PERMA-PIPE, Inc. XTRU-Therm

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Installation Manual

TABLE OF CONTENTS

PREFACE

The objective of this Installation Manual is to provide the installer with recommended installation procedures for PERMA-PIPE'S XTRU-Therm piping system. This Installation Manual should be used in conjunction with all other applicable Installation Manual Supplements and engineering drawings and documentation supplied by PERMA-PIPE for the specific project. This Installation Manual addresses all common aspects of the installation process, from initial receiving and storage through final backfill and operation and maintenance.

If leak detection, heat tracing, and/or other ancillary equipment is included with your XTRU-Therm piping system, refer to the appropriate Installation Manual(s) in conjunction with this Installation Manual. If a particular procedure is not addressed in this Installation Manual, contact PERMA-PIPE for additional information, if needed.

The true operating success of the system is greatly dependent upon proper product application, installation, operation, and maintenance. PERMA-PIPE is committed to supporting the proper application and installation of a complete, high quality insulated piping system. This support includes clear and concise product data, and installation recommendations and expert applications engineering support and field technical assistance.

When installed, tested, operated, and maintained in accordance with these recommendations, a successful installation should be achieved and PERMA-PIPE'S XTRU-Therm piping system will provide excellent service, meeting or exceeding expectations.

GENERAL PRECAUTIONS

Due to the many possible variations in applications, use, installation conditions, and environment these installation recommendations can not address all possibilities. These recommendations are for general applicability, they are believed to be reasonably accurate and reliable. The installer is ultimately responsible for a proper installation. Trained and qualified personnel should be used for all phases of the installation. The importance of a proper installation cannot be overstated.

PERMA-PIPE cannot anticipate every circumstance that might involve hazard. The warnings in this Installation Manual are, therefore, not all-inclusive. The installer must satisfy himself that each procedure, tool, work method or operating technique is safe.

If these recommendations conflict with the project contract specifications or drawings or PERMA-PIPE'S engineering drawings, the more stringent documents should take precedence. If in doubt, please contact your PERMA-PIPE Project Engineer, Project Manager or Field Technical Representative. Any deviations from these recommendations or PERMA-PIPE'S engineering drawings should be reviewed with the appropriate PERMA-PIPE personnel.

Carefully plan and execute the installation sequence to avoid errors and expensive mistakes. **Do Not** skip steps.

For underground installations, **Do Not** complete trench backfilling until all testing and inspection is completed and accepted by the appropriate authority.

INTRODUCTION

XTRU-Therm is a versatile, pre-engineered, factory pre-fabricated insulated piping system for belowground or aboveground applications. XTRU-Therm is available in a wide variety of service pipe materials and for many different applications. The insulation is a low density, low thermal conductivity, rigid polyurethane insulation. The insulation jacket is a durable high density polyethylene (HDPE) material.

The customer is provided with the exact specifications of the XTRU-Therm product supplied for each project.. XTRU-Therm can be purchased in one of three different configurations wth varying degrees of factory prefabrication;

- **XTRU-Therm Custom** – Straight lengths of pipe and fittings are custom fabricated to field verified dimensions and angles. Field cutting of straight lengths of pipe is not required. All field joints are in straight lengths of pipe.
- **XTRU-Therm Xpress** – 20' or 40' insulated straight lengths of pipe. Fittings with standard tangent lengths and standard angles. Straight lengths of pipe are field cut to fit field dimensions. All field joints are in straight lengths of pipe.
- **XTRU-Therm Economy** – 20' or 40' insulated straight lengths of pipe, with field joint and fitting insulation kits. Fittings are field fabricated, insulated and jacketed. Materials are supplied in accordance with an agreed upon bill of material. Service pipe fittings are supplied by the installer unless otherwise specified and purchased. Straight lengths of pipe are field cut to fit field dimensions. Field joints are at all fittings and between straight lengths of pipe.

FIELD TECHNICAL ASSISTANCE

PERMA-PIPE Field Technical Assistance (FTA) is available for on site technical assistance. PERMA-PIPE recommends the use of FTA to support the proper installation of the XTRU-Therm piping system by the installer. Field Technical Assistance is provided when included as part of the customer's purchase order or when purchased separately.

NOTICE

This Installation Manual and the recommendations it contains are reasonably believed to be accurate and reliable. However, due to variations in environment, application or installation, and because the conditions of use are beyond PERMA-PIPE's control, the user of this Installation Manual assumes all risk connected with the use thereof. The installer of these piping products is ultimately responsible for his own work and, thus, the integrity of the system. PERMA-PIPE assumes no responsibility for the use of information presented herein and, hereby, expressly disclaims all liability in regard to such use.

Any technical recommendations, suggestions or advice with respect to storage, handling, installation or use of PERMA-PIPE's materials, by, or on behalf of PERMA-PIPE is an accommodation to the Purchaser for which PERMA-PIPE shall have no responsibility, unless responsibility has been expressly assumed in writing by the President or a Vice-President of PERMA-PIPE.

RECEIVING

All materials have been factory inspected and carefully loaded and braced to prevent damage in shipment to the job site. However, even these efforts are sometimes not enough to prevent damage in transit. It is the carrier's responsibility to deliver the shipment in good condition. It is the receiver's responsibility to report any loss or damage upon receipt. PERMA-PIPE's standard terms are F.O.B. our factory, full freight allowed to job site.

When a shipment arrives at the job site, obtain the following documentation from the carrier before offloading;

- Packing List.
- Bill of Lading
- Material Safety Data Sheets (MSDS Sheets).
- PERMA-PIPE's Part Drawing Layout (PDL), (if applicable)
- Quality Assurance Documentation as applicable (x-ray film/reports, CMTR's, pressure test reports, etc.)

Contact PERMA-PIPE for any missing documentation.

During off-loading, perform the following;

- Check all piping units, cartons, and pallets against the Packing List.
- Visually inspect the piping units, cartoons and pallet materials for damage.
- Review the Material Safely Data Sheets (MSDS) for safe handling and use procedures.

If there are any damaged or missing materials;

- Any shortage or damage must be noted on the Bill of Lading and Packing List.
- Do not dispose of any damaged materials until advised to do so by PERMA-PIPE.
- Immediately submit any claims to the carrier. Failure to do so will result in loss of compensation for missing or damaged materials.
- Notify PERMA-PIPE of these claims if assistance is required.
- If replacement materials are required, they can be ordered from PERMA-PIPE. You will be advised of replacement purchase costs, which will also be required for your freight claim.

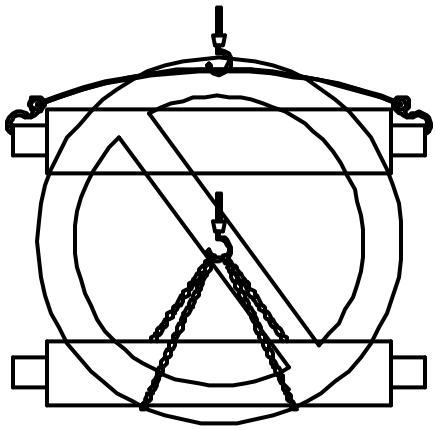
HANDLING

The means by which the piping units are unloaded and handled at the job site is the decision of the receiver. It is imperative that proper care and handling techniques are used to avoid damage. Damaged piping units may require costly repairs, cause property damage, or worse, personal injury. Safety and careful handling should be top priorities when handling any of the piping units.

PERMA-PIPE supplies two nylon slings with each shipment. If additional slings are required, they can be purchased from PERMA-PIPE.

The following procedures are recommended for handling the piping units;

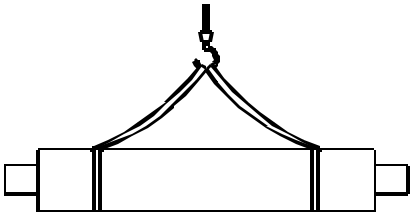
- Support each piping unit with nylon slings during all phases of handling. The nylon slings prevent damage to the piping units.
- **Do Not** use hooks, steel cables or chains for handling any piping units.



- **Do Not** drag or drop piping units.
- **Do Not** strike the piping units against hard surfaces at any time.
- **Do Not** use forklifts for handling piping units.
- **Do Not** use a nylon sling that has been damaged or is fraying. Damaged slings should be cut in half and disposed of.
- If possible, use a spreader bar to maximize control of the piping units during handling. PERMA-PIPE does not supply spreader bars.

HANDLING (cont.)

- Use two nylon slings where possible. The use of two nylon slings provides much more control of the load. A length of pipe suspended with a single nylon sling is more likely to swing out of control, potentially causing a safety hazard.



- Space the slings about 15 - 20 feet apart.
- If a piping unit is damaged during handling, refer to Section 4 for repair recommendations.

SAFETY CONSIDERATIONS

Safety should always be a primary consideration when unloading and handling piping units.

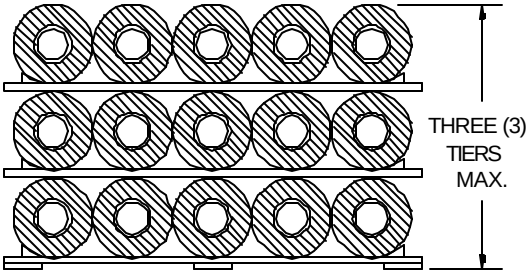
- Never lift more weight than your equipment can safely handle.
- Never lift more weight than the rating of the slings.
- **Do Not** use damaged slings, cut up and dispose of any damaged slings.
- PERMA-PIPE chocks only the outer piping units in each layer (or tier) on the truck. It is important to recognize that as you lift piping units off the truck, nearby piping units may become unstable and roll. Chock piping units that are not being unloaded.

STORAGE

Proper storage of piping units and loose shipped materials is very important. These materials can deteriorate or sustain damage if not properly stored. Proper storage is the responsibility of the receiver. The following procedures are recommended;

PIPING UNITS

- If possible, store the piping units in a warehouse or heated shelter. If this is not possible, store the piping units on high ground to avoid ingress of water into the pipe ends.
- When stacking, stack piping units in the same fashion they were received.
- Wooden shipping braces must be used as runners between layers of pipe.
- **Do Not** stack piping units more than three (3) tiers high.
- Use foam or other padding between layers.



- If the ends of piping units were shipped with plastic covers and/or plastic pipe end caps, **do not** remove them when storing the piping units. If any of the protective covers were damaged in shipping or handling, they must be restored by replacing the protective plastic cover where necessary.
- Use a light colored or opaque tarp to cover outdoor stored piping units to protect the piping units from weather and the Sun's ultraviolet (UV) rays that can discolor or degrade the materials.

LOOSE SHIPPED MATERIALS

- Store all field joint and ship loose materials indoors and in a dry area.
- Keep the materials in their original shipping containers. The recommended storage temperature range for chemicals is 60° - 85° F (18° -29°C).
- Refer to the Material Safety Data Sheets (MSDS Sheets) for proper handling, storage and use. Some materials may be flammable or hazardous. Extreme care must be taken so they are stored away from any open flames.
- **Do Not** allow chemicals to freeze as this may hinder effectiveness or render useless.
- Contact PERMA-PIPE if additional MSDS Sheets are needed.

EXCAVATION

GENERAL

All types of flexible pipe derive some of their strength from the passive soil resistance around the pipe. Therefore, proper excavation and backfilling of the trench is very important to insure a structurally sound system.

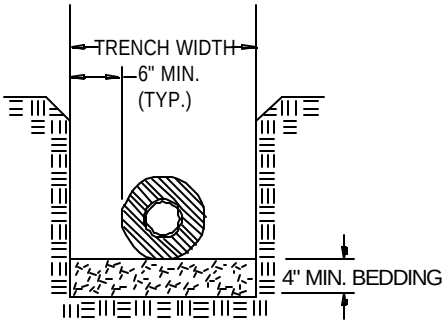
XTRU-Therm piping is designed to handle normal soil and H-20 traffic loading when the recommendations in this Installation Manual are followed and a minimum of 2 feet of properly compacted backfill is provided. It should be noted that shallower burial depths will increase the piping system heat loss/gain slightly. See Section 7 for backfilling and compaction recommendations.

Special burial depths and compaction requirements may be required at taxiways, runways, railways, roadways, and other areas of high surface loading conditions. It is recommended that the customer contact both PERMA-PIPE and the local authority for more specific instructions.

NOTE: All federal, state and local regulations concerning jobsite safety should be observed.

TRENCH WIDTH – SINGLE PIPE

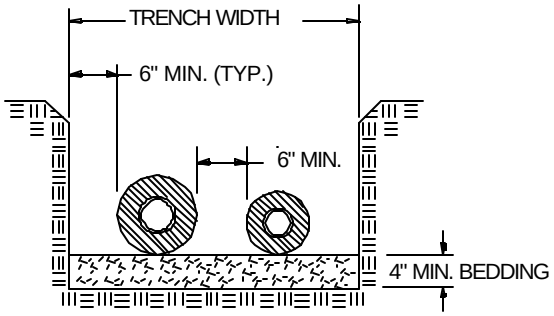
The minimum recommended trench width for a single pipe trench is the insulation jacket diameter plus 12 inches (6 inches between the pipe and trench wall).



TRENCH WIDTH – MULTI-PIPE

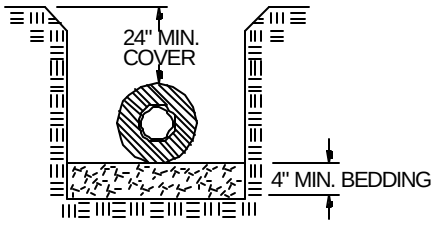
For multi-pipe trenches, pipe centerline dimensions can usually be found on the layout drawings.

The minimum recommended trench width is the sum of all insulation jacket diameters, plus 6 inches between each pipe plus 12 inches (6" between pipes and 6 inches from the pipe to trench wall).



TRENCH DEPTH

The total trench depth should allow for a 4-inch bedding, the largest insulation jacket diameter and a minimum 24 inches cover above the largest insulation jacket diameter. See the contract specifications or drawings for specific burial depth requirements. For cover depths less than 24 inches, contact PERMA-PIPE. If special loading conditions, such as railroads, taxiways, runways are encountered contact PERMA-PIPE and the local authority.



TRENCH BEDDING

The trench floor should be completely cleared of stones and rocks and then covered with 4-inches of compacted bedding. The bedding must be raked uniformly along the entire length of the trench and graded to a minimum slope of 1 inch per 40 feet to allow for gravity draining of the piping system.

Trench bedding material should be in accordance with the recommendations provided in Section 7.

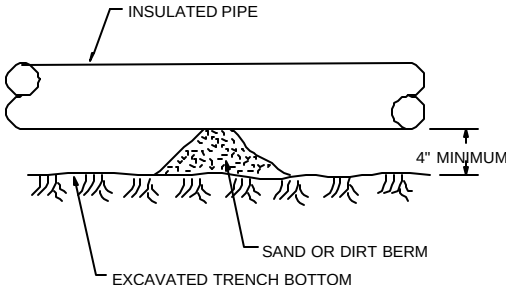
BELL HOLES

Digging bell holes at field joint locations allows room for service pipe joining, testing, and field joint insulating and jacketing. A common way to dig bell holes is to cut across the trench with a backhoe.

The bell holes should be cut into the trench wall and between 1½ and 2 feet below the trench floor. Bell hole locations should be identified and dug before lowering piping units into the trench.

ALTERNATE TRENCH BOTTOM SAND OR DIRT BERMING

An alternate method to trench bedding is to sandbag or dirt berm the bottom of the excavated trench. If the berms elevate the bottom of the pipe above the trench bottom sufficiently, bell holes may not be required. However, the space under the pipe will require backfilling and compacting as described in Section 7.



The material used for the berms should be in accordance with the recommendations provided in Section 7. If bags are used the bags should be cut open to allow proper compacting of the berm material. **Do Not** use wood or other degradable materials for berms.

The trench floor should be completely cleared of stones and rocks before placing the berms. The berms should be elevated to provide a minimum slope of 1 inch per 40 feet to allow for gravity draining of the piping system.

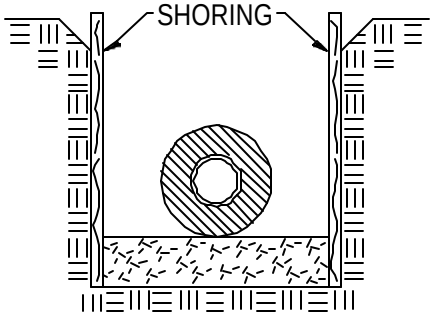
Berm spacing should be approximately 10 feet and berm width at least 6 inches. These values may need to be increased or decreased depending on the service pipe material, size, and weight but should be adequate enough to prevent the pipe from sagging between berms and to prevent the insulation and insulation jacket from being overloaded at the berms.

When ready to begin backfilling, refer to Section 7 for backfilling and compacting recommendations. It is critical that the space under the pipe be properly backfilled and compacted to provide a stable trench bed for the piping system.

SPECIAL SOIL CONDITIONS

UNSTABLE SOIL

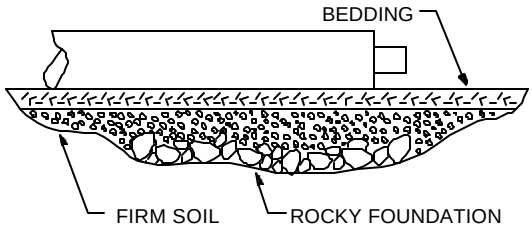
During excavation, an unstable soil condition may be encountered, particularly in installations with deep burials. If this occurs, shore the trench walls before lowering the piping units into the trench. As the shoring is removed, replace it with compacted backfill material.



Organic soils or plastic clays and silts with high liquid limits may be encountered that are incapable of supporting the pipe. Remove the poor soil, and replace it with proper bedding soil to a depth that will provide a firm stable foundation.

ROCK BOTTOM TRENCH

A rocky or uneven trench foundation should be covered with a firm soil or gravel before the trench bedding is placed.



GRANULAR SOIL

In granular soil, the trench wall should be sloped at the natural angle of repose.

OVER EXCAVATION

Any accidental over-excavation should be filled with bedding material and compacted to 90-95% modified proctor.

ASSEMBLY

GENERAL

Assembly of the piping system should be in accordance with the engineering design of the piping system. Proper placement of end seals, anchors, expansion loops, expansion elbows, Z-bends, tees, external expansion pads, thrust blocks, and supports is critical to prevent overstressing of the piping system due to thermal expansion / contraction and other mechanical loads.

The amount of factory pre-fabrication of the XTRU-Therm piping system depends on the configuration it was purchased – Custom, Xpress, or Economy. See the Introduction at the beginning of this Installation Manual for descriptions of each configuration.

XTRU-Therm piping ordered and supplied as a PERMA-PIPE pre-engineered system has been designed for the specified conditions and includes a Layout Drawing that indicates the designed routing and dimensions of the piping system. When the piping units have been fabricated to field dimensions, the Layout Drawing will include the part number of each piping unit and its designated location. Correct placement of the piping units is critical. Piping units installed out of order and/or with unapproved alterations may lead to operating hazards, system failure, and/or voiding of PERMA-PIPE's warranty.

If the XTRU-Therm piping ordered and supplied is not a PERMA-PIPE pre-engineered system, the engineering design of the piping system is the responsibility of others and should be performed by a qualified piping system designer.

ANCILLARY EQUIPMENT

If the XTRU-Therm system being installed includes any ancillary equipment such as leak detection or heat trace, refer to the appropriate Installation Manual(s) and/or PERMA-PIPE documentation in conjunction with this Installation Manual.

PREPARATION AND SET-UP

Personnel performing any phase of installation should be trained and qualified in the procedures they will perform and be familiar with the appropriate sections of this Installation Manual, Installation Manual Supplements, and all engineering drawings and documentation supplied by PERMA-PIPE for the specific project.

Proper tools, equipment, and materials should be used for handling and installation of the piping units to prevent damage. All tools, equipment, and materials needed for a particular operation or procedure should be made readily available before starting. Refer to other sections of this Installation Manual for "specialty" tools that may be required.

COLD / WET WEATHER CONDITIONS

When installing pipe in temperatures below 60°F, or in rain or snow, refer to the Installation Manual Supplement for Cold / Wet Weather Conditions.

LAYOUT

Installation can be simplified by laying the piping units in the order they will be assembled. To avoid damaging the piping units they should not be laid out until trenching and bedding is completed for belowground systems or structural supports completed for aboveground systems.

ABOVEGROUND SYSTEMS - SUPPORTING

XTRU-Therm piping installed aboveground should be properly supported to prevent damage to the insulation or insulation jacket. Insulation shields or equivalent should be used at support locations to prevent overloading of the insulation or insulation jacket. Proper support type (fixed, guide, roller, etc.) and spacing is required to prevent overstressing of the piping system and limit deflection between supports. Sloping, if required, must be provided for in the support system elevations.

CUTTING TO FIELD DIMENSIONS

Piping units may need to be cut to field dimensions. All cuts should be made in straight sections of pipe in the manner described below.

Refer to the appropriate Installation Manual Supplement or PERMA-PIPE drawings for special service pipe end preparation requirements for bell & spigot PVC, ductile iron, FRP, or O-ring or gasketed coupling joints.

- Mark the location of the cut on the insulation jacket.
- Cut back the insulation jacket and insulation to the required dimension on each side of the cut mark. A knife, hand saw, or power saw can be used to cut the insulation jacket and insulation. Be careful not to cut the service pipe.
- Remove all insulation in the cut back area. Clean to bare service pipe material.
- Cut the service pipe and restore the end preparation (weld bevel for steel pipe, shaved OD for FRP pipe, etc.).

SERVICE PIPE JOINING

If sufficient handling equipment is available, it may be easier to complete some field joints before lowering into the trench or lifting onto supports. This may require more than one crane and/or a spreader bar to lower or lift the joined piping units into place. **Do Not** allow the joined piping units to bow when handling. **Do Not** join piping units with flexible joints such as gasketed bell & spigot or o-ring joints before lowering or lifting.

CAUTION: If your XTRU-Therm piping system has been supplied with the pressure testable field joint closure system, be sure to slide the pressure testable closure sleeve over the pipe ends at each field joint before joining the service pipes together.

All service pipe field joints should be completed in the following manner:

- If the piping unit has been supplied with end protection, remove all end protection materials.
- Properly align each field joint. Verify the legs of elbows and tees are perpendicular, and the legs of expansion loops are parallel to each other. If the legs of elbows, tees, and expansion loops are not positioned correctly, it will affect the overall length of the pipe run.
- Use the appropriate service pipe joining technique (weld, braze, adhesive, o-ring/gasketed coupling, etc.) for each field joint. See the appropriate Installation Manual Supplement if required.
- Wrap the field joint area with plastic and seal with tape to keep moisture, rain, water, and dirt away from the service pipe and insulation ends.
- Perform all required service pipe testing and inspection and pressure test the service pipe as described in Section 5.
- After successful completion of all service pipe testing and inspection, insulate and jacket the field joints as described in Section 6.

LOWERING / LIFTING

Piping units should be moved into place in the following manner;

- Remove all free standing water from trenches and bell holes before lowering piping units. Bell holes and trench bedding must be dry during piping unit installation.
- Lower or lift the piping units into place. **Do Not** drop the piping units. Spreader bars or more than one crane may be required depending on the size of the piping unit being handled.
- If the piping units have been supplied with end protection, remove all end protection materials. **Do Not** remove end protection materials until the service pipes are to be joined.

SERVICE PIPE ANCHORS

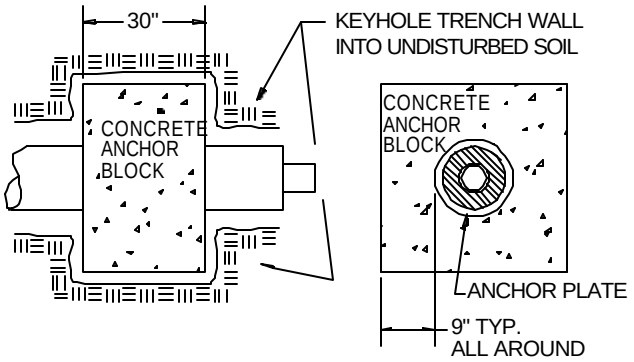
Service pipe anchors control the direction of movement caused by thermal expansion/contraction and the resulting service pipe stresses. Service pipe anchors must be properly placed to prevent overstressing of the piping system.

XTRU-Therm anchors consist of a steel anchor plate rigidly attached to the service pipe. For underground piping systems the anchor plate should be encased in a concrete anchor block as described below. For aboveground systems the anchor plate should be welded to a structure capable of withstanding the loads the anchor plate will apply to it.

CONCRETE ANCHOR BLOCKS

Concrete anchor blocks are used to transfer the service pipe anchor force to the soil. The anchor block should be keyed into undisturbed earth to the maximum extent possible. The backfill around the balance of the anchor block should be compacted as described in Section 7. The resulting soil around the anchor block should have a minimum bearing capacity of 2000 lbs./ft.^{2}. If the soil can not provide this bearing capacity the anchor block size should be increased to increase its bearing surface area enough to offset the lower soil bearing capacity. Contact PERMA-PIPE for assistance if needed.

Anchor block concrete should be 2000 psi minimum rated concrete. Rebar is not required. Anchor blocks for typical applications should be formed to the minimum dimensions shown on the details below.



CONCRETE ANCHOR BLOCKS (cont.)

If unusually high anchor forces will be encountered, such as those resulting from expansion joint thrust forces, larger anchor block and specially designed anchor plates may be required. Contact PERMA-PIPE for assistance if needed.

For multiple pipe trenches, use the dimension in the figure above but increase the width by the additional insulation jacket outside diameters plus the spacing between insulation jackets (6 inches minimum).

UNRESTRAINED JOINTS - CONCRETE THRUST BLOCKS

Concrete thrust blocks are required when the service pipe joints are unrestrained, such as unrestrained gasketed bell and spigot PVC or ductile iron, or o-ring or gasketed couplings, or FRP adhesive joints. Concrete thrust blocks are required for all changes in direction (elbows, tees), changes in size (reducers), and dead ends (caps, plugs, valves).

The size of the thrust block is dependent upon the test pressure, pipe size, type of fitting, number of pipes, and soil conditions. Refer to the Installation Manual Supplement for Concrete Thrust Blocking for thrust block sizing and installation recommendations.

UNRESTRAINED JOINTS – TIE-INS

Transitions from an unrestrained joint system to a restrained joint system are often made when an underground piping system enters a building or manhole or transitions to aboveground piping.

When tying in an unrestrained joint system to a restrained joint system an anchor is required in the restrained joint system to resist the thrust load of the unrestrained joint system. This anchor should be within 5 feet of the end of the unrestrained joint system. The anchor should be designed to withstand the same load as if it were a concrete thrust block, as described above.

EXTERNAL EXANSION PADS

External expansion pads installed around elbows, expansion loops, z-bends, and tees are used to allow thermal expansion/contraction in underground piping systems to prevent overstressing of the service pipe. Expansion pad material is available from PERMA-PIPE.

XTRU-Therm piping ordered and supplied as a PERMA-PIPE pre-engineered system includes a Layout Drawing that indicates the necessary expansion pad locations and thickness and length requirements.

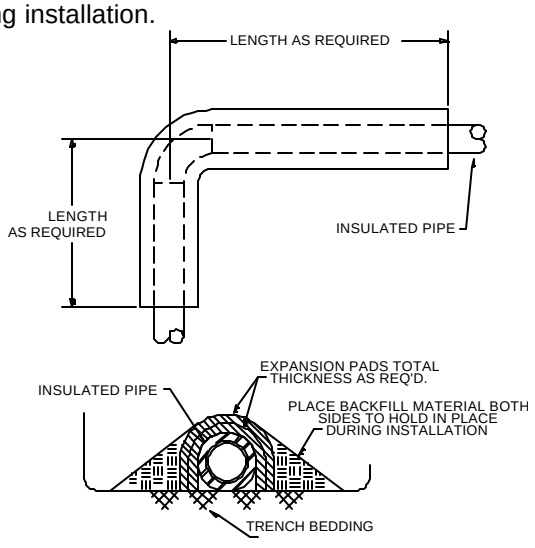
If the XTRU-Therm piping ordered and supplied is not a PERMA-PIPE pre-engineered system, the engineering design of the piping system, including expansion pad requirements, is the responsibility of others and should be performed by a qualified piping system designer.

The total thickness of expansion pad material should be greater than the expected expansion or contraction of the service pipe. The length should be sufficient to allow enough service pipe movement to prevent overstressing of the service pipe.

Expansion pad material is supplied in bulk rolls. The material must be field cut to the width required to wrap around the insulation jacket or previous layer of expansion pad material.

Expansion pads should be installed in the following manner;

- Determine required length and total thickness from PERM-PIPE's Layout Drawing (if a PERMA-PIPE pre-engineered system) or from the responsible engineer's drawing.
- Determine the required width from the measured circumference of the insulation jacket or previous layer of expansion pad material. The expansion pad must cover the top and sides as shown below.
- Cut the expansion pad material to the required width and length.
- Install the required length and number of layers of expansion pad as shown below. Exercise care not to compress the expansion pad material during installation.



WALL OR FLOOR ENTRIES

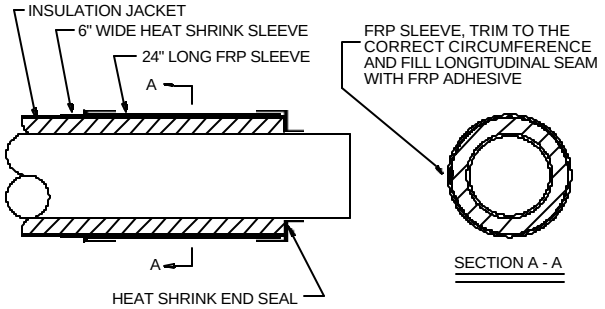
PERMA-PIPE recommends that all building or manhole entries be sleeved and the annular space between the insulation jacket and sleeve sealed by a mechanical rubber seal or waterproof sealant. Wall sleeves and mechanical rubber seals are available from PERMA-PIPE.

Mechanical rubber seals function by compressing onto the insulation jacket and wall sleeve. If a mechanical rubber seal is used, an XTRU-Therm wall/floor entry end seal assembly must be used to prevent the mechanical rubber seal from damaging the insulation and jacket. The XTRU-Therm wall/floor entry end seal assembly provides mechanical reinforcement to the insulation jacket and a water tight seal between this reinforcement and insulation jacket. XTRU-Therm Custom and Xpress wall/floor entry end seals are factory fabricated. XTRU-Therm Economy wall/floor entry end seals are field assembled.

XTRU-Therm ECONOMY WALL/FLOOR ENTRY END SEAL ASSEMBLIES

XTRU-Therm Economy floor/wall entry end seal assemblies consist of an FRP reinforcement sleeve, adhesive, heat shrink sleeve, and heat shrink end seal all supplied by PERMA-PIPE for field assembly. Wall/floor entry end seal assemblies should be assembled in the following manner;

- Measure the circumference of the outside diameter of the insulation jacket.
- Trim the FRP reinforcement sleeve circumference about 1/8 to 1/4 inch smaller than the insulation jacket.
- Abrade and clean the inside diameter of the FRP reinforcement sleeve.
- Abrade and clean the insulation jacket area that will be under the FRP reinforcement sleeve.
- Apply adhesive to the FRP reinforcement sleeve inside diameter.
- Slide the FRP reinforcement sleeve over the insulation jacket. Secure it down tightly to the insulation jacket with steel bands.
- Seal the longitudinal seam with adhesive. Form the seam smooth to the outside surface of the FRP reinforcement sleeve.
- Allow the adhesive to cure.
- Apply a heat shrink sleeve to the back side of the FRP reinforcement sleeve. Follow the heat shrink sleeve recommendations in Section 6.
- Apply a heat shrink end seal to the front side of the FRP reinforcement sleeve. Follow the heat shrink end seal recommendations below.



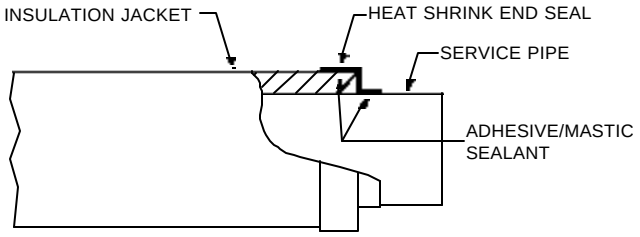
HEAT SHRINK END SEALS

Heat shrink end seals form a water tight seal between the insulation jacket and service pipe. Heating the heat shrink end seal causes the adhesive to soften and the heat shrink end seal to shrink compressing the adhesive and forming a seal between the heat shrink end seal and insulation jacket and service pipe.

Heat shrink end seals should be used at all termination ends and open ends of the XTRU-Therm piping system to prevent ingress of water or moisture.

Depending on the configuration of XTRU-Therm purchased – Custom, Xpress, or Economy, some heat shrink end seals may require field installation.

When field installation of heat shrink end seals is required, refer to the Installation Manual Supplement for Heat Shrink End Seals.



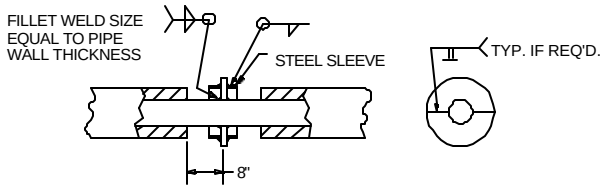
XTRU-Therm ECONOMY FITTINGS

XTRU-Therm Economy service pipe elbows, tees, and reducers are typically supplied by the installer unless otherwise specified and purchased. These fittings should be joined to the service pipe as described above.

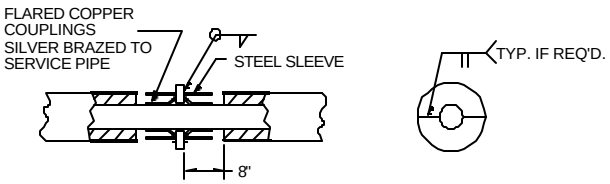
XTRU-Therm ECONOMY ANCHORS-BELOW GROUND

XTRU-Therm Economy belowground anchors are field assembled, insulated, and jacketed. PERMA-PIPE supplies the steel anchor plate and steel sleeves. The anchor should be installed in the following manner;

- Mark the anchor location on the insulation jacket.
- Strip 8 inches of insulation jacket and insulation on each side of the marked location. Clean to bare service pipe material.
- If required to fit over the service pipe, cut the anchor plate in two halves.
- Weld (or braze if copper service pipe) the anchor assembly to the service pipe as shown on PERMA-PIPE's engineering drawings and the figure below.
- Seal weld the anchor plate split seams if the anchor plate was cut in two halves. Grind the seal welds flush and smooth.
- Weld the steel sleeves to both sides of the anchor plate.
- Seal weld the longitudinal seams of the steel sleeves. Grind the outside surface of the welds flush and smooth.
- Grind a minimum 1/16 inch chamfer on all outside edges of the anchor plate.



BELOW GROUND STEEL SERVICE PIPE ANCHOR

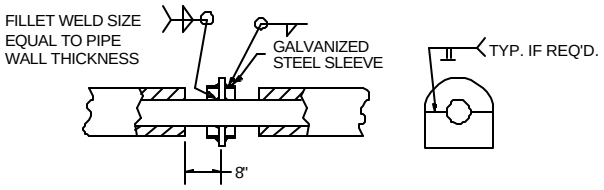


BELOW GROUND COPPER SERVICE PIPE ANCHOR

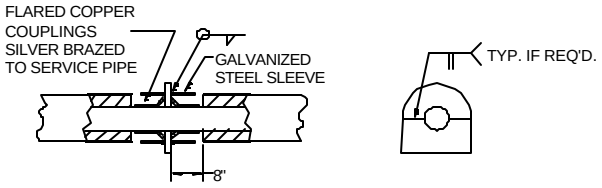
XTRU-Therm ECONOMY ANCHORS-ABOVEGROUND

XTRU-Therm Economy aboveground anchors are field assembled, insulated, and jacketed. PERMA-PIPE supplies the galvanized steel anchor plate and galvanized steel sleeves. The anchor should be installed in the following manner;

- Mark the anchor location on the insulation jacket.
- Strip 8 inches of insulation jacket and insulation on each side of the marked location. Clean to bare service pipe material.
- If required to fit over the service pipe, cut the anchor plate in two halves.
- Weld (or braze if copper service pipe) the anchor assembly to the service pipe as shown on PERMA-PIPE's engineering drawings and the figure below.
- Seal weld the anchor plate split seams if the anchor plate was cut in two halves. Grind the seal welds flush.
- Weld the steel sleeves to both sides of the anchor plate.
- Seal weld the longitudinal seams of the steel sleeves. Grind the outside surface of the welds flush and smooth.
- Apply a zinc rich paint to the exposed weld areas to prevent corrosion.



ABOVEGROUND STEEL SERVICE PIPE ANCHOR



ABOVEGROUND COPPER SERVICE PIPE ANCHOR

ALTERATIONS

When alterations to an XTRU-Therm piping system are necessary, the considerations herein are recommended. Alterations should be performed using the appropriate installation recommendations described in other sections of this Installation Manual.

PERMA-PIPE or the responsible piping system designer should be consulted to properly design the alteration and ensure the alteration will not adversely effect the design and operation of the piping system.

In all cases it is critical that the insulation, insulation jacket, and insulation jacket integrity be fully restored.

PIPE LENGTH

The change in the piping system layout and effect on the piping system stresses must be considered when the piping system dimensions are changed. Even relatively small changes in dimensions can cause overstressing of the piping system if these changes are made in areas, such as expansion elbows or z-bends, where dimensional changes could cause overstressing of the piping system due to the reduction in flexibility or increase in thermal expansion /contraction displacements.

Pipe cutting should be performed as recommended in Section 3.

FITTINGS OR COMPONENTS

The change in the piping system layout and effect on the piping system stresses must be considered for alterations that add or delete fittings, or other piping system components.

The addition or deletion of anchors, elbows, tees, or other piping system components can have serious detrimental effects on the piping system design and operation.

DESIGN TEMPERATURE OR PRESSURE

An increase in design temperature or pressure can cause overstressing of the piping system. The piping system design should be re-evaluated for any changes in design conditions.

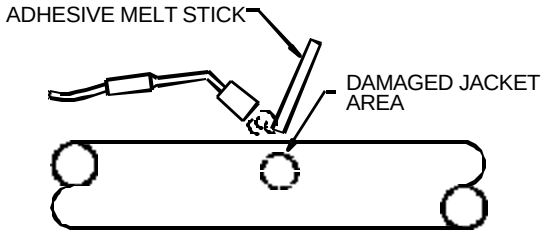
REPAIRS

INSULATION JACKET

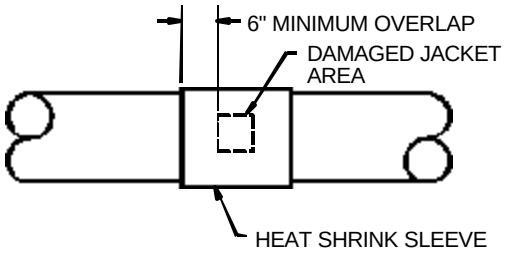
Remove all damaged insulation jacket material up to the point where the insulation jacket is no longer damaged.

Small areas of damaged insulation jacket, up to 3/8 inch x 3/8 inch, can be repaired using an adhesive melt stick. Adhesive melt sticks are available from PERMA-PIPE. Adhesive melt stick repairs can be made in the following manner;

- Remove the damaged insulation jacket material.
- Abrade the edges of the jacket around the repair area. Clean this area with a clean cloth.
- Gently warm the repair area with a propane torch.
- Melt the adhesive melt stick onto the repair area with a propane torch.
- Smooth and blend the surface and edges of the adhesive into the existing jacket.



Small or large areas of damaged insulation jacket can be repaired using a heat shrink sleeve. The width of the heat shrink sleeve should extend a minimum of 6 inches past each edge of the damaged jacket area. See Section 6 of this Installation Manual for heat shrink sleeve installation recommendations.



REPAIRS (cont.)

INSULATION

Remove all damaged insulation material up to the point where the insulation is no longer damaged. Damaged insulation includes insulation that is wet.

Small or large areas of damaged insulation can be repaired using pour foam polyurethane. See Section 6 of this Installation Manual for installation recommendations.

Large areas of damaged insulation can be repaired using pre-form polyurethane insulation. See the Installation Manual Supplement for Pre-Formed Polyurethane Insulation for installation recommendations.

The surface of the repair area should be trimmed to be flush and smooth with the adjacent insulation and insulation jacket.

The insulation jacket must be restored to all insulation repair areas.

SERVICE PIPE

Do Not operate a service pipe that has damage to its pressure retaining capability.

Service pipe damage such as gouges, dents, cracks, bending, or flattening require repair or replacement of the service pipe.

If the service pipe is repaired, the repair method must restore the full pressure retaining capability to the service pipe.

If the service pipe is replaced, an equivalent section of XTRU-Therm piping should be installed with field joints at the connections to the existing system.

TESTING

SERVICE PIPE PRESSURE TESTING

Prior to field joint insulating and jacketing and backfilling (for underground systems), all service pipe joints should be pressure tested in accordance with the applicable ASME B31 piping code and any other contract specifications. In the event of conflict the more stringent requirement should be used.

Prior to pressure testing, all anchors, concrete anchor blocks, concrete thrust blocks and any other piping system thrust restraint devices must be in place.

PERMA-PIPE recommends hydrostatic pressure testing (hydrotesting). Pneumatic testing is not recommended due to the safety hazards associated with a large volume of high pressure gas.

The following steps are recommended to be part of the hydrotest procedure;

- After all service pipes are joined, and before field joint insulating, connect pipe test caps at the ends of the pipe run. Pipe test caps, including flanges and blind flanges for testing purposes, are not supplied by PERMA-PIPE.
- Use a pressure gauge sized properly, and close to, the test pressure.
- Set all valves so the section of piping to be tested will be pressurized. In most cases, it is preferred not to test directly against a valve, because they are sometimes the source of a “leak”, especially during standing or timed tests.
- Fill the service pipe completely with water. Vent the service pipe of all air. Trapped air is a common cause of unexplained pressure drops during a standing hydrotest.
- Slowly pressurize the service pipe to test pressure (typically 1½ times the design pressure).

  CAUTION: under no circumstance should the system be tested at a pressure greater than the maximum pressure rating of any component in the system.
- Maintain the pressure for two hours, allowing for corrections due to temperature changes.
- Visually inspect all exposed joints for signs of leakage.
- Repair and retest any leaking joints.

PRESSURE TESTABLE FIELD JOINTS

If your XTRU-Therm piping system has been supplied with the pressure testable field joint closure system, refer to the Installation Manual Supplement for Pressure Testable Field Joints.

OTHER TESTING AND INSPECTION

Other tests and inspections, such as water hammer testing, field joint weld radiography, dye penetrant or magnetic particle may be required by the contract specifications. It is the installer’s responsibility to perform these test and inspections, as required, for full contract compliance.

INSPECTION

VISUAL INSPECTION

After the piping system has successfully passed the hydrotest and all field joint insulation and insulation jacketing is completed, and prior to backfilling of underground systems, a final visual inspection of the piping system should be made.

- Walk the pipe lines and carefully inspect the piping for any damage and to ensure all work has been completed. For underground systems, this step should be performed just prior to backfilling.
- Remove all anchor block forms, construction materials, soil or any other work that may have caused damage or may cover damaged areas.
- Any damage should be repaired as described in Section 4.

FIELD JOINTS

After completion of all tests and inspections as described in Section 5, each field joint requires application of insulation and insulation jacket to properly complete the field joint.

Field joints are made in straight sections of pipe only for XTRU-Therm Xpress and Custom configurations. Field joints are made in straight sections of pipe and at fittings (elbows, tees, and anchors) for XTRU-Therm Economy.

The standard XTRU-Therm straight field joint consists of a temporary metal mold, polyurethane pour foam insulation and a heat shrink sleeve.

The standard fitting field joint consists of polyurethane pour foam insulation, transition sleeves, a flexible PVC fitting cover, and sealing tape.

If your XTRU-Therm piping system has been supplied with a different type of field joint insulation or jacket refer to the appropriate PERMA-PIPE Installation Manual Supplement and / or engineering documentation.

If your XTRU-Therm piping system has been supplied with the pressure testable field joint closure system, refer to the Installation Manual Supplement for Pressure Testable Field Joints.

When cold or wet weather conditions are present, tenting and heating may be required to enable the proper application of the field joint materials. Refer to the Installation Manual Supplement for Cold / Wet Weather Conditions.

SERVICE PIPE INSULATION

The standard XTRU-Therm service pipe field joint insulation is polyurethane pour foam insulation. This insulation is supplied as two components, A and B, in bulk liquid form.

The installer must prepare the insulation molds around the field joints, measure the proper amounts of insulation components, mix the liquids to initiate a chemical reaction, and pour the insulation into the mold formed around the field joint. When properly measured and mixed the liquids will react and rise to produce a low density (approximately 2.5 – 3.0 lbs./ft.^{3}) rigid polyurethane insulation around the field joint.

The following paragraphs describe PERMA-PIPE's recommendations for applying pour foam insulation to XTRU-Therm field joints.

PREPARATION

All materials, equipment, and tools should be made readily available before starting.

Do Not attempt insulating field joints in wet bell holes. If the bell hole is wet, pump it dry before insulating the field joint.

PERMA-PIPE provides the following materials for field joint insulating;

- Polyurethane pour foam insulation, A and B components, in bulk liquid form
- Metal pour foam mold for straight field joints
- Transition sleeves, PVC fitting cover, and sealing tape for fitting field joints (XTRU-Therm Economy)

NOTE: Insulation components A and B must be stored between 60°F to 85°F before use. Insulation stored below 60°F will not react properly. Insulation stored above 85°F may result in spoiling.

The metal molds provided by PERMA-PIPE can be used to insulate at least 10 field joints when properly maintained.

The installer will need to furnish the following;

- Disposable paper mixing pails
- Measuring containers
- Heavy duty gloves
- Dry rags
- Banding wire, rope, or tape
- Mold release
- Safety clothing
- Tin snips
- Wood rasp
- Stir sticks and/or cordless drill and paint agitator
- Denatured alcohol or equivalent solvent

PREPARING THE MOLD – STRAIGHT JOINTS

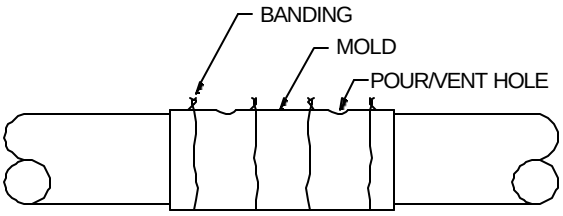
PERMA-PIPE supplies bulk roll sheet metal material for temporary metal molds for field joints in straight sections of pipe. The metal molds should be cut and prepared in the following manner;

- Measure the circumference of the outside diameter of the insulation jacket at both ends of the field joint. It is normal for there to be differences in the insulation jacket outside diameter at fittings and special components. A slight taper in the field joint insulation will compensate this for.

PREPARING THE MOLD – STRAIGHT JOINTS (cont.)

- Cut the sheet metal length to 1.25 times the largest measured circumference of the insulation jacket outside diameter.
  (Length = 1.25 x Maximum Circumference)
- Prior to each use, coat the entire inside surface of the metal mold with a mold release. Mold release is commonly found in fiberglass supply houses. Non-stick coating sprays, such as PAM™, can also be used. Without mold release, insulation may stick to uncoated portions of the metal mold and cause damage to both the insulation and the mold when the mold is removed from the field joint area.
- Wrap the metal mold around the field joint area as shown below. Center it so the ends extend at least 4 inches past the edge of each insulation jacket.
- Band the metal mold with wire, rope or tape 2 inches from each edge. Use two more bands in the middle, evenly spacing all four.

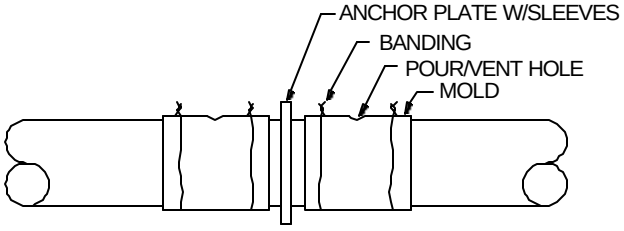
  NOTE: It is important to fasten the metal mold tightly around the insulation jacket. Gaps between the metal mold and insulation jacket will allow some of the rising pour foam insulation to escape. This could result in an incomplete pour and require mixing another small batch of insulation to complete the field joint.
- Cut two 2-3 inches diameter pour and vent holes in the top of the metal mold between the bands.



PREPARING THE MOLD – ANCHOR KITS

Anchors for XTRU-Therm Economy are field assembled, insulated, and jacketed. The insulating mold should be prepared in a manner similar to that for a typical straight field joint as described above but with the following modifications;

- The metal mold for an anchor is not as wide as that required for a straight field joint. The actual width will depend on the amount of insulation and jacket cutback made to install the anchor. It should be wide enough to overlap at least 4 inches on each side.
- One side of the metal mold will wrap around the steel sleeve welded to the anchor plate. The other side will wrap around the insulation jacket.
- Cut only one 2 – 3 inch diameter pour and vent hole.

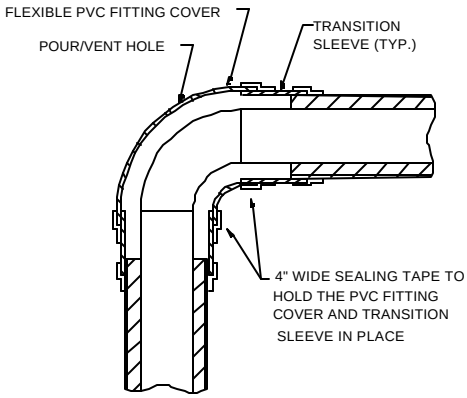


PREPARING THE MOLD - FITTING KITS

Elbow and tee fittings for XTRU-Therm Economy are field assembled, insulated, and jacketed.

The mold for a fitting kit consists of transition sleeves, a flexible PVC fitting cover, and sealing tape. The molds for fittings should be prepared in the following manner;

- Place the transition sleeves on the ends of the straight pipe insulation jacket. Seal the longitudinal and circumferential seams with sealing tape.
- Wrap the flexible PVC fitting cover over the fitting and onto the transition sleeves. Seal the circumferential and longitudinal seams with sealing tape.
- Cut two 2 – 3 inch diameter pour and vent holes in the top of the mold.



NOTE: It is important to tightly seal all seams with sealing tape. Gaps between the mold and insulation jacket will allow some of the rising pour foam insulation to escape. This could result in an incomplete pour and require mixing another small batch of insulation to complete the joint.

MEASURING THE POUR FOAM

Polyurethane foam insulation A and B components are mixed in a 1:1 ratio. The amount of pour foam required for a field joint depends on the volume of the field joint and the density of the polyurethane insulation after it has completely reacted and risen. The density of the field joint insulation is highly dependent on the ambient temperature and service pipe temperature. Cold conditions increase the density of the field joint insulation, which will result in the need for more pour foam to complete a joint.

PERMA-PIPE provides sufficient pour foam materials to do the field joints for each order under typical conditions. If you are experiencing higher pour foam use than would be expected, as outlined herein, monitor your pour foam inventory to avoid running out. Additional pour foam materials are available from PERMA-PIPE.

Below are recommendations for determining the initial pour foam insulation A and B component quantities. The actual quantity used will depend on the factors described above. After a field joint is poured, adjust the pour foam quantity used for subsequent field joints based on the results of the previously poured field joint(s).

Initial pour foam insulation A and B component quantities can be found using the table on this page. This table is based on a standard 12 inch long field joint. For different field joint lengths the values in the table can be adjusted by multiplying by the factor – (actual field joint length (inches) / 12). For elbow, tee, and anchor fittings, approximate the field joint length by measuring along the centerline length of the fitting field joint.

Example: 6 " pipe (6 5/8" OD)
1.5" insulation
16" long field joint

Table ➔ 7 ½ oz. Component A
7 ½ oz. Component B

factor = 16 / 12 = 1.33

Component A = 1.33 x 7 ½ = 10 oz.
Component B = 1.33 x 7 ½ = 10 oz.

Pour Foam Insulation A and B Component Quantities (oz.)[1]

Nominal Pipe Size	Insulation Thickness 1"	1.5"	2"	2.5"	3"
1"	2	3	4	6	7½
1 ¼"	2½	3½	4½	6½	8
1 ½"	2½	3½	5	6½	8½
2"	3	4	5½	7	9
2 ½"	3	4½	6	8	10
3"	3½	5	6½	8½	11
4"	4	6	7½	10	12½
5"	4½	6½	9	11	14
6"	5	7½	10	13	17
8"	6	9	12	16	19
10"	7	10½	14	18	23
12"	8	12	17	21	26
14"	9	13	18	23	28
16"	10	14½	20	25	31
18"	11	16	22	28	34
20"	12	18	24	30	37
24"	14	21	28	35	43
30"	17	26	34	43	52

(1) Table values based on a standard 12 inch long field joint. For different field joint lengths adjust the table values by multiplying by the factor – (actual field joint length (inches) / 12).

For pipe sizes or insulation thickness not in the table, the following equation can be used to determine the initial pour foam insulation A and B component quantities;

$$OZ_A = OZ_B = 1.0 + \frac{(OD_{pipe} + t_{insul.}) \times t_{insul.} \times L}{23}$$

Where; OZ_A = ounces of component A
OZ_B = ounces of component B
OD_{pipe} = outside diameter of service pipe (in.)
$t_{insul.}$ = thickness of insulation (in.)
L = length of field joint (in.) (for elbows and tees, approximate by measuring the length along the centerline)

Example: 6 " pipe (6 5/8" OD)
1.5" insulation
16" long field joint

Calculation ➔ OZ_A = 9.5 oz.
OZ_B = 9.5 oz.

MIXING AND POURING THE POUR FOAM

Do Not mix the A and B components until the mold is prepared and you are ready to begin insulating the field joint. Once mixed, the components will begin a chemical reaction and rise increasing in volume and decreasing in density by a factor of approximately 20.

CAUTION: The chemical reaction will generate heat, causing the mold and insulation to become hot for a short period of time.

Before opening a container of pour foam A or B component, turn the container upside down for about 15 minutes to ensure it is properly mixed prior to being used.

Mix and pour the pour foam in the following manner;

CAUTION: Wear eye protection when mixing and pouring the pour foam A and B components.

- Use two measuring containers, each large enough to hold the required quantity. Mark one of the containers "A" and the other "B". **Do Not** use the containers interchangeably.
- Pour the required amount of component A into the "A" container. Pour an equal amount of component B into the "B" container.
- Combine the contents of both into a paper mixing pail and immediately begin stirring. Use a stirring stick in hot weather and a cordless drill and paint agitator in cool weather. Stir vigorously for about 15 seconds. The insulation begins to react and rise in 15-30 seconds.
- After 15 seconds of stirring, pour the mixture through the pour and vent hole(s) into the mold. The mixture will begin to react and rise filling the mold.
- Discard the paper mixing pail, do not reuse.
- If sufficient pour foam was used, excess insulation will push out through the pour and vent hole(s).
- If the mold does not fill completely, estimate how much more insulation will be required. Mix the A and B components and pour again into the pour hole(s).
- After the pour stops rising, allow the mold and insulation to cool for approximately 10 minutes then cut and trim flush any excess insulation.

The amount of pour foam used for subsequent field joints of similar size and type, assuming there are no volume, field joint length, or temperature changes should be adjusted based on the results of previously poured field joint(s).

REMOVING TEMPORARY METAL MOLDS

The temporary metal molds should be removed in the following manner;

- Remove the banding and carefully peel the metal mold off the insulation. Tearing the metal mold off may damage the insulation or mold.

  If the mold sticks repeatedly, use additional mold release on the mold.
- After each use, clean the inside of the mold with denatured alcohol or an equivalent cleaning solvent to remove any dirt or insulation.
- Patch any voids in the surface of the insulation by mixing another small batch of pour foam. As soon as the pour foam begins to rise in the mixing pail, apply it to the void area(s).
- After the insulation has cooled, trim it flush with the surrounding insulation.
- If the heat shrink sleeve is not being applied immediately after removal of the metal mold, use plastic sheet and tape to seal around the exposed insulation to prevent exposure to water and moisture.

Insulation that becomes wet must be removed and replaced.

INSULATION JACKET

The field joint insulation jacket is designed to keep water and moisture from the insulation and service pipe. The integrity of the insulation jacket is critical to the long life of the XTRU-Therm piping system.

The standard XTRU-Therm straight field joint insulation jacket is a heat shrink sleeve. The insulation jacket for elbow and tee fittings for XTRU-Therm Economy is sealing tape over the transition sleeves and flexible PVC cover. The insulation jacket for XTRU-Therm Economy belowground anchors is a high shrink ratio heat shrink sleeve.

HEAT SHRINK SLEEVES - GENERAL

Heat shrink sleeves form a water tight seal between the sleeve and the insulation jacket and insulation. Heating causes the adhesive backing to soften and the sleeve to shrink, compressing the adhesive and forming a seal between the sleeve and insulation jacket and insulation.

HEAT SHRINK SLEEVES – PREPARATION

All materials, equipment, and tools should be made readily available before starting.

Do Not attempt applying heat shrink sleeves in wet bell holes. If the bell hole is wet, pump it dry before insulating the field joint.

PERMA-PIPE provides the following materials for heat shrink sleeve application;

- Heat shrink sleeve bulk roll material
- Propane torch head - high capacity flame nozzle (For outside diameters less than 18 inches, the minimum, torch size is 150,000 BTU/hr. For outside diameters greater than 18 inches, the minimum torch size is 300,000 BTU/hr.)
  Only use the torch provided or one that is equivalent.

The installer will need to furnish the following;

- Propane tank, hose, fittings, valves, and regulators.
- Hand roller
- Heat resistant gloves

HEAT SHRINK SLEEVE - SIZING

PERMA-PIPE provides heat shrink sleeve material in bulk roll. For each field joint, measure the field joint and cut the heat shrink sleeve length in the following manner;

- Measure the circumference of the outside diameter of the insulation jacket at both ends of the field joint. It is normal for there to be differences in the insulation jacket outside diameter at fittings and special components. A slight taper in the field joint will compensate this for.
- Depending on the maximum circumference measured, add the following for heat shrink sleeve overlap and slack;

	Overlap	Slack
Max. Circ ≤ 27”	4”	2”
27” < Max. Circ ≤ 57”	4”	3”
Max. Circ. > 57”	6”	3”

- Cut the heat shrink sleeve length to the dimension determined above.
- Cut a ½ inch triangle from each corner of the heat shrink sleeve to prevent the corners from peeling up after application.

HEAT SHRINK SLEEVE–HEAT SHRINKING TECHNIQUE

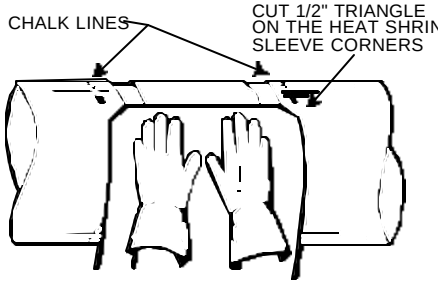
Before starting heat shrink sleeve application, become familiar with the following technique for shrinking a heat shrink sleeve;

- Wear heat resistant gloves whenever working with the propane torch.
- The propane torch flame should be kept at least 6 inches away from the shrink sleeve and at an angle to the surface. Holding the propane torch at an angle allows the flame to bounce off the shrink sleeve and decreases the local intensity of the heat. If the flame is held too close to the surface, the shrink sleeve will burn and may tear around the burned areas.
- Use your body as a shield to protect the flame from the wind. Keep the propane torch at an angle to the sleeve and pointed in the direction the wind is blowing to maintain a fairly even flame. **Do Not** increase the size of the flame, this could overheat and burn the shrink sleeve.
- Keep the propane torch in constant motion. **Do Not** burn the surface.
- Refer to the Installation Guide that is included with the heat shrink sleeve material for additional information.

HEAT SHRINK SLEEVE – APPLICATION

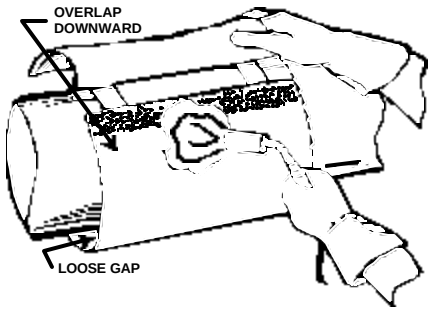
Apply the heat shrink sleeve in the following manner;

- Roughen the surface of the insulation jacket with sandpaper in the areas when the heat shrink sleeve will cover.
- Wipe the field joint area clean with a clean cloth. Use solvent if needed.
- Measure the width of the field joint area and the heat shrink sleeve. Use chalk to mark guidelines on the insulation jacket for the edges of the heat shrink sleeve. The heat shrink sleeve should be centered on the field joint area with a minimum overlap onto the insulation jacket of 4 inches on each end.
- Remove the first 6-10 inches of backing material from the heat shrink sleeve.
- Hold the heat shrink sleeve up. Press the top edge of the heat shrink sleeve just below the top of the field joint and centered between the chalk lines.
- Heat the top 2 inches of the sleeve with the propane torch until it becomes soft and adheres to the polyurethane insulation and insulation jacket.

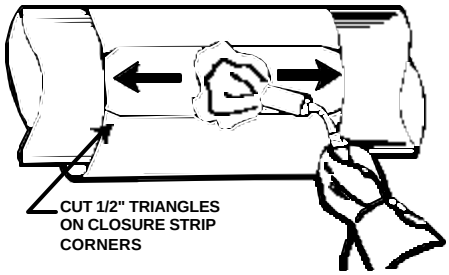


HEAT SHRINK SLEEVE – APPLICATION (CONT.)

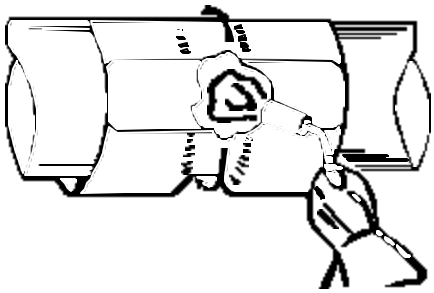
- Wrap the heat shrink sleeve around the field joint so the lower portion forms a loose gap that hangs about 1 inch from the bottom of the insulation jacket. This gives the sleeve room to shrink properly. If the sleeve is wrapped snugly, without a gap, it may pull apart or tear during heating.
- Stay within the chalk guidelines. Reheat the top 2 inches of the heat shrink sleeve before overlapping. Be sure to overlap downward.



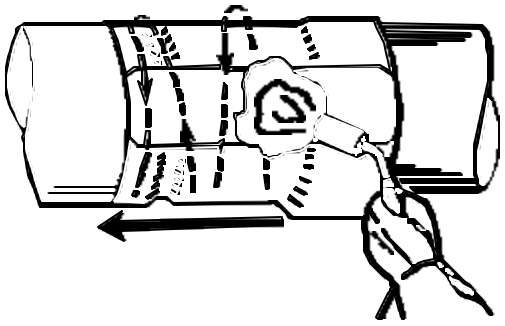
- Cut a ½ inch triangle from each corner of the closure strip to prevent the corners from peeling up after application.
- Peel the backing strip off the closure strip and preheat the closure strip for approximately 5 seconds until it becomes soft.
- Attach the closure strip directly over the seam of the shrink sleeve. Overlap and press down firmly. Do not try to smooth the closure strip at this time.



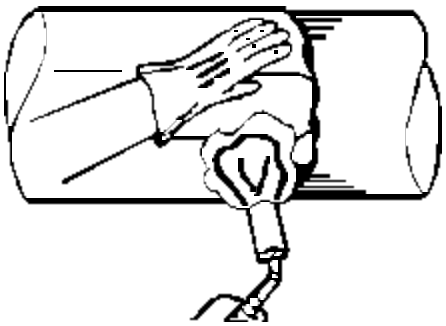
- Heat the <u>center</u> section of the heat shrink sleeve all the way around until it shrinks.



- When the center of the heat shrink sleeve has shrunk, begin to move the propane torch with an up-and –down spiral motion around the sleeve toward the left edge.



- When the left side has shrunk, heat the right side in the same up-and-down spiral manner.
- Reduce the flame slightly and shrink the edges of the sleeve onto the insulation jacket. Black adhesive escaping at the edges of the heat shrink sleeve indicates a good bond and shrinkage.
- Heat the closure strip with the propane torch until it sticks to the heat shrink sleeve. Use a wooden wallpaper roller to apply pressure to the closure strip. Sufficient heat and pressure, is required to completely fuse the closure strip to the heat shrink sleeve seam.
- If the heat shrink sleeve edge raises up, reheat and press down firmly.
- While the heat shrink sleeve is still hot and soft, use a hand roller to gently roll the sleeve surface and push any trapped air up and out of the sleeve. Reheat, if necessary.



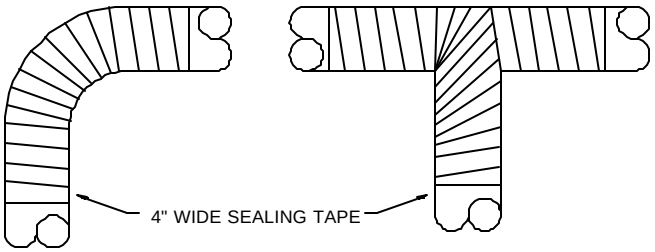
SEALING TAPE – XTRU-Therm ECONOMY FITTINGS

The insulation jacket for XTRU-Therm Economy elbow and tee fittings is 4 inch wide sealing tape over the transition sleeves and flexible PVC cover that are used for the insulation mold.

CAUTION: PERMA-PIPE's standard sealing tape is for belowground applications and is not resistant to the Sun's ultraviolet (UV) rays. Aboveground, UV resistant sealing tape is available from PERMA-PIPE when specified and ordered for aboveground service. Verify that the correct sealing tape has been purchased and received prior to use.

The sealing tape should be applied in the following manner;

- Roughen the surface of the insulation jacket, transition sleeves, and flexible PVC cover with sandpaper in the areas that will be covered with sealing tape.
- Wipe the area clean with a clean cloth. Use solvent if needed.
- Spirally wrap the sealing tape, with at least ½ inch overlap between layers, starting and finishing on the insulation jacket and completely covering the transition sleeves and flexible PVC cover.
- Apply the sealing tape smooth and without air bubbles or open seams.

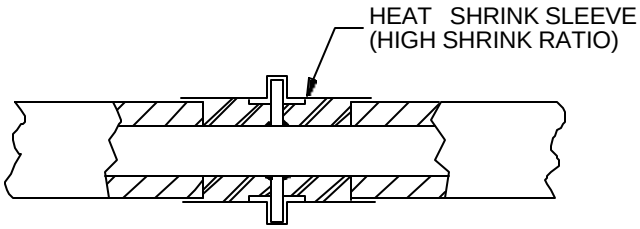


XTRU-Therm ECONOMY ANCHORS - BELOWGROUND

XTRU-Therm Economy belowground anchors are field assembled, insulated, and jacketed. The entire anchor assembly is jacketed with a high shrink ratio heat shrink sleeve. The heat shrink sleeve application recommendations above should be used for the installation of these heat shrink sleeves with the following modification;

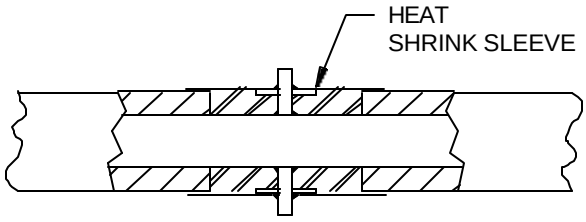
- The maximum circumference used to determine the length to cut the shrink sleeve should be the circumference of the outside diameter of the anchor plate.

CAUTION: Verify the heat shrink sleeves being used for the anchors are high ratio heat shrink sleeves, do not mix or confuse them with the heat shrink sleeves for straight field joints.



XTRU-Therm ECONOMY ANCHORS - ABOVEGROUND

XTRU-Therm Economy aboveground anchors are field assembled, insulated, and jacketed. The aboveground anchors have welded steel sleeve extensions for sealing a standard heat shrink sleeve onto. The heat shrink sleeve application recommendations above should be used for the installation of these heat shrink sleeves.



BACKFILLING

GENERAL

All types of flexible pipe derive some of their strength from the passive soil resistance around the pipe. Therefore, proper backfilling of the trench is very important to insure a structurally sound system.

XTRU-Therm piping is designed to handle normal soil and H20 traffic loading when these recommendations are followed and a minimum of 2 feet of properly compacted backfill is provided. It should be noted that shallower burial depths will increase the piping system heat loss/gain slightly.

If these recommendations conflict with the project contract specifications or drawings or PERMA-PIPE'S engineering drawings, the more stringent documents should take precedence. If in doubt, please contact your PERMA-PIPE Project Engineer, Project Manager or Field Technical Representative. Any deviations from these recommendations or PERMA-PIPE'S engineering drawings should be reviewed with the appropriate PERMA-PIPE personnel.

HIGH SURFACE LOADING CONDITIONS

Special burial depths and compaction requirements may be required at taxiways, runways, railways, roadways, and other areas of high surface loading conditions. It is recommended that the customer contact both PERMA-PIPE and the local authority for more specific instructions.

TRENCH BED AND INITIAL BACKFILL MATERIALS

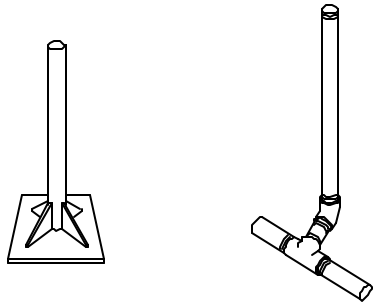
The following specifications should be used for the backfill material used for the trench bedding and initial backfill. Local geo-technical or soil testing laboratories can test backfill materials for compliance with these requirements.

- Sand or a sand-gravel mixture in which the gravel is either pea gravel or crushed stone without sharp edges.
- No unstable soil, such as plant or vegetable residue, clay or silt lumps, or frozen earth.
- Particles not larger than ¾ inch in diameter.
- 90% minimum passing a No. 4 sieve.
- 90% minimum retained by a No.200 sieve.

Flowable fills can be used if they meet the above requirements. However, PERMA-PIPE advises caution when using flowable fill due to the potential difficulty that may exist if re-excavation is required for repairs, modifications, or replacement.

EQUIPMENT AND TOOLS

The critical part of the backfill process is the compaction of the soil underneath, alongside, and up to 6" above the piping. Hand tamping tools can be constructed using small diameter pipe and plate materials. These tools will compact the soil firmly and evenly around the pipe and should be used instead of mechanical tampers to prevent damage to the insulation or insulation jacket.



Mechanical compactors or wheeled or tracked vehicles can be used for the trench bed and after a minimum of 12 inches of compacted soil is above the top of the insulation jacket.

TRENCH BEDDING AND INITIAL BACKFILL

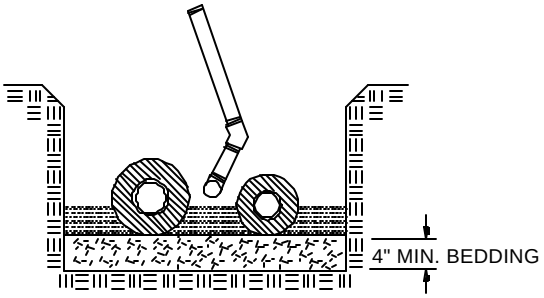
Material used for the trench bedding and initial backfill must be in accordance with the specifications above. Place the trench bed and initial backfill material in the following manner;

- Prior to backfilling, remove any foreign materials such as shoring, braces and support blocks.
- Under normal conditions, place trench bedding and initial backfill material in 6 inch lifts and compact to 90% modified proctor.
- Water can be added to the backfill material to achieve the optimum moisture content. Less compaction effort is required when the backfill material is at the optimum moisture content.

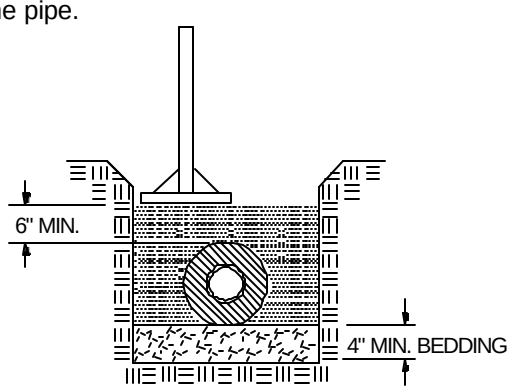
  Local geo-technical or soil testing laboratories can provide soil testing to determine the optimum moisture content and the soil density required to meet the proctor / compaction requirements.

INITIAL BACKFILL (continued)

- Proper compaction of the haunching materials, that section of the backfill extending from the bottom of the pipe to the centerline, should be performed using the hand tamping tool described above.



- Place and compact the initial backfill from the bottom of the trench to 6 inches above the top of the pipe.



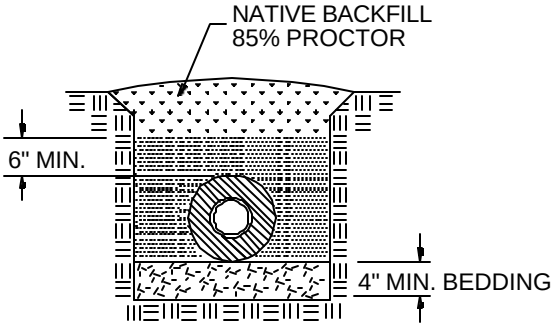
- **Do Not** use mechanical compactors or wheel or tracked vehicles for compaction until a minimum of 12 inches of compacted soil is above the top the insulation jacket.

FINAL BACKFILL

The final backfill material can be native soil but should free of rocks larger than 3 inches in diameter, frozen earth, organic material, plant or vegetable residue, or foreign matter.

Place the final backfill material to grade in 1 foot lifts and compact to 85% modified proctor.

Use of mechanical compaction equipment to complete the final backfill is suggested, but **Do Not** use mechanical compactors until a minimum of 12 inches of compacted soil is above the top of the insulation jacket.



GENERAL

PERMA-PIPE's XTRU-Therm piping system is designed for long, reliable service when properly installed, operated, and maintained.

If heat trace, leak detection, and/or other ancillary equipment is included with your XTRU-Therm piping system, refer to the appropriate Installation Manual for operation and maintenance instructions.

OPERATION

The piping system should be operated within the temperature and pressure limits designed for to prevent overstressing of the piping, damage to the insulation, or other related problems.

During start up, operation, and shut down the piping system should be heated and cooled slowly to prevent thermal shock and avoid slug flow conditions.

Abrupt changes in flowrate should be avoided to prevent water hammer and surge effects.

For corrosive fluid services, fluid treatment and / or de-aeration should be performed to prevent or retard interior corrosion of the service pipe.

MAINTENANCE

Periodic maintenance should be performed to ensure the XTRU-Therm piping system is in good condition and to maximize its service life. Any signs of damage, degradation, or deterioration should be identified, evaluated, and repaired.

It is critical that the insulation jacket integrity is maintained and the insulation is kept dry to prevent degradation to the insulation and corrosion of the service pipe.

At least twice a year the piping system should be inspected so any problems that may arise can be detected early. The actual frequency of inspection should be adjusted to account for service and operating conditions, climate, and/or ground conditions.

PERMA-PIPE INSPECTION SERVICES can provide infrared leak detection and energy evaluation surveys, sonic leak detection, ultrasonic pipe wall thickness testing and evaluation, and tracer gas leak detection services. These service can be useful for inspecting and maintaining your piping system. Contact PERMA-PIPE for additional information.

An inspection and maintenance log should be set up with all inspections and maintenance recorded. The inspection and maintenance log can be helpful for identify trends, providing documentation of inspection and maintenance activities, and troubleshooting.

UNDERGROUND SYSTEMS

- Inspect all insulation termination ends, building entries, manhole entries, and valve pits. Under no circumstances should water be allowed to cover insulation termination ends. Accumulating water should be immediately removed.
- On all wall and floor entries, inspect the link seals, packings, or other sealing devices being used to assure proper sealing of ground water.
- Inspect all exposed piping.
- Investigate any signs of excessive heat loss or heat gain.
- Observe the landscape for signs of fluid leakage or excessive heat loss or gain. Grass browning or snow melting above the piping are signs of excessive heat loss or gain.
- Inspect for signs of other excavations or constructions that could interfere with the piping.

Any signs of damage, degradation, or deterioration should be identified, evaluated, and repaired.

ABOVEGROUND SYSTEMS

- Inspect all insulation termination ends.
- Inspect all insulation jacket, and field joint closures.
- Inspect the insulation jacket and insulation at all support points.
- Inspect all exposed piping.
- Investigate any signs of excessive heat loss or heat gain.

Any signs of damage, degradation, or deterioration should be identified, evaluated, and repaired.

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http://www.permapipe.com

Installation Manual

WARRANTY

Seller warrants to the original Buyer only that the products sold hereunder will substantially comply with the above referenced technical specifications for the products and that no product will have any defect in Seller's design, workmanship or material. Seller shall not be responsible for and does not warrant the installation of the products. Seller agrees to provide field services as provided herein and warrants only that the information provided to Seller during such field service visits will be consistent with Seller's recommendations for installation. Seller specifically rejects all other warranties in the contract documents for the project, which may apply to Seller's products. The foregoing warranty shall be in effect with respect to each product sold hereunder only for a period of fifteen (15) months from the date of completion of testing of such product, but in no event more than eighteen (18) months from the date of shipment by Seller of such product; provided, however, no claim shall be permitted under the warranties contained herein unless Buyer shall give to Seller written notice of all respects in which Buyer claims the product to be defective or at a variance with specifications within ten (10) days from the date Buyer discovers or should have discovered a defect or variance from specifications, but in no event later than eighteen (18) months after shipment of such product, and unless Buyer shall afford Seller a reasonable opportunity to inspect such product after notice has been given. The foregoing warranties shall not apply to any products or components thereof, which have been subject to abnormal or improper use, negligence or accident or which have been altered or repaired by someone other than Seller or Seller's authorized representative. No product shall be returned without Seller's prior written consent. Buyer shall accept minor variations in dimensions or other variance from specifications provided that there is no impairment of function or useful life of the product. Seller warrants that its title to the product sold hereunder is good, and that the transfer thereof to Buyer is rightful.

Seller's obligations under the warranties contained herein and any other provision of the Agreement determined to constitute a warranty by the Seller of the products to be sold pursuant hereto, and Buyer's remedies for any defective or non-conforming products shall be limited solely to the repair or replacement, as elected by Seller of defective or non-conforming materials.

To the maximum extent permitted by law, Buyer irrevocably waives all claims against Seller for money damages relating to the condition, use and performance of the goods sold pursuant hereto, including claims based upon tort, strict liability, negligence and product liability. Notwithstanding the provisions of the preceding sentence, if money damages are assessed against the Seller, in no event shall Seller's liability for such damages exceed the purchase price of products sold by Seller.

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