Contractor shall deliver to the SDR a notarized statement signed by a principal officer of both the supplying and the contracting firm, stating that the installation is satisfactory and in accordance with the plans and specifications.

- D. Cleaning of Piping: The Contractor is responsible for cleaning the interior of the carrier pipe as required by the described in the system supplier.
- E. Field Tests: The Contractor is responsible for performing all field tests required by and described by system supplier.

END OF SECTION