

# **INSTALLATION GUIDELINE FOR TRYMER® INSULATION**

## ITW INSULATION SYSTEMS

### **TRYMER® RIGID POLYISOCYANURATE INSULATION IN CHILLED WATER APPLICATIONS (35°F to 60°F)**

#### **1 SCOPE**

- 1.1 This guideline covers the installation of Trymer® Rigid Polyisocyanurate Insulation on chilled water piping systems in commercial and industrial applications, including associated vessels, tanks, and equipment. Guidelines are provided for both indoor and outdoor applications.
- 1.2 Trymer Insulation is also suitable for use on hot piping and refrigeration systems. For details on these applications, see the ITW guidelines on the use of Trymer Insulation in hot and refrigeration applications.
- 1.3 Product data sheets and other ITW literature are referenced throughout this guideline. Consult your ITW Pipe Insulation Engineering Manual or go to <http://www.itwinsulation.com> for the latest version of these documents.
- 1.4 The information contained in this guideline and referenced ITW documents are current as of October, 2016. This guideline is subject to revision without notice. Contact ITW Insulation Systems Customer Information Group at 1-800-231-1024 or your local ITW Representative for the most recent version of this guideline or other ITW referenced literature.
- 1.5 Due to the variations in service conditions and use, this guideline may not be pertinent for every application. A design or specifying engineer can create specifications tailored to particular applications or owner's needs. Such a design or specification engineering service may be more familiar with local conditions, budgets, environment, and desired service life of the system allowing them to generate a precise specification.
- 1.6 It is the intent of this document to provide guidelines for the installation of Trymer Insulation and Saran™ Vapor Retarder Film and Saran™ Tape manufactured by ITW Insulation Systems. This guideline may not be suitable and shall not be used for the purpose of installing another insulation manufacturer's product. While supplemental insulation products may be referenced in this guideline, ITW recommends consulting the manufacturers of such products for proper installation and handling.
- 1.7 **This guideline is offered as a guide for the purpose described herein. No warranty of procedures, either expressed or implied is intended. All other express or implied warranties of merchantability or fitness for a particular purpose are disclaimed.**

#### **2 GENERAL**

- 2.1 All piping shall be free of foreign substances and free of surface moisture or frost prior to the application of insulation.
- 2.2 All insulation material shall be delivered to the project site in original, unbroken factory packaging labeled with product designation and thickness. The shipping package should not be air-tight. Shipment of materials from the manufacturer to the installation location shall be in weather tight transportation. Insulation materials delivered to the jobsite shall be stored so as to protect the materials from moisture and weather during storage and installation. Insulation material shall be protected from sunlight to avoid exposure to UV light from the sun.
- 2.3 All testing of piping systems shall be completed prior to the installation of the insulation system.
- 2.4 Refer to insulation thickness charts in Appendix C to determine recommended insulation thickness based on desired design criteria for ambient and service conditions.

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### **3 MATERIALS OF CONSTRUCTION**

#### **3.1 INSULATION MATERIALS FOR PIPING, FITTINGS, AND VALVES**

- 3.1.1 Insulation used in non-plenum applications shall be Trymer 2000XP or Trymer 25-50 Rigid Polyisocyanurate Insulation manufactured by ITW Insulation Systems.
- 3.1.2 Insulation used in plenums shall be Trymer 25-50 with ASTM E84 Flame Spread/Smoke Developed Indices of  $\leq 25/50$  at up to 1.5 inches of insulation thickness. In plenums where the thickness is greater than 1.5 inches, insulation shall be Trymer Supercel Phenolic (TSP) Insulation. Consult the ITW Installation Guideline for TSP for more information.
- 3.1.3 Insulation shall meet the requirements of ASTM C-591, type IV "Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation".
- 3.1.4 Insulation shall have a maximum thermal conductivity of 0.19 BTU-in/hr-ft<sup>2</sup>°F (0.027 W/m·°C) at 75°F.

#### **3.2 FABRICATION OF INSULATION**

- 3.2.1 Insulation shall be fabricated in required shapes from bun stock in accordance with ASTM C-450 "Standard Practice for Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments" and C-585 "Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System)". Insulation shall be factory fabricated from bun stock.
- 3.2.2 Fittings, such as valves, valve stations, flanges, 90° and 45° elbows, and tees shall be two pieces' fly-cut or routed as the preferred fabrication method. For diameters too large for fly cutting or routing, the pieces shall be fabricated in two halves with each half made up of mitered sections. Both methods shall be in accordance with ASTM C-450 and ASTM C-585. Larger outer diameter valves and flanges may be slightly oversized and cavities filled with tightly packed loose glass fiber or polyurethane spray foam (see Figure 1 in Appendix B). The size and number of cavities shall be kept to a minimum. Refer to application section 4.1.2 for related additional information.
- 3.2.3 Store the bun stock at normal shop (indoor) conditions for at least 24 hours before fabrication. This will allow the Trymer bun stock to equilibrate to the shop conditions. For best fabrication quality, it is recommended that Trymer buns be fabricated into pipe shells in conveyor direction (36" direction) to maximize flatness. The fabricated pipe shells may be aged for 24 hours before vapor retarder attachment. Similarly, after fabrication of the fittings/elbows/tees, allow the cut pieces to age for 24 hours before factory application of the vapor retarder to the fabricated pieces. After application of vapor retarder, fabricated pipe shells shall not be stored for more than one month either in the warehouse or at a job site before final installation.

#### **3.3 ADHESIVES, JOINT SEALERS AND MASTICS**

- 3.3.1 Solvent and water based adhesives, joint sealers and mastics may be used in contact with Trymer Insulation. Mastics shall remain flexible at the lowest expected ambient temperature.
- 3.3.2 Joint sealers for PVC jacketing slip joints, shall be vapor retarder type, moisture and water resistant, non- hardening, and flexible with a service temperature range from -50°F to +200°F.
- 3.3.3 Vapor retarder type mastic or joint sealers should be applied on insulation longitudinal joints and butt joints to prevent moisture and moisture vapor infiltration. Typical mastic or joint sealer can be CHIL-PERM CP-30, CHIL- PERM WB CP-35, AK-CRYL CP-9, VI-CRYL CP-10/11 from Childers Products Company or approved equal. Please consult mastic or joint sealant manufacturer for recommended products.
- 3.3.4 Solvent or water based adhesives may be used to attach the Saran Film to the outer surface of the Trymer insulation for factory applied Saran Film. Refer to the Saran installation guidelines. Consult adhesive manufacturer's literature for instructions on handling adhesives including required operating temperatures. Potential adhesives for use in this application include: a) Childers CP 88 adhesive (solvent adhesive) b) Foster 81-05 adhesive (solvent adhesive) c) Foster 85-50 adhesive ( water based adhesive) d) Childers CP 56 adhesive (water based adhesive) e) Foster 85-60 adhesive (water based adhesive).

### 3.4 VAPOR RETARDER

- 3.4.1 For pipe, the vapor retarder shall be Saran 540 Vapor Retarder Film and Saran 520 Saran Vapor Retarder Tape. Refer to ASTM standards C-755, ASTM C921 and C-1136 for information on selection and specification of vapor retarders. Refer to product literature and installation guidelines on Saran film and tape for recommended application instructions.
- 3.4.2 Saran shall not be left exposed in outdoor applications for longer than 2 weeks.
- 3.4.3 Elbows and fittings shall be wrapped with Saran 520 Vapor Retarder Tape. When the nominal pipe size is 6" or less, use 1" wide Saran 520 tape. When the nominal pipe size is between 6" and 12", use 2" wide Saran 520 tape. When the nominal pipe size is greater than 12", use 3" wide Saran 520 tape.
- 3.4.4 Vapor retarder butt joints shall be sealed with 3" wide Saran 520 Vapor Retarder Tape (see Figure 3 in Appendix B).
- 3.4.5 Vapor Retarder shall have a maximum permeance of 0.030 perm.
- 3.4.6 Vapor retarder may be factory or field applied to the outer surface of pipe insulation. Refer to Installation Guideline on Saran Vapor Retarder Film for additional information.
- 3.4.7 Where Self Seal Lap (SSL) tape is used to join the longitudinal seams of the vapor retarder, all vapor retarder surfaces should be cleaned and free of dust/ grease/ oil/etc. before application of the SSL tape to ensure good adhesion between the tape and vapor retarder. The width of the SSL tape shall be 1½" or greater. The recommended SSL tapes can be: Venture SSL 1124, Venture SSL 3693 FLE, Venture SSL 1163, or Venture SSL 514CW. ITW does not recommend the use of mastics over the longitudinal joint.
- 3.4.8 Where outer protective jacketing is used on tanks, vessels, and equipment, use Saran 540 or 560 Vapor Retarder Film or approved equal.
- 3.4.9 Where the vapor retarder is field-applied, the Trymer PIR insulation shall be held closed using filament tape applied to the insulation surface prior to vapor retarder installation. The taping pattern shall follow the guidelines in Table 1 in Appendix B. The vapor retarder shall be held closed using the self-sealing lap tape on the longitudinal joint and vapor retarder tape or butt strips on the butt joints.
- 3.4.10 Where the vapor retarder is factory-applied and protective jacketing consisting of PVC with solvent welded longitudinal joints or metal with banding is used, the Trymer PIR insulation and vapor retarder shall be held closed using just the self-sealing lap on the longitudinal joint of the vapor retarder and the vapor retarder tape at the butt joints. There is no need for any additional taping of the insulation/vapor retarder. Refer to Table 1 in Appendix B for additional details on taping guidelines.
- 3.4.11 Where the vapor retarder is factory-applied and outer protective jacketing such as metal or PVC is not used, the Trymer PIR insulation and vapor retarder shall be held closed following the taping guidelines in Table 1 in Appendix B for the appropriate pipe size, insulation thickness, and vapor retarder material. See Figure 6 for additional details on taping of Trymer PIR if Saran Vapor Retarder is used. See Figure 7 for additional details on taping of Trymer PIR if Saran Vapor Retarder is not used.
- 3.4.12 ITW does not recommend the use of mastics over Saran tape.

### 3.5 PROTECTIVE JACKETING MATERIALS

#### 3.5.1 Indoor Applications

- 3.5.1.1 On piping systems where mechanical abuse is minimal, Saran 540 film can be used as the outer jacketing. See 3.4.9 for banding requirements.
- 3.5.1.2 Where Saran film is the outer jacketing, Saran 520 tape shall serve as the outer jacketing on all fittings, elbows, valves, caps, etc.
- 3.5.1.3 If protective jacketing is required on piping, tanks, vessels, or equipment such as in industrial applications, it shall be PVC material. Consult jacketing manufacturer for recommended PVC thicknesses. Typical PVC Jacketing thicknesses are 0.010 to 0.030". Jacketing shall be tough and capable of enduring frequent wash-downs with hot water or cleaning agents. All joints of a PVC jacket shall be solvent welded to prevent moisture infiltration into the insulation system.
- 3.5.1.4 When using PVC jacketing, supply preformed PVC covers for all fittings, tees, elbows, valves, caps, etc. at same PVC thickness as on straight pipe sections.
- 3.5.1.5 PVC protective jacketing shall not be considered a vapor retarder. See 3.4.1 and 3.4.3 for vapor retarder

recommendation.

- 3.5.1.6 Neither rivets, screws, staples nor any other fastener capable of penetrating the underlying vapor retarder shall be used to secure the jacketing.
- 3.5.1.7 Saran 560 Vapor Retarder Film may be used as a combination vapor retarder and protective jacket unless degree of mechanical abuse is very high. It may be used in lieu of the Saran 540 Vapor Retarder Film and the PVC jacketing. Consult manufacturer for details.
- 3.5.2 **Outdoor Applications**
  - 3.5.2.1 Jacketing shall be aluminum metal cladding. Jacketing shall be aluminum alloys 3003, 1100 or 3105 meeting ASTM B-209 with H-14 temper and minimum 2 ½ mil thickness polyfilm moisture barrier on the inner side. Consult jacketing manufacturer for recommended thicknesses and usage. Typical thickness is 0.016".
  - 3.5.2.2 Aluminum jacketing for all fittings, tees, elbows, valves, caps, etc. shall be sectional, factory contoured, or field-fabricated to fit closely around insulation.
  - 3.5.2.3 Banding for jacketing shall be 0.02" thick by 1/2" wide stainless steel.
  - 3.5.2.4 Aluminum protective jacketing shall not be considered a vapor retarder. See 3.4.1 and 3.4.3 for vapor retarder recommendation.
  - 3.5.2.5 Neither rivets, screws, staples nor any other fastener capable of penetrating the underlying vapor retarder shall be used to secure the aluminum jacketing.
- 3.5.3 **Underground Applications**
  - 3.5.3.1 Underground jacketing shall be vapor retarder material with chemical resistance to ground water. Products to be used are Saran 560 as manufactured by ITW Insulation Systems or 50 mil self-adhesive laminated membrane type vapor retarder product. For trench details refer to Figure 2 in Appendix B.

## **4 APPLICATION**

### **4.1 PIPING - GENERAL**

- 4.1.1 Orient longitudinal joints between half sections in the 3 and 9 o'clock position on the pipe.
- 4.1.2 Install pre-fabricated insulation fittings on elbows, tees, and valves. Insulation at fittings shall be the same thickness as on pipe straight sections.
- 4.1.3 Bottom insulation sections in hanger saddles shall be Trymer 25-50, 2000XP, 3000, or higher density/strength Trymer PIR Insulation for resistance to compression on pipe diameters 4" and greater. Consult insulation manufacturer for your specific scenario. Saddles shall wrap the insulation in an arc between 120° and 180° depending upon the load.
- 4.1.4 For both factory and field applied vapor retarders systems, securement of the insulation and vapor retarder shall be done in accordance with sections 3.4.9, 3.4.10, and 3.4.11.
- 4.1.5 For both factory and field applied Saran Vapor Retarder, staggering of the butt joints in the top and bottom insulation sections is not necessary.
- 4.1.6 All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor retarder must be continuous. Any tape or banding shall be neatly aligned and overall work must be of high quality appearance and workmanship.
- 4.1.7 Elbows and fittings shall be wrapped with Saran 520 Vapor Retarder Tape. See Section 3.4.3 for Saran tape usage. Saran 520 tape shall be wrapped in a spiral configuration. When Saran Vapor Retarder is factory-applied, lap joint shall be sealed with SSL tape. Apply Saran 520 tape around the butt joint with a ¼ circumference overlap. See details in Figure 3 and Figure 4 in Appendix B.
- 4.1.8 When jacketing is used, before it can be installed on a portion of the piping, the vapor retarder system on that portion must be complete and continuous.

### **4.2 INDOOR PIPING**

- 4.2.1 This section covers indoor areas including, but not limited to, mechanical rooms, process areas, plenums, and inhabited areas. Consult applicable codes for areas where flame and smoke requirements may apply.
- 4.2.2 Refer to section 3.1 for insulation material specification on indoor jacketing.
- 4.2.3 Insulation systems on indoor piping, valves and flanges shall all be covered per jacketing requirements in section 3.5.1.
- 4.2.4 Seal around protrusions, such as valve stems with a full bead of silicone sealant.

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### 4.3 OUTDOOR PIPING

- 4.3.1 This section covers outdoor areas including, but not limited to, process areas, rooftops and rooftop equipment.
- 4.3.2 Trymer Insulation shall be protected from prolonged exposure to UV light and weather upon installation.
- 4.3.3 Outdoors, Saran Products shall be covered with a jacketing material within two weeks of installation to eliminate long-term exposure to UV light. Refer to section 3.5.2 for material specification on outdoor jacketing.
- 4.3.4 Outdoor jacketing overlap shall be a minimum of 2" at butt joints and a minimum of 2" at longitudinal joints. Jacketing shall be caulked before closing and banding and the joints positioned in an orientation such that the opening points down to minimize water infiltration.
- 4.3.5 Straight sections of jacketing shall be neatly secured with bands and seals with a maximum spacing of 9" on center. End joints shall be secured with bands and seals centered directly over joint. Do not use screws, staples or other fasteners capable of penetrating the underlying vapor retarder.

### 4.4 UNDERGROUND PIPING FOR INDUSTRIAL APPLICATIONS

- 4.4.1 Refer to section 3.5.3 for jacketing requirements.
- 4.4.2 Butt joints in the top and bottom insulation sections shall be staggered from each other.
- 4.4.3 Saran 560 vapor retarder shall be field applied to allow for staggering of insulation.

### 4.5 TANK, VESSEL, AND EQUIPMENT INSULATION FOR INDUSTRIAL APPLICATIONS

- 4.5.1 All insulation materials shall be the same as those used on the pipe associated with the tank, vessel, or equipment (industrial and commercial).
- 4.5.2 Tank and vessel head segments shall be curved or flat cut to fit in single piece or segments per ASTM C-450. Head segments shall be cut so as to eliminate voids at the head section and in a minimum number of pieces so as to eliminate through joints.
- 4.5.3 Prefabricated flat head sections shall be installed at the same thickness as the vessel walls. Void area behind the flat head shall be filled with spray applied polyurethane foam. Curved segments shall be fabricated to fit the contour of the surface in equal size pieces to go around the vessel with a minimum number of through joints. Cutting in the field shall be minimized. All sections shall be tightly butted and free of voids and gaps. Refer to Figure 5 in Appendix B.
- 4.5.4 Vertical vessels greater than 4 feet in diameter require an insulation support ring welded or bolted around the bottom of the tank to prevent the shell insulation from sliding down.
- 4.5.5 Secure the tank insulation with stainless steel bands on 12-inch centers.
- 4.5.6 Install Saran 560CX Vapor Retarder product. Tightly wrap the vessel or equipment (industrial and commercial) insulation circumferentially with Saran film. Overlap the seams by a minimum of 2 inches. Seal the overlapped seams with Saran 560CX Vapor Retarder Tape. On vertical vessels apply the Saran film starting with the bottom course and work upwards. Each course should overlap on top of the one below it thus providing a joint that will naturally shed water.
- 4.5.7 The vapor retarder on curved head sections shall be mastic/fab/mastic or approved alternate. Flat head sections can be covered with Saran 540CX or 560CX films. Lap joints shall be sealed with Saran 560 Vapor Retarder Tape.
- 4.5.8 Legs and appendages attached directly to the shell shall be insulated out from the vessel head or wall four times the insulation thickness and the insulation termination sealed with a vapor stop.
- 4.5.9 Indoor tanks, vessels, and equipment (industrial and commercial), where mechanical abuse is anticipated shall be covered with PVC jacketing per section 3.5.1. Indoor tanks, vessels, and equipment, where mechanical abuse is not anticipated, see section 3.4.8. On outdoor equipment use aluminum jacketing per section 3.5.2. Rivets, screws, or other fasteners capable of puncturing the vapor retarder shall not be used to attach jacketing.

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## 5 APPENDICES

### 5.1 APPENDIX A: CORROSION RESISTANT METAL COATINGS

5.1.1 **GENERAL NOTE** Corrosion of metal pipe, vessels, and equipment under insulation, while not typically caused by the insulation, is still a significant issue that must be considered during the design of any mechanical insulation system. The propensity for corrosion is dependent on many factors including the ambient environment and the operating temperature of the metal. The recommendations below represent the general practice in the industry but are not meant to take the place of proper system design and specification by a qualified design engineer familiar with this type of construction.

We recommend that the owner consult such an engineer and have them work closely with the fabricator, the contractor, and ITW to help insure a properly designed, installed, and long-lasting insulation system free of corrosion.

#### 5.1.2 SPECIFIC RECOMMENDATIONS

5.1.2.1 **Stainless Steel** All 300 series stainless steel shall be coated with an epoxy primer at 5 mil thickness and an epoxy finish coat at 5 mil thickness if operating in a temperature range between 140°F and 300°F or if in a cycling temperature service where the service temperature is between 140° and 300°F for more than 20% of the time. Consult a coating manufacturer for appropriate coating materials and application methods based on the operating temperature range of the equipment.

5.1.2.2 **Carbon Steel** All carbon steel operating at a service temperature between 32°F and 300°F or in cycling temperature service where the service temperature is between 32°F and 300°F for more than 20% of the time shall be at a minimum primer coated with an epoxy coating. Consult a coating manufacturer for appropriate coating materials and application methods for the operating temperature range of the equipment.

### 5.2 APPENDIX B: DETAILS

The following details are referenced in the text of this guideline by their Table or Figure numbers. The diagrams included in this section are representative of details used within the industry. However, they are not intended to display the only accepted method of installation but to serve more as an example of commonly used and acceptable practice

## TAPING GUIDELINES

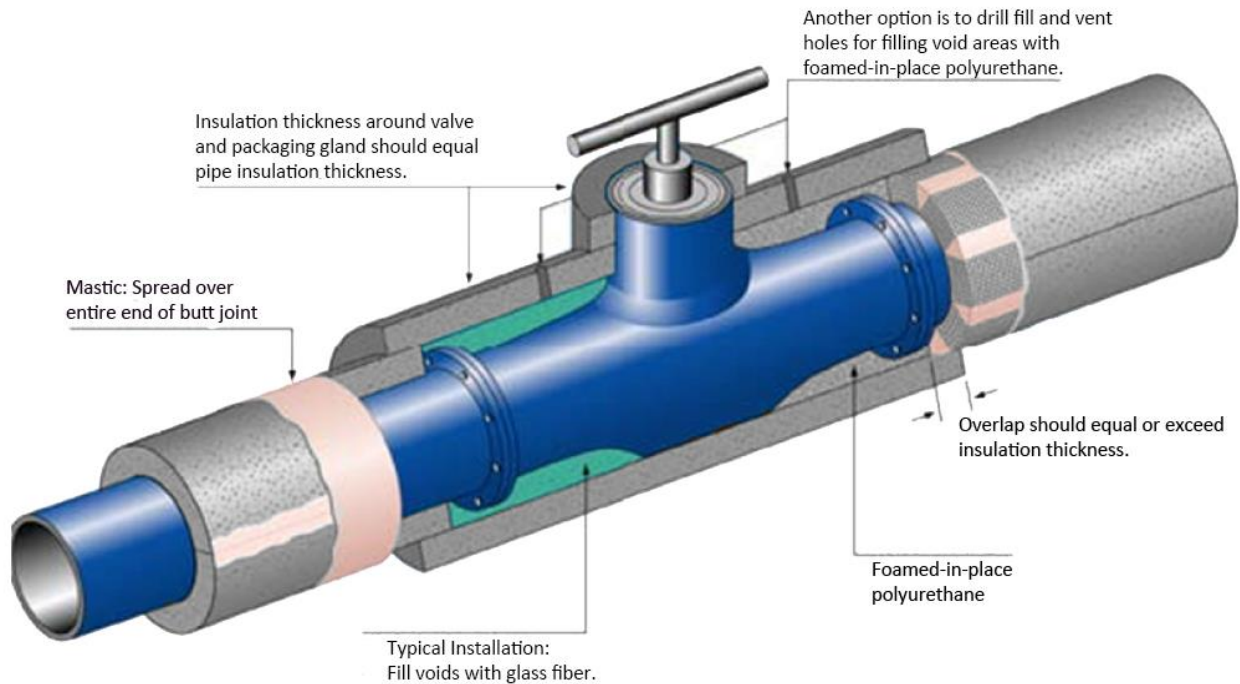
Vapor Retarder Application	Exterior Protective Jacket Used (Metal, PVC, etc.)	NPS (inches)	Nominal Insulation Thickness	Vapor Retarder Used	Taping Guidelines
Field-Applied	Yes or No	All	All	All	¾ inch wide filament tape on 12 inch centers with 50% circumferential overlap (1-1/2 wraps) applied to insulation surface prior to vapor retarder installation.
Factory-Applied	Yes	All	All	All	No taping of insulation is necessary.
	No	<4 inches	≤1 inch	All	No taping of insulation is necessary. SSL and butt strips/tape sufficient.
			>1 inch	Saran	Saran 520CX Tape or ¾ inch wide filament tape on 18 inch centers with 25% circumferential overlap (1-1/4 wraps) applied to outer surface of vapor retarder.
		Not Saran		¾ inch wide filament tape on 12 inch centers with 25% circumferential overlap (1-1/4 wraps) applied to outer surface of vapor retarder.	
		≥4 inches		All	Saran
			Not Saran		¾ inch wide filament tape on 12 inch centers with 25% circumferential overlap (1-1/4 wraps) applied to outer surface of vapor retarder.

**Table 1**

### Detail Notes:

- See **Figure 6** for additional details on taping of Trymer PIR with factory-applied vapor retarder if Saran Vapor Retarder is used.
- See **Figure 7** for additional details on taping of Trymer PIR with factory-applied vapor retarder if a vapor retarder other than Saran is used.
- Refer to sections 3.4.9, 3.4.10, and 3.4.11 for more information.

## VALVE INSULATION DETAIL (Including Optional Filling of Voids)



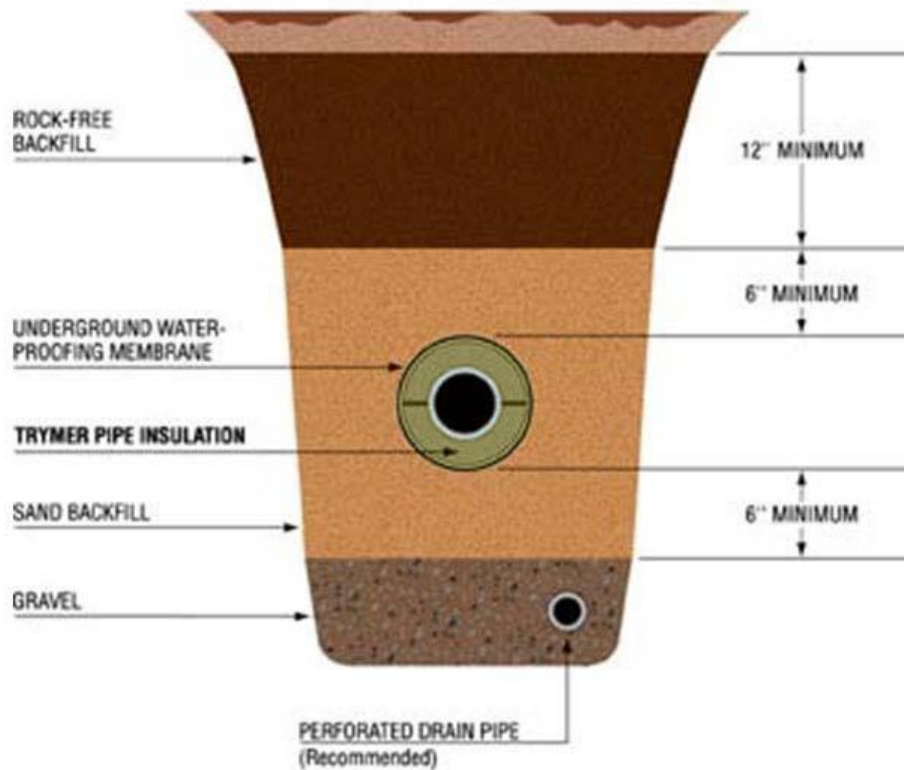
**Figure 1**

### Detail Notes:

- The preferred way to insulate a valve or fitting is with prefabricated tight fitting insulation pieces. If that approach is not used, this detail shows an alternative.
- If desired, voids around valve can be filled with foam-in-place polyurethane or glass fiber.
- Vapor retarder on valve shall be continuous with that on attached pipe.



## TRENCH DETAILS

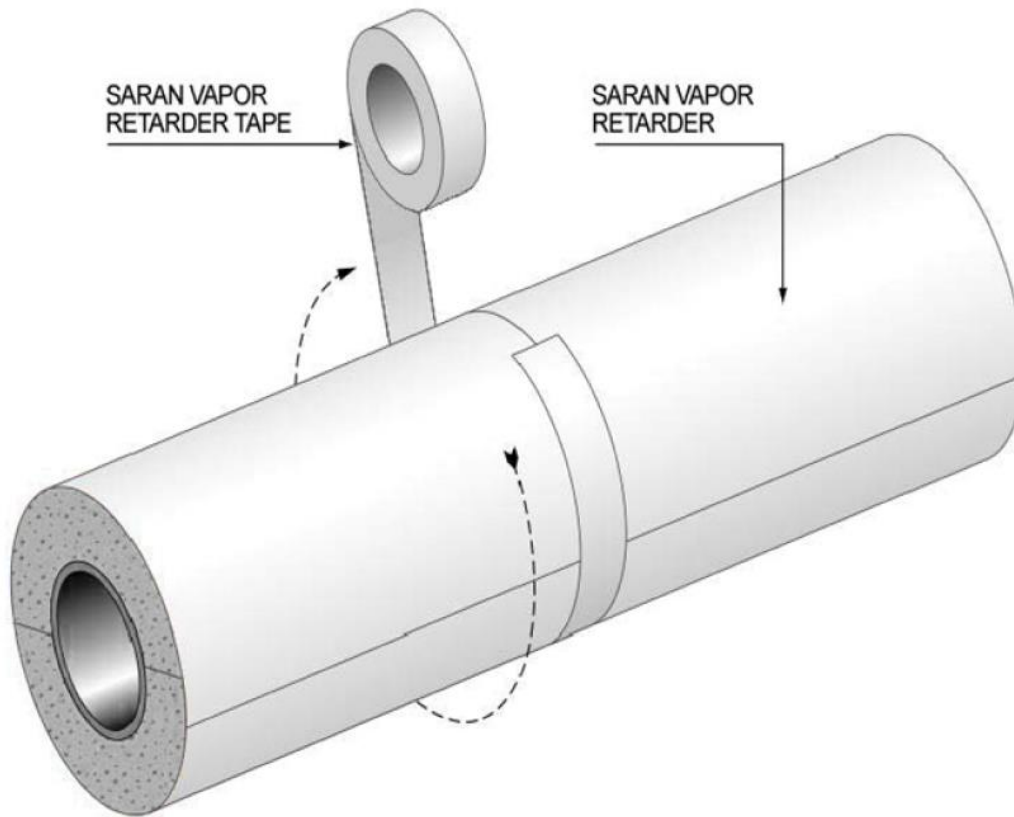


**Figure 2**

### Detail Notes:

- Insulation shall be used in conjunction with a waterproof membrane. Protective jacketing products alone are not sufficient for immersion in groundwater. Refer to section 3.5.3.1 of this guideline for recommended jacketing.
- Earth fill around the pipe shall be sand without contaminants that may puncture the vapor retarder.
- Drain tile in trench bottom is recommended to minimize exposure of the insulation system to groundwater.

## FACTORY APPLIED SARAN™ FILM AND SARAN™ TAPE APPLICATION



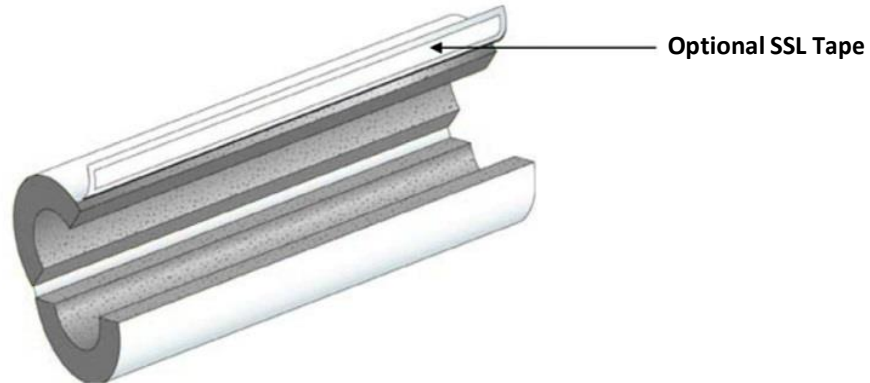
**Figure 3**

### Detail Notes:

- Saran Vapor Retarder Film lap seal to be SSL tape or liquid adhesive per Installation Guide for Saran.
- Saran 520 Vapor Retarder Tape shall be used on butt joints.
- Saran tape used at butt joints shall be 3 inches wide.
- Wrap tape around butt joint 1.25 times the circumference (1 ¼ wraps).

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## FACTORY APPLIED SARAN™ FILM WITH SSL TAPE ON LAP JOINT

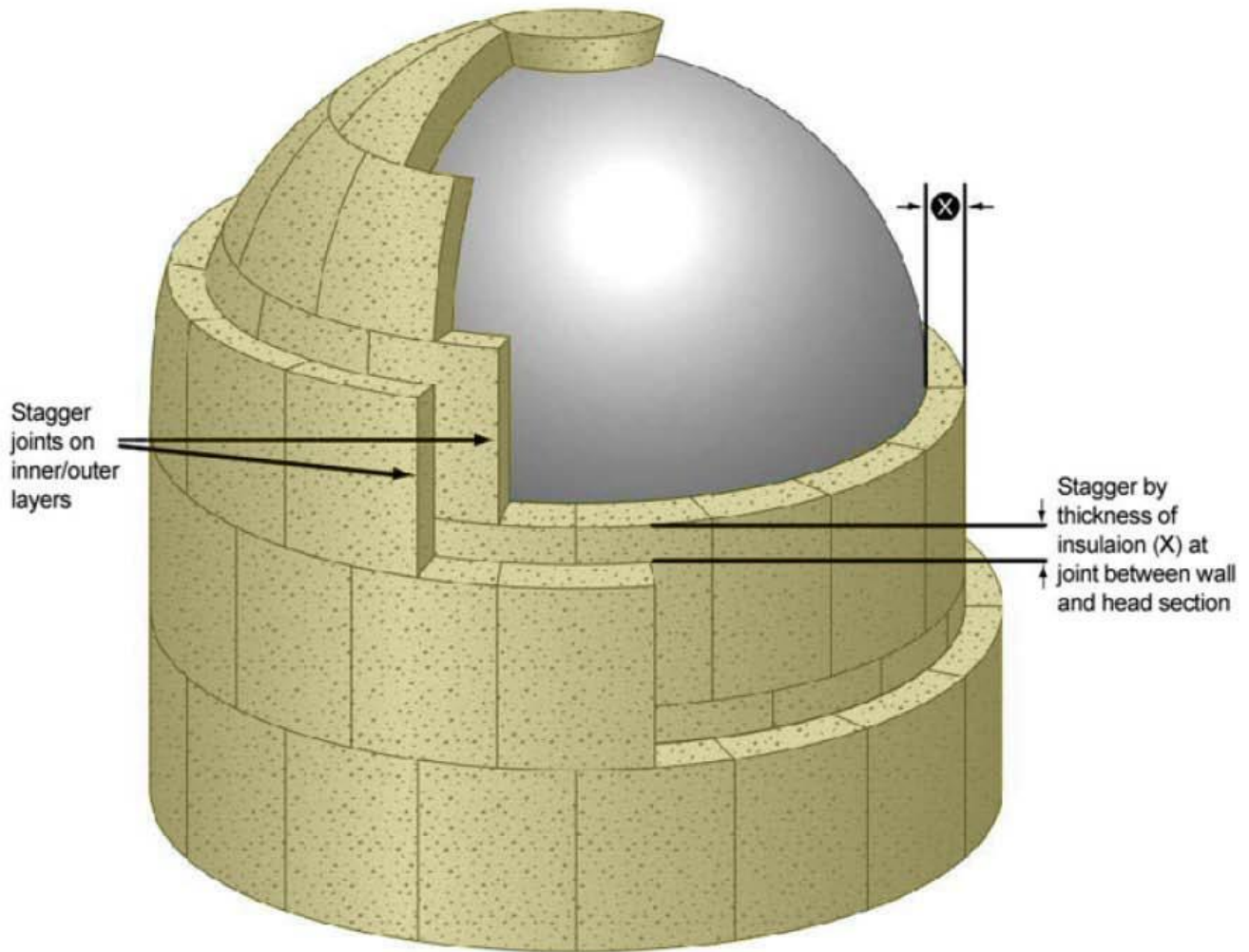


**Figure 4**

### Detail Notes:

- Saran Vapor Retarder Film can be installed using SSL tape as shown above or using liquid adhesives.
- Butt joints to be covered a minimum of 1.5" on each side of joint by Saran 520 Tape or butt strip.

## TANK AND VESSEL INSULATION DETAIL



**Figure 5**

### DETAIL NOTES:

- Insulation thickness on tanks, vessels, and equipment (X in above diagram) shall be that same as the thickness on the associated piping.
- Insulation shall be installed so that the vertical joints in each course are staggered from the joints in the courses on either side by half the width of a full section.
- Where mastics or sealants are required to bond the insulation sections to the tank head consult the manufacturer's recommendations on service and application temperature.

## TAPING PATTERN FOR CHILLED WATER APPLICATIONS

**Figure 6**



**Figure 7**

**Figure 6** shows Saran as the factory-applied vapor retarder. 1" or greater Saran 520 tape should be used to wrap outside of the Saran vapor retarder at 18" centers with 25% circumferential overlap (1 ¼ wraps).

**Figure 7** shows a vapor retarder other than Saran as the factory-applied vapor retarder. 1" or greater Saran 520 tape or ¾" or greater filament tape should be used to wrap outside of the vapor retarder at 12" centers with 25% circumferential overlap (1 ¼ wraps).

### 5.3 APPENDIX C: THICKNESS TABLES

The following tables show the Trymer 25-50 or Trymer 2000XP PIR insulation thickness necessary to achieve the specified design criterion. Where this is condensation control, the thickness shown is that necessary to prevent condensation on the outer surface of the insulation system (vapor retarder or jacketing).

These thickness requirements are applicable only for the specific design conditions and design criterion shown with each table. A number of assumptions are also made, including proper system design and installation. There may be additional factors the tables do not address that could influence the end results. These thickness tables are not meant to replace proper system design and specification by a qualified design engineer familiar with specific ambient design parameters for a given locality. We recommend that you consult such an engineer and have them work closely with the contractor, and ITW to help insure a properly designed, installed, and long-lasting insulation system. Thickness calculations for condensation control are based on the heat flow algorithms in ASTM C680-10. The required insulation thicknesses include a safety factor in the form of the conservative k-Factor values used by ITW to characterize the performance of our PIR insulation materials. Actual operating conditions can vary. Consult a design engineer to determine the applicability of these conditions for your application and to determine if any additional safety factor is appropriate.

**Thickness Tables shown below**

- 1) Required T25-50 or T2000XP Thickness for Energy Conservation Per ASHRAE 90.1 and the IECC Model Code
- 2) Required T25-50 or T2000XP Thickness for Condensation Control in Indoor Conditioned Space Chilled Water Applications
- 3) Required T25-50 or T2000XP Thickness for Condensation Control in Indoor Unconditioned Space Chilled Water Applications
- 4) Required T25-50 or T2000XP Thickness for Condensation Control in Outdoor Harsh Condition Chilled Water Applications

**Thickness Table #1**  
**Required T25-50 or T2000XP PIR Insulation Thickness for Energy Conservation**

Based on only energy conservation/efficiency as shown in table 6.8.3-2 in ASHRAE 90.1-13 which is incorporated exactly in the IECC-15.

NPS Range (inches)	Required <sup>a</sup> Insulation Thickness (inches) For Chilled Water Applications <sup>b</sup> for Various Insulations					
	Trymer 25-50 or 2000XP <sup>c</sup>		Glass Fiber		Cellular Glass <sup>c</sup>	
	35°F Pipe	40°F Pipe	35°F Pipe	40°F Pipe	35°F Pipe	40°F Pipe
<1	0.30	0.32	0.5	0.5	0.59	0.61
1 to ≤1.5	0.50	0.33	1.0	0.5	1.20	0.60
1.5 to ≤4	0.64	0.66	1.0	1.0	1.16	1.19
4 to ≤8	0.66	0.68	1.0	1.0	1.15	1.17
≥8	1.0	0.70	1.5	1.0	1.73	1.17

<sup>a</sup>Required insulation thickness was determined using the method required by ASHRAE 90.1-13 which is shown in footnote a) of table 6.8.3-2 in the 90.1-15 standard.

<sup>b</sup>Only the design conditions of pipe temperature and pipe size are considered in the portions of the energy codes governing pipe insulation. Other conditions including ambient temperature, wind, and jacket type are not considered.

<sup>c</sup>The thickness values shown for Trymer PIR and cellular glass are those required by the ASHRAE 90.1 and IECC energy codes to achieve the desired energy conservation/efficiency and do not consider other factors such as condensation control, minimum thicknesses available for pipe insulation, or the thicknesses at which pipe insulation is actually fabricated. In many cases, the next larger half-inch increment of size would have to be used. For example, a cellular glass required thickness of 1.19 inches would not be available so a nominal thickness of 1.5 inches would be the next smallest size commercially available.

**Thickness Table #2**

Required T25-50 or T2000XP Thickness for Condensation Control in Indoor Conditioned Space Chilled Water Applications

Ambient Temp = 75°F

Outer surface = Saran, PVC, ASJ, or mastic ( $\epsilon = 0.90$ )

Ambient Relative Humidity = 75%, 80%, 85%

Wind Velocity = 1 mph

Dewpoint =  $\leq 66.6^\circ\text{F}$ ,  $68.4^\circ\text{F}$ ,  $70.2^\circ\text{F}$

Geometry = Horizontal Pipe

**Insulation Thickness in Inches Necessary to Prevent Condensation**

NPS (in)	Relative Humidity $\leq 75\%$				Relative Humidity 80%				Relative Humidity 85%			
	Service Temperature ( $^\circ\text{F}$ )				Service Temperature ( $^\circ\text{F}$ )				Service Temperature ( $^\circ\text{F}$ )			
	35	40	45	50	35	40	45	50	35	40	45	50
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
1.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5
4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5
6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	0.5	0.5
8	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	0.5
10	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	1	1	1	0.5
12	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	0.5	0.5
14	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	1	1	1	0.5
16	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	1	1	1	0.5
18	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	1	1	1	0.5
20	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	1	1	1	0.5
22	0.5	0.5	0.5	0.5	1	1	0.5	0.5	1	1	1	0.5
24	0.5	0.5	0.5	0.5	1	1	0.5	0.5	1	1	1	1
28	0.5	0.5	0.5	0.5	1	1	0.5	0.5	1	1	1	1
30	0.5	0.5	0.5	0.5	1	1	0.5	0.5	1	1	1	1
36	0.5	0.5	0.5	0.5	1	1	0.5	0.5	1	1	1	1

*The table above shows required thicknesses of 0.5 inches' nominal in some locations because this is what is actually calculated as being needed. However, for pipe insulation applications, ITW recommends that the minimum thickness for Trymer PIR be 1-inch nominal for shipping and handling purposes.*

**Thickness Table #3**

Required T25-50 or T2000XP Thickness for Condensation Control in Indoor Unconditioned Space Chilled Water Applications

Ambient Temp = 90°F  
 Ambient Relative Humidity = 80%, 85%, 90%  
 Dew point = ≤83.0°F, 84.9°F, 86.6°F

Outer surface = Saran, PVC, ASJ, or mastic (ε = 0.90)  
 Wind Velocity = 1 mph  
 Geometry = Horizontal Pipe

**Insulation Thickness in Inches Necessary to Prevent Condensation**

NPS (in)	Relative Humidity 80%				Relative Humidity 85%				Relative Humidity 90%			
	Service Temperature (°F)				Service Temperature (°F)				Service Temperature (°F)			
	35	40	45	50	35	40	45	50	35	40	45	50
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	0.5
1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	1
1.5	0.5	0.5	0.5	0.5	1	1	0.5	0.5	1	1	1	1
2	0.5	0.5	0.5	0.5	1	1	0.5	0.5	1	1	1	1
3	1	0.5	0.5	0.5	1	1	1	1	1.5	1	1	1
4	1	0.5	0.5	0.5	1	1	1	1	1.5	1.5	1	1
6	1	1	0.5	0.5	1	1	1	1	1.5	1.5	1.5	1
8	1	1	1	0.5	1	1	1	1	1.5	1.5	1.5	1
10	1	1	1	0.5	1	1	1	1	1.5	1.5	1.5	1.5
12	1	0.5	0.5	0.5	1	1	1	1	1.5	1.5	1.5	1
14	1	1	1	1	1	1	1	1	2	1.5	1.5	1.5
16	1	1	1	1	1.5	1	1	1	2	1.5	1.5	1.5
18	1	1	1	1	1.5	1	1	1	2	1.5	1.5	1.5
20	1	1	1	1	1.5	1	1	1	2	2	1.5	1.5
22	1	1	1	1	1.5	1	1	1	2	2	1.5	1.5
24	1	1	1	1	1.5	1	1	1	2	2	1.5	1.5
28	1	1	1	1	1.5	1.5	1	1	2	2	1.5	1.5
30	1	1	1	1	1.5	1.5	1	1	2	2	1.5	1.5
36	1	1	1	1	1.5	1.5	1	1	2	2	1.5	1.5

The table above shows required thicknesses of 0.5 inches nominal in some locations because this is what is actually calculated as being needed. However, for pipe insulation applications, ITW recommends that the minimum thickness for Trymer PIR be 1-inch nominal for shipping and handling purposes.



**Thickness Table #4**

Required T25-50 or T2000XP Thickness for Condensation Control and to Limit Heat Gain in Outdoor Harsh Condition Chilled Water Applications

Ambient Temp = 90°F

Ambient Relative Humidity = 80%, 85%, 90%

Dew point = ≤83.0°F, 84.9°F, 86.6°F

Outer surface = Aluminum jacketing ( $\epsilon = 0.1$ )

Wind Velocity = 7 mph

Geometry = Horizontal Pipe

**Insulation Thickness in Inches Necessary to Prevent Condensation and Limit Heat Gain to ≤8 Btu/hr-ft<sup>2</sup>**

NPS (in)	Relative Humidity 80%				Relative Humidity 85%				Relative Humidity 90%			
	Service Temperature (°F)				Service Temperature (°F)				Service Temperature (°F)			
	35	40	45	50	35	40	45	50	35	40	45	50
0.5	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1
1.5	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1	1	1	1	1
6	1.5	1	1	1	1.5	1	1	1	1.5	1	1	1
8	1.5	1	1	1	1.5	1	1	1	1.5	1	1	1
10	1.5	1	1	1	1.5	1	1	1	1.5	1	1	1
12	1	1	1	1	1.5	1	1	1	1.5	1	1	1
14	1.5	1.5	1	1	1.5	1.5	1	1	1.5	1.5	1	1
16	1.5	1.5	1	1	1.5	1.5	1	1	1.5	1.5	1.5	1
18	1.5	1.5	1	1	1.5	1.5	1	1	1.5	1.5	1.5	1
20	1.5	1.5	1	1	1.5	1.5	1	1	1.5	1.5	1.5	1
22	1.5	1.5	1	1	1.5	1.5	1	1	1.5	1.5	1.5	1
24	1.5	1.5	1	1	1.5	1.5	1	1	1.5	1.5	1.5	1.5
28	1.5	1.5	1	1	1.5	1.5	1	1	1.5	1.5	1.5	1.5
30	1.5	1.5	1	1	1.5	1.5	1	1	2	1.5	1.5	1.5
36	1.5	1.5	1	1	1.5	1.5	1	1	2	1.5	1.5	1.5

Since this is an outdoor application, it is impossible for the pipe to be located in a plenum. Further, it is likely that the flammability requirements related to pipe insulation contained in the Mechanical Code are not even applicable. Still, it would be reasonable to require the same flammability limit for insulation outside of the building as is used for insulation indoors but not in a plenum. This limit is called "Class A" or "Class 1" and is an ASTM E84 flame spread/smoke developed maximum of 25/450. Trymer 2000XP PIR meets this flame/smoke requirement at all thicknesses. For these reasons, we recommend the use of Trymer 2000XP in outdoor applications. Trymer 25-50 could be used but would be slightly higher in cost.

Since this is an outdoor application, the energy efficiency requirements of ASHRAE 90.1 and the IECC likely do not apply but energy efficiency is still of concern. Therefore, a heat gain limit of 8 Btu/hr-ft<sup>2</sup> of outer jacket surface is applied in addition to a condensation control requirement. This heat gain limit is the one normally used in the insulation industry for cold pipe.