

Design Standards

Underground Piping Installation and Insulation Requirements

Uninsulated underground thermal piping systems experience significant energy losses to the soil over the course of their operating life. For example, a 100 foot section of uninsulated 12 inch HDPE Chilled Water line buried 3 feet below grade can easily gain over one billion Btu's of heat over a 30 year period. To minimize the heat gain/loss of these piping systems, Texas A&M University has chosen a mineral powder insulation system, similar to Gilsulate 500, as the Campus standard for insulating underground thermal lines. In addition to its insulating properties, this type of insulation system: 1) Is hydrophobic, 2) Has a high electrical resistivity preventing galvanic action between metal pipe and the soil, 3) Has good load bearing properties and 4) Is "green" since it's made from minerals.

The information shown below needs to be included in the FP&C Facility Design Guidelines, Division 33 – Utilities.

Work Includes:

An underground piping insulation system must be provided to enclose and provide thermal and waterproofing protection for piping specified and shown on Plans, including but not limited to the following:

- Piping insulation including expansion units.
- Miscellaneous materials incidental to complete installation of insulated underground sections.
- Supervision of installation as specified.

General:

Insulating material which adheres to or becomes joined in any manner to piping during cycle of operation shall not be used.

Contractors are solely responsible to complete work for entire run of piping between points specified and shown on plans.

Adequate space and clearance with insulated underground piping system shall be provided to allow free movement of piping and avoid stress or abrasions to piping. No wood, masonry, metal, or any other abrasive pipe supports or guides, shall be left in contact with piping.

Provide fittings and accessories necessary and incidental to type of system selected.

Store materials and equipment on work site on wood platforms or members; stack and pile in substantial and safe manner so products will not easily dislodge while in storage.

Replace or repair wet or damaged insulation as directed by Engineer or product installation requirements.

Complete hydrostatic tests for all new lines. Perform hydrostatic leak test at 1.5 times maximum operating pressure to ensure piping system is free from leaks before application of field applied insulation and closures. UEM technical staff must be notified in advance of planned hydrostatic test and be present to witness the test. See pipe manufacturer's recommendations for testing procedures.

All parts of system to be intact, undamaged, and free from leaks before backfilling with insulation material. Upon completion of backfilling of insulation material, work must be approved by construction inspector and UEM representative before final backfilling is performed. Piping or insulation installation that is deemed to be inadequate or incorrect by Engineer, construction inspector, or UEM representative must be corrected to meet specifications prior to backfilling.

Excavation, Filling & Backfilling

Final grading for setting pipe units to be performed immediately prior to setting units or concrete supporting pad in trenches; backfilling around completed insulated system to be under direction of supervisor for installation of insulated underground system.

Restore all finished grades and improvements as detailed.

Type of Construction:

The system for insulating pipes shall keep water and moisture from pipes.

Type of material and construction: The insulation shall be a dry, free flowing granular product formulated from selected inert, inorganic materials. It shall be non-toxic, non-flammable, and completely free of asbestos. It shall require no mixing prior to installation, and no curing. It shall be completely compatible with all materials typically used for piping in the service temperature range of +35°F to +230°F. It shall be of sufficient density so any stones or rocks inadvertently falling on insulation will not penetrate or migrate into or through insulation during placement and back-filling operations.

The insulation shall be composed of granular particles that cohesively bond with each other to form a closed cell compacted mass that effectively isolates pipe surfaces from air, water, moisture and chemicals. The granules shall be surface treated to render it hydrophobic. The compacted insulation shall be capable of withstanding up to 12,000 psf (58,000 kg/M²) at the manufacturer's recommended density.

The insulation shall have a thermal coefficient of heat conductivity (K factor) of no more than 0.60 BTU/hr. /ft²/°F/in. at manufacturer's recommended use density and a mean temperature of 175°F and 0.65 at a mean temperature of 300°F by the guarded hot plate method of ASTM C-277. If an insulation with higher thermal conductivity is proposed, bidding shall be based on the equivalent

amount of insulation required to minimize heat loss/gain to that which would result with the thermal conductivities specified in the proceeding sentence. See Figure No. 1 for required insulation envelope dimensions.

Electrical resistivity of the insulation shall be greater than 10^{12} Ohm-cm.

The insulation shall be mineral powder with characteristics as described above similar to GILSULATE 500 as manufactured by American Thermal Products Inc.

The system shall be installed according to the published recommendations of the insulation manufacturer. The installer shall consult with and arrange for field assistance from the manufacturer's representative prior to placement of the insulation system. Pipes, anchors-guides and expansion shall be in compliance with the recommendations of the insulation manufacturer or as shown on plans and specifications. Backfilling operations shall be performed according to Section, EXCAVATION, FILLING AND BACKFILLING.

Placing Materials: Insulation materials used must be capable of being placed and consolidated to prescribed density prior to any backfilling operation. Use of backfill to provide compaction of the material is not acceptable.

Installation Sequence: (Refer to Insulation Manufacturer's Installation Sequence and notes.)

Excavate trench as near as possible to the required width of piping and insulation and pile backfill all on one side. Install pipes with required guides, supports, and anchors as shown on drawings and specifications. Perform pressure testing.

Grade and compact trench under pipes leaving required space for specified thickness of insulation. Clean any dirt or debris off pipes.

Precut gypsum board with attached spacers on the exterior may be driven into place. Horizontal spacers are used to determine envelope width. Leave forming in place. Forms are held away from pipes by temporary spacers which must be removed as insulation is installed and consolidated. Side forms must not extend above the finished consolidated insulation level of the envelope.

Provide compact sand or clean backfill behind the forms to pipe height.

All standing water shall be removed prior to placing insulation.

To minimize dust, empty the bags near pipes with as little "free fall" as possible. Fill trench to mid pipe height and consolidate. Remove spacers and temporary supports as work progresses.

Add additional layers of insulation and consolidate to specified thickness and density. A rod type concrete vibrator with a $1\frac{1}{2}$ - 2" diameter head is the best and quickest means of consolidating insulation. Insert the head of the vibrator and pull along slowly.

Walk on the consolidated insulation envelope to insure use density, footprints of approximately 1" deep or less are expected. Insulation coverage shall be according to insulation manufacturer recommendations or as shown on Plans.

Additional 2" of insulation is required over pipes in areas passing under streets or parking.

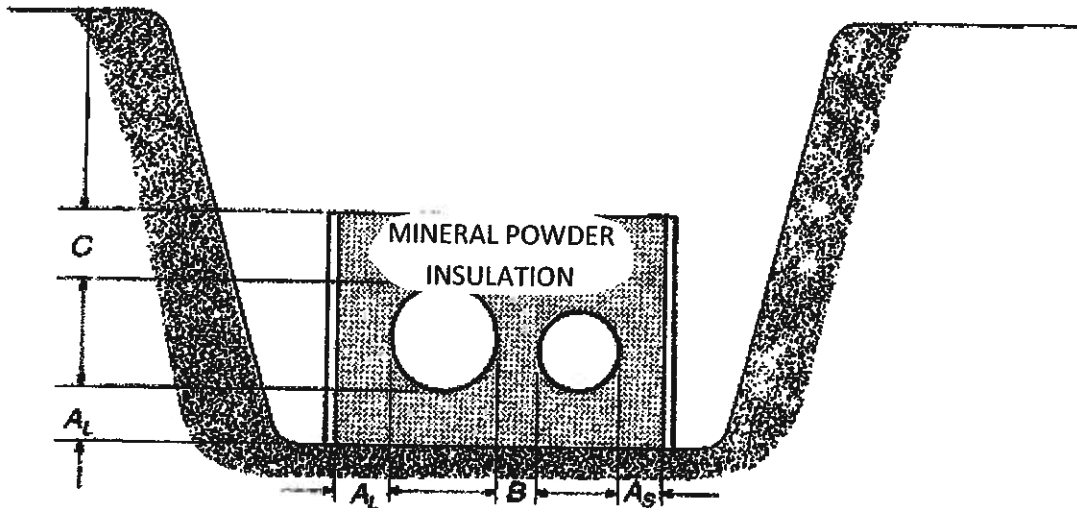
Complete compaction of sand backfill behind forms. Place a layer of flattened empty bags on top of the insulation envelope. Walk on top of the bags and hand place 6" clean backfill on top of empty bags to protect against damage in case of storms. Complete backfilling to grade level as specified under Section, EXCAVATION, FILLING, & BACKFILLING as soon as possible. Provide a minimum of 12" earth backfill.

Guarantee: Contractor shall guarantee installation of insulating system for a period of one (1) year from date of acceptance by Owner against deterioration of insulating value, compaction or water leakage under normal operation conditions. Contractor, however, shall not be responsible for damage or failure of system due to damage caused by other parties.

Design of the Insulation Envelope

Pipe Coverage Selection

Figure No.1



A_L. COVERAGE FOR LARGE PIPE DIAMETER
A_S. COVERAGE FOR SMALL PIPE DIAMETER
B. SELECTED FOR SMALL PIPE DIAMETER
C. COVERAGE FOR LARGE PIPE DIAMETER

TABLE 1

Gilsulate 500 or Approved Equal Envelope Dimensions								
Operating Temperature			35°F To 100°F			101°F To 230°F		
Norm. Pipe Size	Outside Dis.	Pipé Area Sq.In.	Dimensions In Inches					
			A	B	C	A	B	C
1	1.315	1.36	3	6	4	3	6	4
2	2.375	4.43	3	6	4	3	6	4
3	3.500	9.62	3	6	5	3	6	5
4	4.500	15.90	4	6	5	4	6	5
5	5.563	24.31	4	6	5	4	6	5
6	6.625	34.47	4	6	5	4	6	5
8	8.625	58.43	4	6	5	5	6	6
10	10.750	90.76	4	6	6	5	6	6
12	12.750	127.68	4	6	6	6	6	7
14	14.000	153.94	5	6	6	6	6	7
16	16.000	201.06	5	6	6	6	6	7
18	18.000	254.47	5	6	6	6	6	8
20	20.000	314.16	5	6	7	6	6	8
24	24.000	452.39	5	6	7	6	6	8

Based on thermal conductivities (K factors) of Gilsulate 500xr insulation.

If a product with higher K factors is proposed, insulation thicknesses shall be increased to provide a resistance to heat flow equivalent to the Gilsulate insulation shown in Figure 1.

Add 2 inches to C Dimension under streets. Parking lots and railroads tracks.