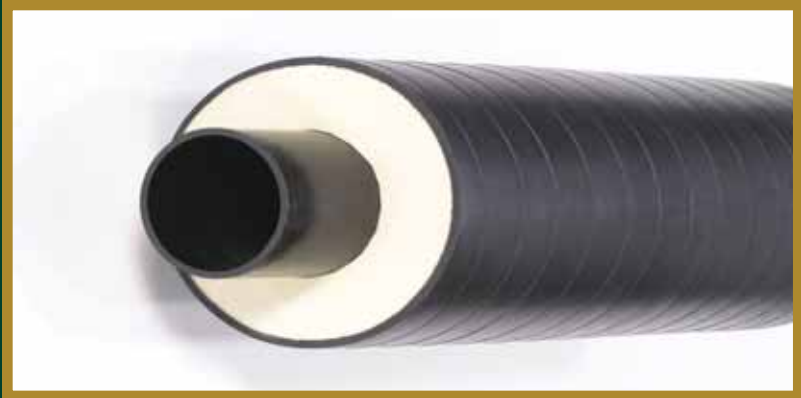


Polyethylene Jacketed Polyurethane Insulated Piping System
with Multi-Layered Corrosion Protection

XTRU-THERM[®] GOLD



The First District Energy
Preinsulated Piping
System Incorporating
the Corrosion Protection
Technology of the Oil
and Gas Industry



CORROSION



**PREMATURE
FAILURE**



**COSTLY REPAIRS
and
REPLACEMENTS**



XTRU-THERM® GOLD insulation prior to the application of the seamless HDPE jacket

Now for the first time in District Heating and Cooling, Perma-Pipe introduces the same corrosion protection technology used in the Oil and Gas industry. An additional corrosion coating layer is applied to the outer service pipe prior to the application of the polyurethane foam and polyethylene (HDPE) jacket. This coating will protect the steel in the event the outer jacket is ever breached during operation.

SHOT BLASTED STEEL SERVICE PIPE

For the best corrosion protection the steel substrate must be blasted to a near white surface. The resulting profile and anchor pattern allows the coating to properly adhere for maximum protection and long life.

SERVICE PIPE COATING

PERMA-PIPE offers three different coating options; Epoxy, Urethane Elastomer and Zinc. Epoxy is one of the most widely used coatings in a wide variety of industrial applications. Urethane Elastomers have been used for many years for direct burial in all types of soils. Zinc is an excellent coating for high temperatures and when boiling conditions may be present.

POLYURETHANE SPRAY FOAM INSULATION

The XTRU-THERM® GOLD insulation is a high thermal efficient polyurethane foam insulation suitable for temperatures from cryogenic applications up to 250°F.

In contrast to foam injected insulated piping systems, the XTRU-THERM® GOLD spray process assures void-free insulation. By applying insulation before the jacket is applied, a complete visual inspection of the insulation is performed assuring void-free insulation and therefore, providing maximum thermal efficiency.

SEAMLESS HDPE JACKET

PERMA-PIPE's extrusion process produces a high strength, seamless, high density polyethylene (HDPE) jacket over the insulation for maximum insulation protection from the environment.

Elbow insulation jackets are constructed of seamless, molded HDPE. Tee insulation jackets are extrusion welded construction.

PERMA-PIPE applies the high strength HDPE jacket to systems having a service pipe as large as 36 inches. The XTRU-THERM® GOLD jacket is an excellent choice for both underground and above ground installations.

XTRU-THERM® GOLD SYSTEM FEATURES

Corrosion Coated Steel Service Pipe
 Seamless Extruded HDPE Jacket
 Low Thermal Conductivity Polyurethane Insulation
 Insulation Thickness to Meet Application Needs
 Fully Bonded Jacket / Insulation / Service Pipe System
 Preengineered Components

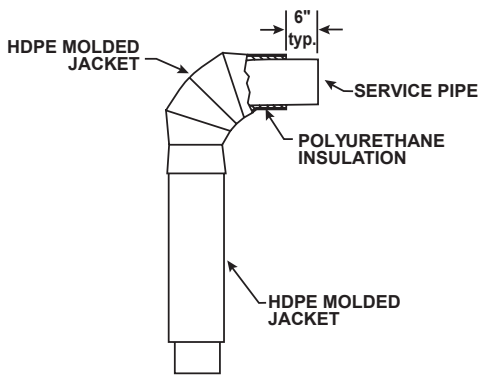
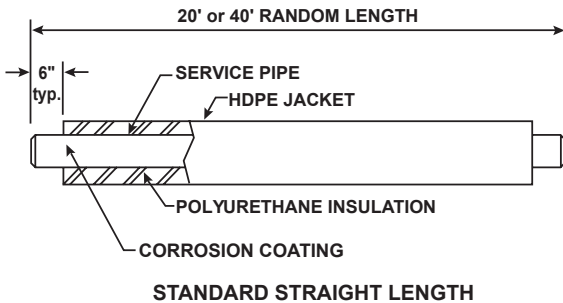
FULLY ENGINEERED

The XTRU-THERM® GOLD piping system is completely engineered by PERMA-PIPE's experienced engineering staff. Straight lengths, elbows, tees, anchors and end seals are all preengineered components.

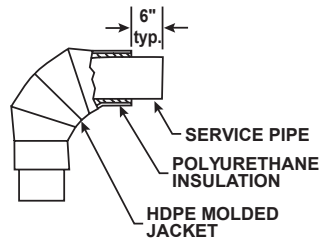
Thermal stress and displacement, heat loss/gain, soil loading calculations and layout drawings can be provided. The XTRU-THERM® GOLD system is engineered to reduce field costs by providing factory fabricated fittings and components to reduce field connections, as compared to the field kit method.

FULLY BONDED SYSTEM

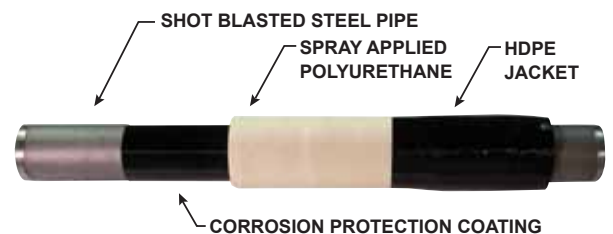
PERMA-PIPE treats the HDPE jacket so that it bonds to the polyurethane foam insulation. This bonding, along with the insulation bond to the service pipe, results in a completely bonded system. All components expand and contract as a system. There are no gaps for water to travel through, which can degrade the insulation or service pipe.



90° ELBOW WITH EXTENDED LEG FOR EXPANSION LOOPS



STANDARD 90° ELBOW FOR DIRECTION CHANGES



FIELD JOINT CLOSURE

Step 1

Complete service pipe joint.



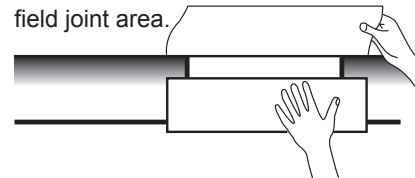
Step 2

Pour foam insulation.



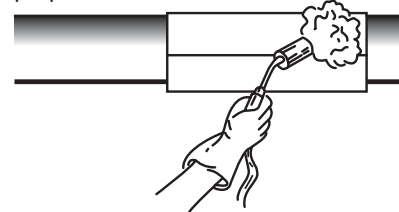
Step 3

Wrap shrink sleeve around field joint area.



Step 4

Shrink sleeve using propane torch.



GENERAL

All underground and above ground chilled water, condensate return and hot water lines shall be XTRU-THERM® GOLD, as manufactured by PERMA-PIPE. All straight sections, fittings, anchors and other accessories shall be factory fabricated, insulated and jacketed. Field insulation of fittings shall not be allowed. The piping system layout shall be analyzed by the piping system manufacturer, to determine the stresses and displacements of the service pipe. The piping system design and manufacture shall be in strict conformance with ASME B31.1, latest edition. Installation of the piping system shall be in accordance with the manufacturer's instructions.

SERVICE PIPE

The service pipe shall be standard weight ASTM A53 Gr. B, ERW carbon steel, except for condensate return lines, which shall be Schedule 80. All joints shall be butt welded for 2.5 inches and larger, and socket welded for 2 inches and smaller. Where possible, straight sections shall be supplied in 40 foot random lengths, with piping exposed at each end for field joint fabrication.

SERVICE PIPE COATING

The exterior steel pipe surface shall be abrasive blast-cleaned to a minimum of a near white surface, SSPC-SP10-63T. Profile must be a minimum of 1.5 mil peak to valley range. Any areas of rust bloom or oil shall be wiped and reblasted.

After blasting, the steel service pipe shall be coated with (choose one option) (Epoxy) (Urethane Elastomer) (Zinc)

The epoxy coating shall be a two part coating consisting of a base material and curing agent spray applied to a minimum

thickness of 8-12 mil. The coated pipe shall be holiday tested at 1,000 volts to ensure a void free coating. Areas of the conduit not passing the holiday test shall be patch coated and retested.

The urethane elastomer coating shall be a sprayable two component, aromatic, corrosion protection elastomeric coating applied to a minimum thickness of 20 mil. The coated pipe shall be holiday tested at 2,500 volts to ensure a void free coating. Areas of the pipe not passing the holiday test shall be patch coated and retested.

The zinc coating shall be a high solids inorganic zinc rich coating that protects the steel galvanically, thus eliminating sub-film corrosion. The zinc coating shall be a two part sprayable coating consisting of a liquid base portion and a dry powdered metal. The two components when mixed together can be spray applied. The dry film thickness shall be in a range of 2 to 4 mil.

INSULATION

The service pipe insulation shall be polyurethane foam with 2 lb/ft³ minimum density, 90% minimum closed cell content and maximum initial thermal conductivity of 0.18 Btu-in/hr-ft²-°F. The insulation shall completely fill the annular space between the service pipe and jacket and shall be bonded to both. Systems using open cell insulation or a nonbonded design shall not be allowed. The insulation shall be provided to the minimum thickness specified below:

| Pipe Size (in) | Insulation Thickness (in) | |
|----------------|---------------------------|-----------|
| | Chilled Water | Hot Water |
| 1 - 8 | 1 | 1 |
| 10 - 12 | 1 | 1.5 |
| 14 - 36 | 1.5 | 2 |

INSULATION JACKET

The outer protective insulation jacket shall be seamless high density polyethylene (HDPE) in accordance with ASTM D3350 minimum cell classification PE 345444 C. PVC or tape materials are not allowed. The minimum thickness of the HDPE jacket shall be as follows:

| Jacket OD (in) | Jacket Thickness (in) |
|----------------|-----------------------|
| OD ≤ 12 | .100 |
| 12 < OD ≤ 24 | .125 |
| OD > 24 | .150 |

ACCESSORIES

Elbows, tees, reducers, anchors, field joints and end seals shall be designed and factory fabricated to prevent the ingress of moisture into the system.

FITTINGS

All fittings shall be factory prefabricated and pre-insulated. Straight tangent lengths shall be added to all ends, so that all field joints are at straight sections of pipe. Elbow insulation jackets shall be molded HDPE. Tee insulation jackets shall be extrusion welded or butt fusion welded HDPE. Gluing, taping or hot air welding of the insulation jacket shall not be allowed.

FIELD JOINTS

The service pipe shall be hydrostatically tested to 150 psig or 1.5 times the design pressure whichever is greater. Insulation shall then be poured in place into the field joint area. All field applied insulation shall be placed only in straight sections of pipe. Field insulation of fittings is not acceptable. The installer shall seal the field joint area with a heat shrinkable adhesive backed sleeve. Backfilling shall not begin until the heat shrink sleeve has cooled. All insulation and jacketing materials for the field joint shall be furnished by PERMA-PIPE.

PERMA-PIPE®

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