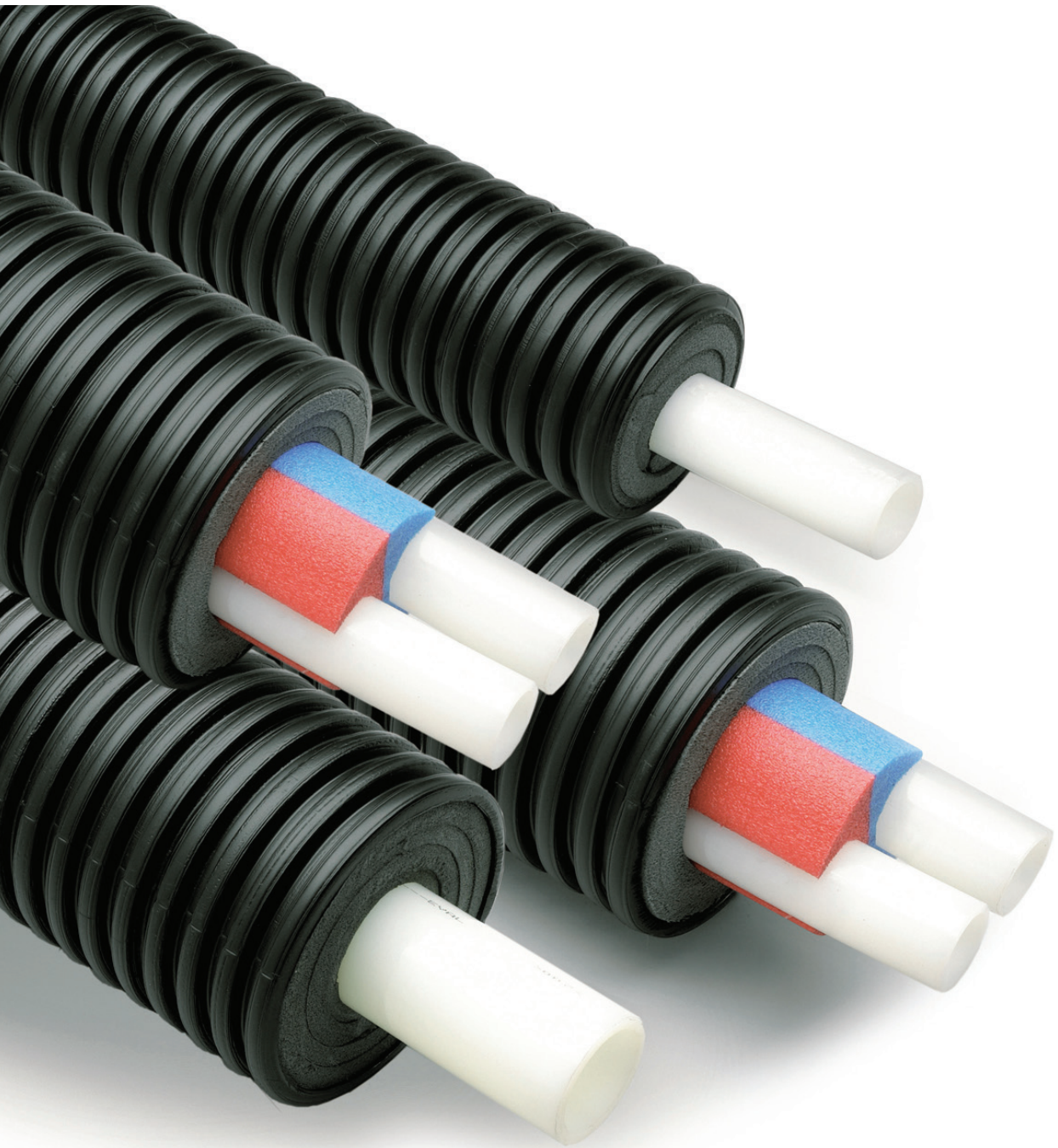
Pre-insulated Pipe Systems
Design and Installation Manual

Pre-insulated pipe system at its best — versatile, sustainable, and flexible



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This design and installation manual is published for heating contractors, engineers, architects, designers, building officials and other individuals interested in pre-insulated distribution systems. This manual describes Uponor Pre-insulated Pipe systems featuring the Ecoflex® product line.

Uponor has used reasonable efforts in collecting, preparing and providing quality information and material in this document. However, system enhancements may result in modification of features or specifications without notice.

All information in this guide is accurate and dependable, including drawings, pictures, and graphical presentations, representing current knowledge. As we continue to update and add new features to our line of pre-insulated pipe technology, Uponor does not guarantee the accuracy or completeness of the information contained in this document. Uponor is not liable for installation practices that deviate from this installation guide or are not acceptable practices within the mechanical trades.

To ensure proper system specification, this manual includes both the installation guide and product design manual for Uponor Pre-insulated Pipe systems. Uponor Pre-insulated Pipe systems are versatile and applicable for a variety of uses. Please direct any questions concerning the suitability of an application or a specific design to Uponor Technical Services at 888.594.7726.

Liability for Uponor Pre-insulated Pipe (Ecoflex) products is stated in our written warranty available upon request from Uponor. The user of the product must study the suitability of the product to the designed purpose. Uponor reserves the right to change the product or accessories without prior written notification.

For the most current technical information, go to the Uponor website at **uponor.com.**

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Glossary of Terms

To understand the design and installation of pre-insulated plastic piping systems, it is important to become familiar with the terminology used in this manual. Some of the definitions found in this chapter are unique to pre-insulated plastic piping systems, and some may be applicable only to Ecoflex applications. Following is a list of terms used in this manual.

Ambient Temperature — Temperature of the surrounding environment.

BAR — Metric equivalent of 14.5038 psi.

BTU (British Thermal Unit) — A unit of measure equal to the amount of energy necessary to raise the temperature of one pound of water one degree Fahrenheit

- **BTU/h** — The amount of BTU expended per hour
- **BTU/h/ft²** — The amount of BTU expended per hour per square foot of panel. BTU/h/ft² is derived by dividing the BTU/h by the amount of available square footage in the room to be heated.

Closed Loop — Any piping arrangement in a circulating system that protects the circulating medium (water) against exposure to atmospheric pressure.

Closed System — Any closed-loop hydronic piping system that prevents atmospheric oxygen from entering the system to a degree, effectively protecting components from excessive oxidative corrosion (See DIN 4726 in this glossary.)

Conduction — A process of heat transfer whereby heat moves through a material or between two materials that are in direct contact with each other.

Convection — Transfer of heat by movement of a liquid or a gas

- Natural convection is a result of movement caused by changes in density as temperature changes within a fluid medium, such as a liquid or a gas.
- Forced convection is the result of mechanical force moving a fluid or gas.

Crosslinking — A chemical process that changes the molecular structure of a polymer material by linking otherwise independent hydrocarbon chains. Crosslinking creates a three-dimensional network of hydrocarbons. The final product is incapable of being melted and is insoluble.

DIN — DIN is an abbreviation for the German Institute of Standards (Deutsches Institut fur Normung).

DIN 4726 — An internationally recognized standard that prescribes, among other things, the maximum rate of oxygen diffusion allowed for non-metallic pipes used in closed-loop hydronic heating systems.

Differential Temperature (Δt) — The difference in temperature between two opposing masses used to describe the potential that exists for heat transfer.

Engel Method — This is a peroxide-based method of manufacturing crosslinked polyethylene (PEX) piping. Engel-method PEX is crosslinked during the extrusion process while the raw polyethylene is above its crystal melting temperature, creating an even, consistent three-dimensional network of joined hydrocarbons.

EPDM — An abbreviation for Ethylene Propylene Diene Monomer (EPDM) — it has excellent temperature and chemical resistance, and is widely used for gasket and seal material.

EVOH — Enhanced oxygen barrier performance from modification of ethylene vinyl alcohol copolymers.

Feet of Head – Piping system pressures and pressure/friction losses are often referred to in ″feet of head" or ″foot head.″ Feet of head equals the amount of pressure that would result from a column of water one foot high. For example, a 20-foot head is the pressure at the bottom of a 20-foot column of water.

HDPE — An abbreviation for high-density polyethylene, having a standard density of 0.941 g/cm³ (gram per cubic centimeter) or greater.

Head Pressure Loss — The pressure available at the outlet side of a pump or inlet side of a flow-conducting system. It is expressed in feet of head. Feet of head is the height of a column of water that is supported by a pump against standard atmospheric pressure.

Heating Load — The amount of energy (in BTU/h) required for space heating.

K Factor (thermal conductivity) — The time rate of steady-state heat flow through a unit area of homogeneous material induced by a unit temperature gradient in a direction perpendicular to that unit area:

- In inch-pound units, BTU x in./h x ft² °F
- In SI units, W/m x K

Glossary of Terms

Linear Expansion (thermal) — Refers to the physical material characteristic of a body, which causes it to expand in the presence of heat. It is known as heat expansion. Linear expansion creates a force within the product, which, if held back by huge compressive strengths such as concrete, will transmit itself as an internal stress. Unlike other piping products, PEX is highly resistant to stresses caused by linear expansion.

Open System — A circulating hydronic system exposed to atmospheric conditions. Open systems require components resistant to oxidative corrosion. Open systems are the result of continual introduction of fresh water, open vessels or oxygen diffusion through nonmetallic components.

PE — Abbreviation for polyethylene.

PEX-a — PEX manufactured using the Engel method.

PEX-b — PEX manufactured using the Silane method.

PEX-c — PEX manufactured using the Radiation method.

Pressure Loss — The loss of fluid pressure between any two points in a flow-conducting system, expressed in pounds per square inch (psi). The loss of pressure is caused by friction against the tubing walls and is further influenced by the tubing size, length and texture of the inside wall of the tubing, fittings, valves and other components. The temperature and viscosity of the fluid also influence pressure loss.

Primary/Secondary Pumping — The boiler loop with its own circulator is referred to as the primary loop. Secondary loop is any feed from the primary (boiler loop) that is the same or lower temperature with its own circulator for flow control.

R-value — A measure of a material's ability to resist the flow of heat:

- R-value is expressed in BTU/h/ft^2 (1/U = R).
- R-value is also expressed as the reciprocal of an insulation K factor multiplied by the thickness in inches.

Radiation — The process in which energy in the form of rays of light or heat is transferred from body to body without heating the intermediate air acting as the transfer medium.

Standard Dimension Ratio (SDR) — A specific ratio of the average specified diameter to the minimum specified wall thickness — the smaller the SDR number, the thicker will be the pipe wall thickness.

Thermal Conductivity (K) — A property of materials that indicates the amount of heat (BTU) that penetrates 1 square foot of a uniform material, one inch thick, in one hour for each degree Fahrenheit difference in temperature between the surfaces:

- It is expressed in BTU/h/ft^2/°F.
- The thermal conductivity of PEX is 0.22 BTU/h/ft^2/°F.

Thermal Mass — Any material used to store heat energy or the affinity for heat energy

Thermal Transfer Coefficient — This describes the transfer of heat from a bordering surface expressed in BTU/h/ ft^2/°F. Thermal transfer coefficient is comprised of radiation, convection and conduction properties, as well as the orientation of the radiant surface (floor, ceiling or wall).

U-value — The capability of a substance to transfer heat; it is used to describe the conductance of a material or composite of materials in construction. U-value is expressed in BTU/h/ft^2 and is the inverse function of R-value (1/R = U).

UV-light Stabilizers — Frequently used in plastics, the primary function is to protect the substance from long-term degradation effects from light, most frequently ultraviolet light. Different UV-light stabilizers are utilized depending upon the substrate, intended functional life, and sensitivity to UV degradation.

Velocity — This is the speed of fluid at a specific flow expressed in feet per second (fps).

Chapter 1

Uponor Pre-insulated Pipe Systems Overview

Uponor Pre-insulated Pipe systems feature Ecoflex® piping for hot and cold fluid distribution. These coiled, watertight, corrosion-proof pipes are easy to install directly into the excavation site. With coil lengths available up to 1,000 feet, you will need few, if any, underground joints, resulting in seamless piping runs.

Ecoflex Thermal Single and Thermal Twin feature Wirsbo hePEX™ oxygen-barrier service pipe. Ecoflex Potable PEX features Uponor AquaPEX® service pipe.

Protected by multi-layered insulation and a waterproof, corrugated HDPE jacket, Uponor pre-insulated pipes ensure dependable, trouble-free performance for decades.

Features and Benefits

There are many attractive features of Ecoflex as a pipe distribution system:

- **Corrosion resistant** — Materials help ensure a long system service life
- **Lightweight** — Coils are easy to handle and move around
- **Durable** — Waterproof solution suitable for most any soil condition
- **Flexible** — Unbonded insulation layers and corrugated outer jacket provide installation ease
- **Energy efficient** — Closed-cell insulation to retain system integrity
- **Long coils** — Enables faster, easier installs with few or no underground connections

Product Line

Uponor Pre-insulated Pipe systems include the Ecoflex product line with separate pipeline systems for heating systems, cooling systems and potable-water supply.

The Ecoflex product offering includes:

- Thermal Single
- Thermal Twin
- Potable PEX
- Potable PEX Twin
- Potable PEX Plus

Chapter 2

Products and Hardware

Pre-insulated Pipe Construction

The outer jacket of the Ecoflex pipe is constructed of waterproof, corrugated high-density polyethylene (HDPE). Between the service pipe and the jacket are layers of closed-cell insulation, and the service pipe is PEX-a crosslinked polyethylene.

- For Ecoflex Potable PEX, the service pipe is Uponor AquaPEX.
- For Ecoflex Thermal, the service pipe is Wirsbo hePEX.

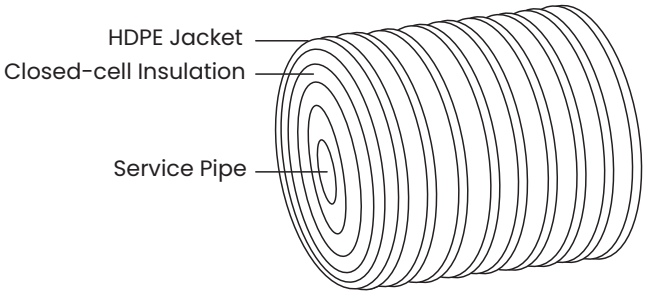


Figure 2-1: Pipe construction

Jacket

The unique construction of the HDPE corrugated outer jacket results in strength and flexibility — it makes the jacket stiff in the cross-sectional direction and flexible in the longitudinal direction.

Jacket Sizes		
Outer Dimension	**Wall Thickness**	**Wall Thickness**
2.7"	0.055"	1.4mm
5.5"	0.083"	2.1mm
6.9"	0.059"	1.5mm
7.9"	0.047"	1.2mm

Table 2-1: Jacket sizes

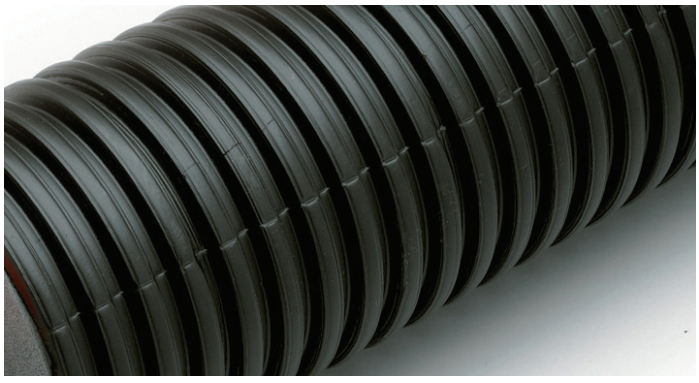


Figure 2-2: Pipe jacket

Closed-cell Insulation

All Uponor pre-insulated piping products feature closed-cell PEX-foam insulation. The closed cellular structure of the insulation prevents water absorption. The insulation quickly regains its original shape after bending.

Property	Value
Density	2.0 lb./ft.^{3} (0.032 kg/dm^3)
Thermal conductivity	0.28 BTU · in./ft.^{2} ·h· °F (0.037 W/m^2)
Tensile strength	43 psi (3 bar)
Hardness, 40% compression	0.25 lb. · in.^{2}
Absorption of water by insulation at 68°F (20°C) 24 hours immersed in	2.0%
Vapor permeability	0.1 g/100 in.^{2} d (1.5 g/m^{2}d)

Table 2-2: Properties of closed-cell insulation

Figure 2-3: Closed-cell insulation

Service Pipe

Uponor Ecoflex Thermal Single, Thermal Twin, Potable PEX, Potable PEX Twin, and Potable PEX Plus all feature PEX service pipe. The "PE" refers to polyethylene, the raw material used to make PEX, and the "X" refers to the crosslinking of the polyethylene across its molecular chains. Linking the molecular chains into a three-dimensional network makes PEX remarkably durable within a wide range of temperatures and pressures. Because of the crosslinking process, PEX-a has a high resistance to heat and pressure, good chemical resistance, and excellent flow properties resistant to scaling.

Thermal Single and Thermal Twin feature Wirsbo hePEX oxygen-barrier service pipe and are designed for hydronic heating and cooling applications. Potable PEX, Potable PEX Twin, and Potable PEX Plus feature Uponor AquaPEX service pipe and are designed for domestic potable hot and cold water applications.

Property	English Units	SI Units
Approximate modules of elasticity (Secant at 1% and 73°F/22.8°C)	91,350 psi	630 N/mm^2
Tensile yield strength at 68˚F (20˚C) per DIN 53455	2.76-3.77 psi	19-26 N/mm^2
Piping density	59 $lbs./ft^3$	936 Kg/m^3
Impact strength	Will not fail under impact at temperatures of -284°F/-140°C	
Water absorption	Room temperature = 0.01% Boiling for 40 days = 0.07%	
Coefficient of friction (surface-roughness factor)	0.000019 inches	0.0005 mm
Surface tension	0.00014 lbs./inches	25 dyne/cm
Coefficient of linear expansion at 135°F/57°C	Avg. = $9.2*10^{-5}$ in/in•°F	Avg. = $1.7*10^{-4}$ m/m•°C
Softening temperature	264°F to 268°F	129°C to 131°C
Specific heat	0.55 Btu/lb•°F	2302.3 J/kg•°C
Coefficient of thermal conductivity	0.219 Btu/(hr•ft•°F)	0.38 W/(m•°K)
Degree of crosslinking	70 to 89% (per ASTM F876)	
Minimum bend radius	Six times the outside diameter	

Table 2-3: Material properties of Uponor PEX piping

Ecoflex Thermal Single

Ecoflex Thermal Single is a service pipe constructed of PEX-a. PEX-a is highly regarded for its exceptional durability and resistance to chemicals. Suitable for fluids from -58°F (14°C) to 200°F (93°C), it offers exceptional performance in a wide variety of applications.

Property	Temp.	Value
Density	---	59 lb./ft.^{3} (0.945 kg/dm^3)
Smoothness Value	---	0.02 mil
Coefficient of Thermal Expansion	68°F (20°C)	78 · 10^{-6} in./in. · °F (1.4 m/m · °C)
	212°F (100°C)	114 · 10^{-6} in./in. · °F (2.05 m/m · °C)
Tensile Strength	68°F (20°C)	2,800 to 3,800 psi (193 to 262 bar)
	212°F (100°C)	1,300 to 1,900 psi (90 to 131 bar)
Modulus of Elasticity	68°F (20°C)	87,000 to 130,000 psi (5,998 to 8,963 bar)
	180°F (82°C)	44,000 to 58,000 psi (3,033 to 3,999 bar)

Table 2-4: Properties of PEX-a service pipe

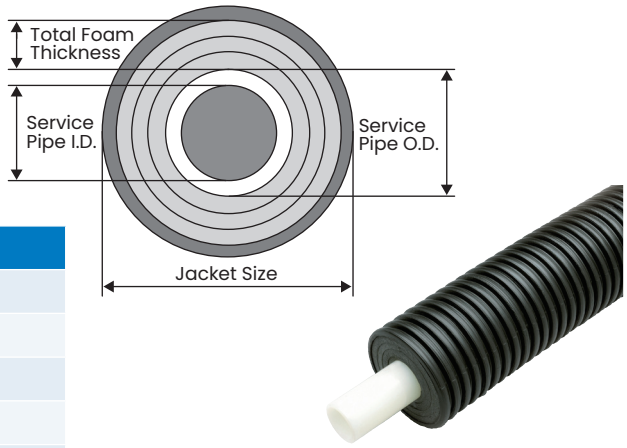


Figure 2-4: Ecoflex Thermal Single piping

Ecoflex Thermal Single is available in a single service pipe in ASTM sizes from ¾" to 4".

Product Number	Description	Jacket Size	Total Foam Thickness	Insulation Value	Service Pipe I.D.	Service Pipe O.D.	Max. Coil Length	Weight per Foot
5012775	¾" Thermal Single	2.7"	0.71"	R-9.3	0.671"	0.875"	1,000'	0.35 lbs.
5012710	1" Thermal Single	2.7"	0.59"	R-7.4	0.862"	1.125"	1,000'	0.38 lbs.
5015510	1" Thermal Single	5.5"	1.85"	R-12.3	0.862"	1.125"	600'	0.90 lbs.
5015513	1¼" Thermal Single	5.5"	1.73"	R-10.7	1.054"	1.375"	500'	0.85 lbs.
5016915	1½" Thermal Single	6.9"	2.13"	R-10.8	1.244"	1.625"	300'	1.46 lbs.
5016920	2" Thermal Single	6.9"	1.93"	R-8.9	1.629"	2.125"	300'	1.80 lbs.
5016925	2½" Thermal Single	6.9"	1.65"	R-7.2	2.011"	2.625"	300'	1.97 lbs.
5017930	3" Thermal Single	7.9"	1.93"	R-7.0	2.398"	3.125"	300'	2.80 lbs.
5017940	4" Thermal Single	7.9"	1.42"	R-4.8	3.169"	4.125"	300'	3.7 lbs.

Table 2-5: Ecoflex Thermal Single product information

Ecoflex Thermal Twin

Ecoflex Thermal Twin features the same characteristics as Ecoflex Thermal Single piping, but features two service pipes in a single outer jacket. It is available from 1" to 2½" ASTM sizes. The outer jacket consists of a corrugated HDPE shell with closed-cell PEX insulation between the HDPE shell and PEX service pipes. For connections, use ProPEX expansion fittings.

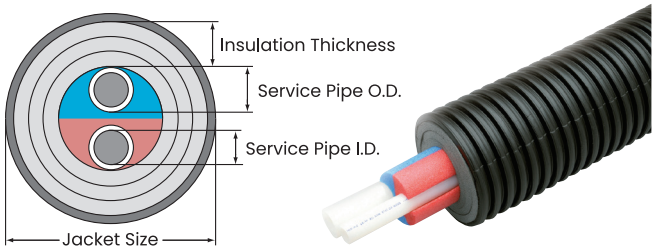


Figure 2-5: Ecoflex Thermal Twin piping

Product Number	Description	Jacket Size	Total Foam Thickness	Insulation Value	Service Pipe I.D.	Service Pipe O.D.	Max. Coil Length	Weight per Foot
5026910	1" Thermal Twin	6.9"	1.54"	R-11.3	0.862"	1.125"	600'	1.30 lbs.
5025513	1¼" Thermal Twin Jr.	5.5"	0.79"	R-7.4	1.054"	1.375"	600'	1.28 lbs.
5026913	1¼" Thermal Twin	6.9"	1.34"	R-9.5	1.054"	1.375"	500'	1.40 lbs.
5026915	1½" Thermal Twin	6.9"	1.06"	R-7.7	1.244"	1.625"	300'	1.55 lbs.
5027920	2" Thermal Twin	7.9"	1.06"	R-6.5	1.629"	2.125"	300'	2.68 lbs.
5027925	2½" Thermal Twin	7.9"	0.71"	R-4.5	2.011"	2.625"	300'	3.40 lbs.

Table 2-6: Ecoflex Thermal Twin product information

Ecoflex Potable PEX

Designed for domestic potable hot and cold water distribution, Uponor Ecoflex Potable PEX products feature Uponor AquaPEX service pipe, which does not have an oxygen barrier. Potable PEX Single is available with service pipe sizes from ¾" to 3", Potable PEX Twin is available with service pipe sizes from 1" to 2", and Potable PEX Plus is available with 1¼" service pipe. For connections, use ProPEX expansion fittings.

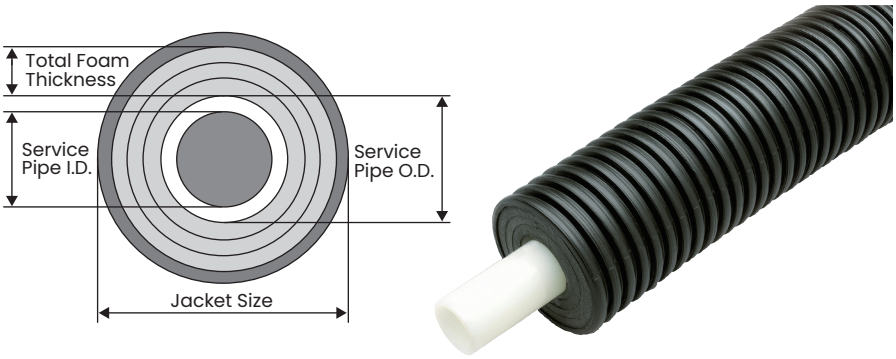


Figure 2-6: Ecoflex Potable PEX piping

Product Number	Description	Jacket Size	Total Foam Thickness	Insulation Value	Service Pipe I.D.	Service Pipe O.D.	Stnd. Coil Length*	Weight per Foot
5212775	¾" Potable PEX	2.7"	0.71"	R-9.3	0.671"	0.875"	1,000'	0.35 lbs.
5212710	1" Potable PEX	2.7"	0.59"	R-7.4	0.862"	1.125"	1,000'	0.38 lbs.
5215510	1" Potable PEX	5.5"	1.85"	R-12.3	0.862"	1.125"	600'	0.75 lbs.
5215513	1¼" Potable PEX	5.5"	1.73"	R-10.7	1.054"	1.375"	500'	0.85 lbs.
5216915	1½" Potable PEX	6.9"	2.13"	R-10.8	1.244"	1.625"	300'	1.40 lbs.
5216920	2" Potable PEX	6.9"	1.93"	R-8.9	1.629"	2.125"	300'	1.80 lbs.
5217030	3" Potable PEX	7.9"	1.93"	R-7.0	2.398"	3.125"	300'	2.80 lbs.

Note: For applications requiring 2½" potable, use part number 5016925, which is listed for both thermal and potable applications.

Table 2-7: Ecoflex Potable PEX

Product Number	Description	Jacket Size	Total Foam Thickness	Insulation Value	Service Pipe I.D.	Service Pipe O.D.	Stnd. Coil Length*	Weight per Foot
5226910	1" Potable PEX Twin	6.9"	1.54"	R-11.3	0.862"	1.125"	600'	1.30 lbs.
5226913	1¼" Potable PEX Twin	6.9"	1.34"	R-9.5	1.054"	1.375"	500'	1.40 lbs.
5226915	1½" Potable PEX Twin	6.9"	1.06"	R-7.7	1.244"	1.625"	300'	1.55 lbs.
5227920	2" Potable PEX Twin	7.9"	1.06"	R-6.5	1.629"	2.125"	300'	2.68 lbs.

Table 2-8: Ecoflex Potable PEX Twin

Product Number	Description	Jacket Size	Total Foam Thickness	Insulation Value	Service Pipe I.D.	Service Pipe O.D.	Stnd. Coil Length*	Weight per Foot
54555513	1¼" Potable PEX Plus, 5 W/ft. 240VAC	5.5"	1.73"	R-10.7	1.054"	1.375"	300'	1.05 lbs.

Table 2-9: Ecoflex Potable PEX Plus

*Standard coil lengths based on production standards; for other coil lengths, submit requests through the Uponor Special Product Request (SPR) process.

Ecoflex potable PEX plus is a pre-insulated pipe with a heat trace wire applied on the pipe

Heat-trace Power Terminal Block

Heat-trace End Seal

Figure 2-7: Ecoflex Potable PEX Plus

Product Accessories

Uponor offers the following components designed exclusively for use with Uponor Ecoflex Pre-insulated Pipe.

- Rubber End Caps
- ProPEX Fittings
- WIPEX Fittings
- Reducer Bushings
- Wall Sleeve with Heat Shrink Kit
- Compression Wall Seal
- Insulation Kits
  - Straight Insulation Kits
  - Tee Insulation Kits
  - 90-degree Insulation Kits
  - H-insulation Kits

Rubber End Caps

Ecoflex EPDM Rubber End Caps seal the exposed insulation between the jacket and service pipe when you cut the pipe to make a connection. Use single end caps with Ecoflex Thermal Single, Ecoflex Potable PEX, and Ecoflex Potable PEX Plus. Use twin end caps with Ecoflex Thermal Twin and Ecoflex Potable PEX Twin. Each end cap comes with a stainless-steel clamp and an EPDM rubber o-ring.

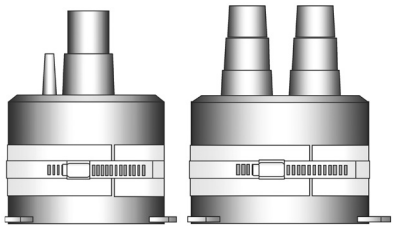


Figure 2-8: Rubber end caps

ProPEX Fittings

Available in brass, lead-free (LF) brass, and engineered polymer (EP), Uponor offers a full line of ProPEX fittings designed to ensure strong, reliable connections with Uponor PEX tubing. ProPEX fittings hold tight in strength tests at up to 2,900 lbs. of pull force and easily withstand high temperature and pressures well above ASTM standards.

ProPEX Brass and Lead-Free (LF) Brass Fittings and Transitions — Uponor offers ProPEX fittings and transitions in brass and lead-free (LF) brass for use in hydronic distribution and potable plumbing systems. Refer to the Uponor Product Catalog for the complete offering.

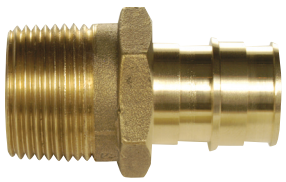


Figure 2-9: ProPEX brass fitting example

EP Fittings

Comprised of thermoplastic, high-performance, advanced materials, EP fittings are available in several styles and are suitable for use under conditions of high impact, heat, and moisture. These strong, durable fittings are made of an advanced engineered polymer that is highly resistant to corrosive environments. Unaffected by the fluctuating cost of metal, EP fittings are an economical solution for insulated plumbing and heating projects.

Note: A ProPEX Expansion Tool and ProPEX Rings are required to make a ProPEX expansion connection. Refer to the Uponor Product Catalog for details.

Figure 2-10: ProPEX EP fitting example

WIPEX Fittings

Manufactured from dezincification-resistant brass, WIPEX compression fittings connect 4" Wirsbo hePEX pipe to a male NPT thread.

Figure 2-11: 4" WIPEX Fitting

Connection Vaults

The Ecoflex Connection Vault makes piping branches, reductions and connections easy. Step-down outlets are compatible with Ecoflex piping. Connection vaults are insulated, watertight and designed for burial below grade. Refer to **Chapter 3: Design Considerations** for details.

Figure 2-12: Connection Vault

Shrink Sleeves for Connection Vaults

Ecoflex Shrink Sleeves ensure a watertight seal between the Ecoflex pipe and the exterior of the Connection Vault.

Figure 2-13: Shrink Sleeves

Straight Insulation Kits

The Straight Insulation Kit makes an insulated straight connection of single or twin-style Ecoflex products with a jacket size of 5.5", 6.9" and 7.9". The kit features two shells, stainless steel bolts, plastic pins and joint sealing compound. Only use Uponor Rubber End Caps with this kit. The shells of the kit feature an inch of closed-cell PEX insulation sealed with a durable, watertight outer coating. Stainless steel clamps ensure tight closure of the shells over the connection.

Figure 2-14: Straight Insulation Kit

Tee Insulation Kits

The Tee Insulation Kit makes an insulated Tee-connection of single or twin-style Ecoflex products with a jacket size of 5.5", 6.9" and 7.9". The shells of the kit feature an inch of closed-cell PEX insulation sealed with a durable, watertight outer coating. The kit features two shells, stainless steel bolts, plastic pins and joint sealing compound. Reducer bushings are required to fit smaller jacket sizes into the Tee Insulation Kit.

Figure 2-15: Tee Insulation Kit

90-degree Elbow Insulation Kits

The Elbow Insulation Kit makes an insulated elbow connection of single or twin-style Ecoflex products with a jacket size of 5.5", 6.9" or 7.9". You can cut the ends of the elbow to connect to any of these three jacket sizes. The kit features two shells, stainless steel bolts, plastic pins and joint-sealing compound.

Figure 2-16: 90-degree Elbow Insulation Kit

H-insulation Kits

The H-insulation Kit allows for several options of insulated connections between four or five branches of single and twin-style Ecoflex Pre-insulated Pipe with a jacket size of 5.5", 6.9" or 7.9". The kit features two shells, stainless steel bolts, plastic pins and joint-sealing compound.

Figure 2-17: H-insulation Kit

Note: End Caps are required at all ends of the piping system to ensure system integrity. Use these insulation kits with Uponor Rubber End Caps only.

Ecoflex Reducer Bushings

Reducer Bushings adjust the pipe jacket diameter to fit the respective branch diameter on the Straight or Tee Insulation Kits.

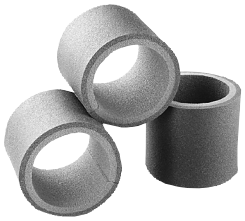


Figure 2-18: Reducer bushings

Wall Sleeve with Heat Shrink Seal Kit

The Wall Sleeve and Heat Shrink Seal Kits offer a simple installation for new block construction or an existing wall with irregular hole. Wall Sleeves, though not engineered for specific bearing loads, offer installation convenience and compatibility.

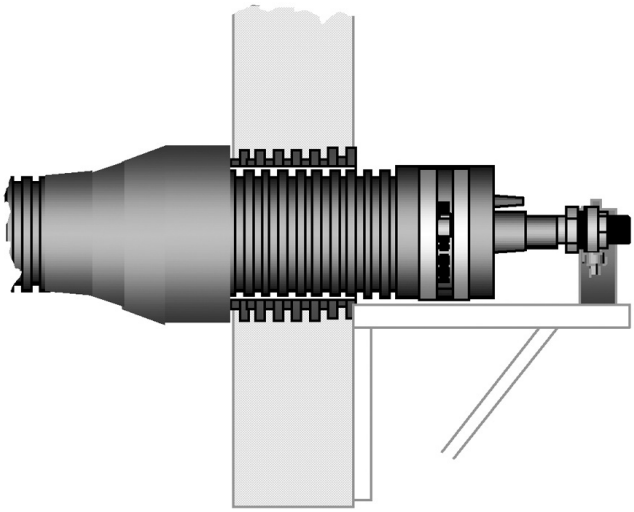


Figure 2-19: Wall Sleeve with Heat Shrink Seal Kit

Compression Wall Seal

Use the Compression Wall Seal with the Wall Sleeve or use alone when a field core drill is preferred.

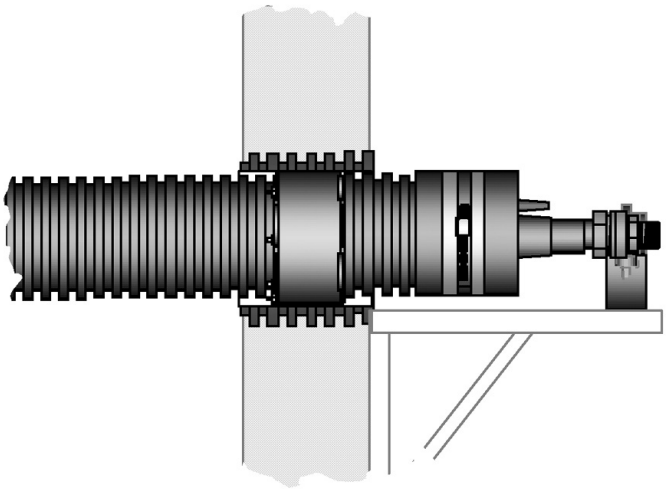


Figure 2-20: Compression Wall Seal

If a filed core drill is preferred, you can use the Compression Wall Seal alone. Refer to **Table 2-10** for the required core drill size.

Wall Seal Product Number	Jacket Size (inches)	Optimal Core Drill Size (inches)	Wall Seal Length (inches)	Compatible Wall Sleeve with Heat Shrink Seal Kit
1007358	2.7	4.75	4.125	1018266
1007360	5.5	8	5.375	1018269
1007361	6.9	10	5.375	1018268
1007362	7.9	10	5.25	1018268

Table 2-10: Optimal core drill size

Accessory Applications Chart

Part Number	Service Pipe	Jacket Size	Adapter	Rubber End Cap	Tee	Straight	Elbow	Compression Wall Seal	Wall Sleeve Kit
Thermal Single Pipes									
5012775	¾"	2.7"	Q5527575	5852710	1021990 1007357	1021992 1007357	1021991 1007357	1007358	1018266
5012710	1"	2.7"	Q5521010	5852710	1021990 1007357	1021992 1007357	1021991 1007357	1007358	1018266
5015510	1"	5.5"	Q5521010	5855513	1021990	1021992	1021991	1007360	1018269
5015513	1¼"	5.5"	Q5521313	5855513	1021990	1021992	1021991	1007360	1018269
5016915	1½"	6.9"	Q5521515	5856930	1021990	1021992	1021991	1007361	1018268
5016920	2"	6.9"	Q5522020	5856930	1021990	1021992	1021991	1007361	1018268
5016925	2½"	6.9"	LF4522525	5856930	1021990	1021992	1021991	1007361	1018268
5017930	3"	7.9"	LF4523030	5857940	1021990	1021992	1021991	1007362	1018268
5017940	4"	7.9"	5550040	5857940	1021990	1021992	1021991	1007362	1018268
Thermal Twin Pipes									
5026910	1"	6.9"	Q5521010	5956915	1021990	1021992	1021991	1007361	1018268
5025513	1¼"	5.5"	Q5521313	5955513	1021990	1021992	1021991	1007360	1018269
5026913	1¼"	6.9"	Q5521313	5956915	1021990	1021992	1021991	1007361	1018268
5026915	1½"	6.9"	Q5521515	5956915	1021990	1021992	1021991	1007361	1018268
5027920	2"	7.9"	Q5522020	5957925	1021990	1021992	1021991	1007362	1018268
5027925	2½"	7.9"	LF4522525	5957925	1021990	1021992	1021991	1007362	1018268
Potable PEX Single Pipes									
5212775	¾"	2.7"	LF4527575	5852710	1021990 1007357	1021992 1007357	1021991 1007357	1007358	1018266
5212710	1"	2.7"	LF4521010	5852710	1021990 1007357	1021992 1007357	1021991 1007357	1007358	1018266
5215510	1"	5.5"	LF4521010	5855513	1021990	1021992	1021991	1007360	1018269
5215513	1¼"	5.5"	LF4521313	5855513	1021990	1021992	1021991	1007360	1018269
5216915	1½"	6.9"	LF4521515	5856930	1021990	1021992	1021991	1007361	1018268
5216920	2"	6.9"	LF4522020	5856930	1021990	1021992	1021991	1007361	1018268
5217930	3"	7.9"	LF4523030	5857940	1021990	1021992	1021991	1007362	1018268
Potable PEX Twin Pipes									
5226910	1"	6.9"	LF4521010	5956915	1021990	1021992	1021991	1007361	1018268
5226913	1¼"	6.9"	LF4521313	5956915	1021990	1021992	1021991	1007361	1018268
5226915	1½"	6.9"	LF4521515	5956915	1021990	1021992	1021991	1007361	1018268
5227920	2"	7.9"	LF4522020	5957925	1021990	1021992	1021991	1007362	1018268
Potable PEX Plus Pipes									
54555513	1¼"	5.5"	LF4521313	5855513	1021990	1021992	1021991	1007360	1018269

Table 2-11: Accessory applications chart

Chapter 3

Design Considerations

The Uponor Pre-insulated Piping system allows considerable flexibility in underground piping design for the engineer or contractor. Compared with traditional branch piping strategies, the Uponor Pre-insulated Piping system products offer alternatives that will save installation time and improve the overall quality of the system.

Consider the features outlined in this section to design the most cost-effective and energy-efficient system possible. Uponor recommends the system designer become familiar with this manual to ensure proper specifications for your project.

Traditional Piping Versus Ecoflex Design

Traditional rigid pipe systems (steel, copper and most plastic pipes) require some type of connection about every 20 feet in addition to directional and tee fittings. The system designer typically uses a main line with tee connections positioned to provide perpendicular branch lines to specific locations. Many connections are required below ground. The branch design method also requires constructing straight and level trenches to accommodate rigid pipe, or incorporating costly elevation transitions in the design. The system designer must also install expansion loops to provide for thermal expansion and contraction forces.

Pipe Flexibility

Uponor Pre-insulated Ecoflex Piping offers superior flexibility. The closed-cell insulation and the corrugated high-density polyethylene (HDPE) outer jacket enable the system designer and installer to avoid many of the expensive and difficult aspects of installing rigid pipe systems. Refer to **Table 3-1** for the bend radius of Ecoflex pipe.

Longer Pipe Length

Ecoflex is available in coil lengths of 300, 500, 600, or 1,000 feet, depending on the service pipe size. These longer coil lengths eliminate most, if not all, buried connections and pipe joints.

Fewer buried connections and pipe joints translate to lower labor costs associated with completing below-grade connections. Fewer underground connections can also provide less risk for potential joint failures. Traditional branch design method generally does not make use of the long pipe lengths available with Ecoflex products. Refer to the product tables in **Chapter 2** for maximum coil lengths.

Thermal and Potable PEX	Jacket Size	Bend Radius
¾" Single	2.7"	6"
1" Single	2.7"	8"
1" Single	5.5"	10"
1¼" Single	5.5"	12"
1½" Single	6.9"	14"
2" Single	6.9"	18"
2½" Single	6.9"	30"
3" Single	7.9"	32"
4" Single*	7.9"	48"
1" Twin	6.9"	20"
1¼" Twin Jr.	5.5"	28"
1¼" Twin	6.9"	28"
1½" Twin	6.9"	32"
2" Twin	7.9"	40"
2½" Twin*	7.9"	48"

*Thermal product only

Table 3-1: Ecoflex bend radius

Design Layout Options

The Ecoflex system provides the designer with several design layout options to reduce system cost while enhancing performance.

Direct-run Piping

In the case of smaller applications, reduce or eliminate below-grade connections by locating heating or cooling equipment within reach of the standard coil pipe length.

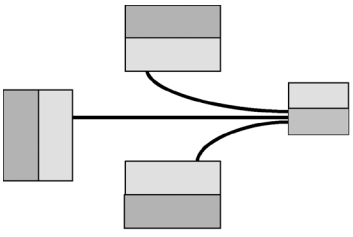


Figure 3-1: Piping layout sample

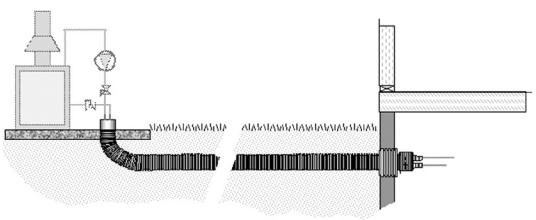


Figure 3-2: Reduces below-grade connections

Building-to-Building (Daisy Chain) Piping

In the case of connecting multiple buildings, install pipe from building to building, completing all connections within each structure. This eliminates all below-grade connections, and provides a convenient interior location for all pipe connections. Typically, only a small mechanical area within each structure is required for interior system piping. Refer to **Figures 3-3** and **3-4**.

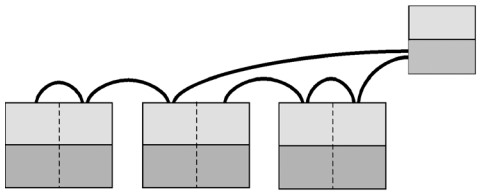


Figure 3-3: Daisy-chain method

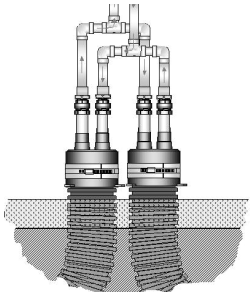


Figure 3-4: Interior pipe connections

Pipe Connection Considerations

Insulation Kit Piping

The design plans of your pipe distribution system may include connecting two or more runs of piping and may include a variety of possible configurations. Uponor Pre-insulated Piping Systems feature several types of insulation kits for connecting Ecoflex Thermal and Potable PEX, including:

- Straight Insulation Kits — For straight connections between two runs of Ecoflex piping
- Tee Insulation Kits — For tee joint insulated connections between three runs of piping
- 90-degree Elbow Insulation Kits — For elbow insulated connections of Ecoflex piping
- H-insulation Kits — For connections between multiple runs of Ecoflex piping

The kits provide insulated connections for both single and twin pipes with jacket sizes of 2.7", 5.5", 6.9", and 7.9". Note that for 2.7" jackets, reducer bushings are required (part number 1007357). The kit features two shells, stainless-steel bolts, plastic pins, and joint-sealing compound. Refer to **Chapter 2: Products and Hardware**, for illustrated descriptions of these kits and their functionality.

Refer to **Chapter 4: Installation Guide** on **page 29** for connection examples for insulation lists.

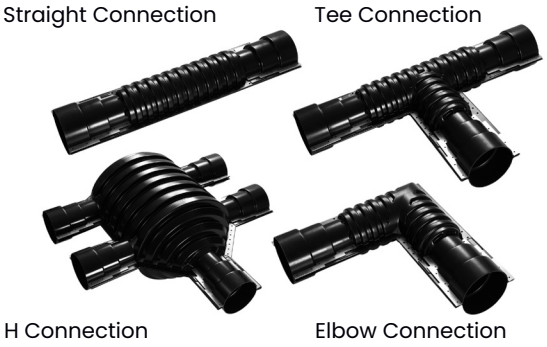


Figure 3-5: Insulation kits for pipe connections

Connection Vault Piping

In systems that require multiple connections, Uponor offers the Connection Vault. It is a pre-insulated, watertight chamber specifically designed for burial below grade. A watertight lid opens to a generous enclosed area for multiple pipe connections. You can assemble and test all distribution connections before making the pipe connections.

The vault is compatible with the 5.5", 6.9", and 7.9" jacket sizes of Ecoflex pipes (see **Figure 3-6**). These are particularly suited for larger projects.

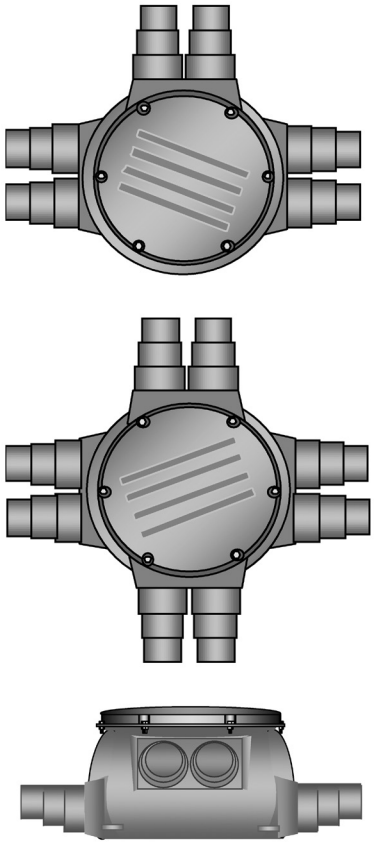


Figure 3-6: Connection Vaults

Uponor recommends that you install the vault in an easily accessible location for future requirements (inspecting connections, adding piping circuits, etc.). Remember that you may need to order any required couplings or unions for these future requirements. We recommend locating the vault in an easily accessible jobsite location for inspecting connections or adding piping circuits.

Note: The Connection Vault requires the following material per outlet used.

- Rubber End Cap: 1 each
- Male Threaded Adapter Fitting: 1 each for single pipes, 2 each for twin pipes
- Heat Shrink Sleeve: 1 each
- Nipples, tees, and elbows: Varies depending on configuration

See **Figure 3-7** for examples of pipe connections made using the Connection Vault.

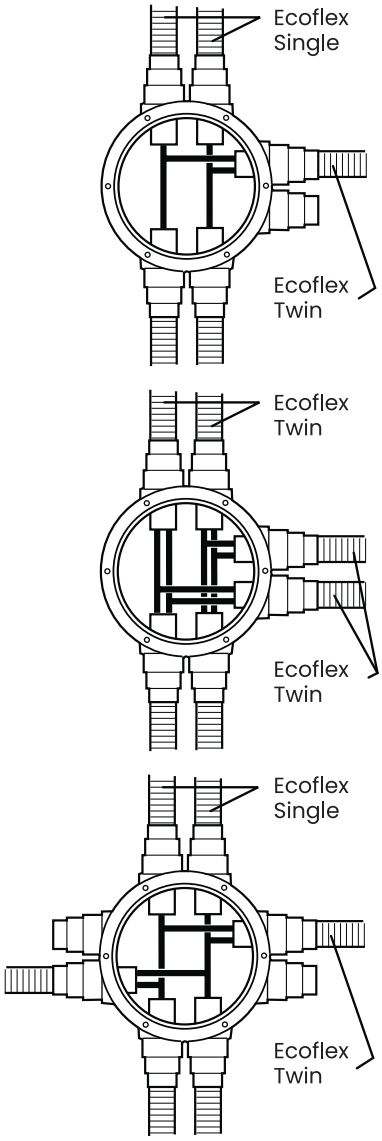


Figure 3-7: Pipe connection example

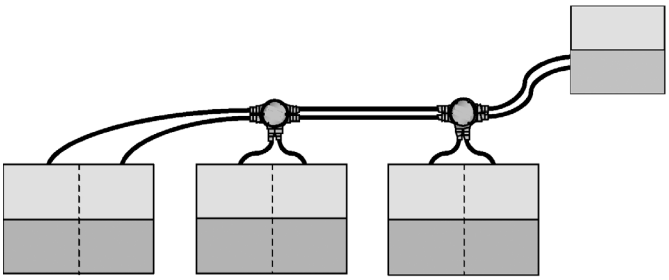


Figure 3-8: Typical configuration

Figure 3-8 demonstrates the use of connection vaults in a typical configuration. Flow volumes require a separate supply and return pipe (Ecoflex Thermal Single) to the vaults, but thereafter, the installer can use a twin pipe (Ecoflex Thermal Twin) to maximize system efficiency and minimize trench size. Refer to **Figure 3-9**.

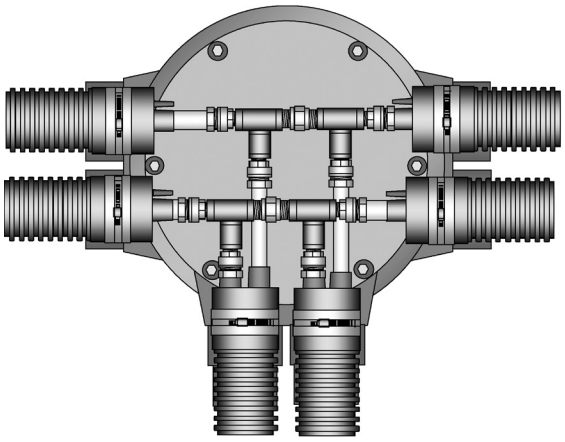


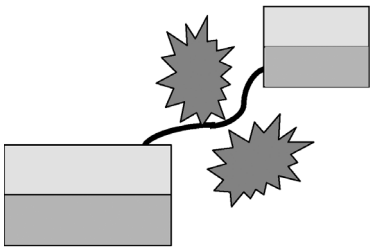
Figure 3-9: Supply and return to vault

Pipe-routing Considerations

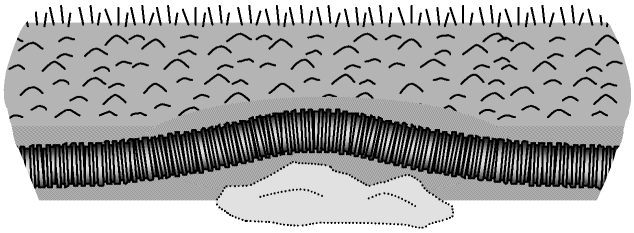
Obstacle Avoidance

To avoid excavating existing landscaping, dig a trench around the obstacle area. This also applies to existing utilities, such as water, sewer and electrical. In most cases, you can install Ecoflex over or under existing pipes. Ensure proper location and clearance before excavating near utilities. Refer to all state and local codes and authorities for proper application and installation.

When unforeseen below-grade obstacles do arise, such as large boulders or solid rock, simply adjust the elevation of the trench depth, and consider adding backfill to obtain the recommended 2-foot coverage. This feature saves considerable excavation costs if rocky soil conditions are present. When emergency repairs require a temporary solution, or in extreme rocky conditions, you can simply place Ecoflex piping on top of the ground over a sand bed, with a clean fill placed over the piping to the proper thickness. The outer jacket is UV-light stabilized (see glossary), and will not deteriorate over time. However, take care to keep the PEX service pipe away from extended UV-light exposure.



Figures 3-10: UV-stabilized outer jacket prevents sun damage



Figures 3-11: Laying Ecoflex piping

Linear Expansion and Contraction

Expansion loops or special compensation piping that allow linear expansion and contraction are not required when using Ecoflex piping. The unique nature of the service pipe encasement and the expansion absorption intrinsic to these products virtually eliminates the effects of linear expansion. Uponor recommends that you install proper mounting brackets at all transition points to avoid damage caused by linear expansion movement when transitioning to rigid piping systems from the Ecoflex service pipes.

Reduction in Required Fittings

Eliminate the need for 90- or 45-degree fittings to change direction of the piping layout by taking advantage of the flexibility inherent in Ecoflex products. Prepare the trench based on the acceptable pipe bend radius to eliminate additional connections. In addition, directional changes that occur when trenching uphill or down need no special fittings or consideration. Refer to **Table 3-1** on **page 21** for bend radius information.

Energy Savings by Design

Uponor has designed Ecoflex piping and accessories to maximize the energy efficiency of the system. Contamination of an insulated underground piping system by ground water is the highest threat to any pre-insulated distribution system. The Ecoflex watertight HDPE outer jackets provide long-term thermal efficiency for years of trouble-free operation. If an underground connection is required, make sure you install the proper insulation kit and end cap to continue the watertight seal for the system.

Pipe Heat Loss

Based on conventional heat transfer logic, it is important to keep insulation thickness and outer jacket diameter in balance. Excessive insulation requires a larger outer jacket that increases the surface area through which energy is lost. The **Uponor PEX Friction Loss Tables** in **Appendix A** show that Thermal Twin heat loss per foot is less than an equivalent-sized Thermal Single product when based on two Thermal Single pipes versus one Thermal Twin pipe. Uponor recommends the use of Thermal Twin whenever possible during the design phase of heating systems (see **Figure 3-12**).

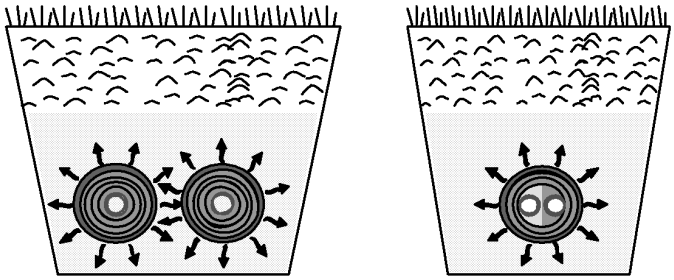


Figure 3-12: Thermal Twin recommended

Selecting System Components

Uponor offers a complete line of accessories as well as the insulation kits described previously. Consult with your local Uponor representative for the pipe connection alternatives that best meet your specific needs. This section describes product accessories available for installing Ecoflex pipe.

Rubber End Caps

Uponor recommends using Uponor Rubber End Caps whenever you terminate the Ecoflex pipe to prevent any contamination from water or other material that could compromise the integrity of the insulated piping system. Rubber End Caps are available for all pipe configurations.

Adapter Fittings

For PEX service pipe connections, use Uponor ProPEX expansion fittings or adapters in sizes up to 3". For 4" PEX connections, use WIPEX brass compression fittings.

Fixing the Pipe

When you join Ecoflex products to other systems, such as mechanical room equipment or existing metal piping, make sure you properly secure the service pipe. Plastic pipes expand and contract dramatically with changes in temperature. To avoid damage to the Ecoflex pipe system and the pipe components adjoined, use a typical bracket and clamp arrangement as shown in **Figure 3-13**.

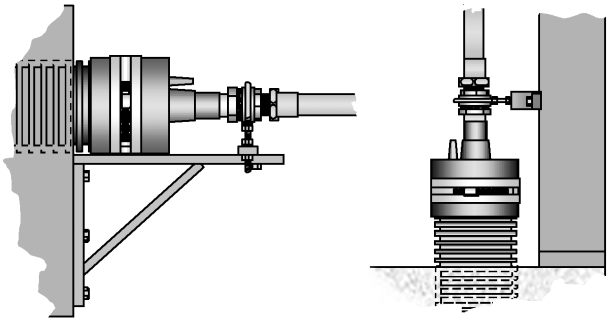


Figure 3-13: Secure piping with bracket and clamp

For larger dimensions, be sure to extend the length of the pipe out of the floor or wall enough to make the pipe relaxed. If the pipe is too short and there are tensions when connecting it, you may experience problems when the system is operational.

Ensure the outer jacket always extends at least 6" beyond finished wall or floor to allow room to install the Rubber End Cap, which provides protection against contamination (such as a boiler leak). Every project is different. You will need to purchase brackets required for your particular configuration not sold by Uponor. If you have questions about what accessories you may need for your project, ask your local Uponor representative.

Note: All terminations require:
- Rubber End Cap, 1 each
- Male Threaded Adapter Fitting, 1 each (2 each for Thermal Twin)
- Mounting bracket

Wall Penetrations

When penetrating a concrete foundation wall that is required to be watertight, use the installation methods described in this section. Refer to **Chapter 4: Installation Guide** for detailed installation procedures.

New Concrete Block or Existing Wall — The Wall Sleeve with Heat Shrink Seal Kit includes an 18-inch sleeve and heat shrink sleeve. You can grout the sleeve into place in the block wall with conventional silicone caulk. The heat shrink seal ensures a watertight connection between the Wall Sleeve with Heat Shrink Seal Kit and the Ecoflex outer jacket. Uponor recommends routing the pipe as straight as possible through the Wall Sleeve with Heat Shrink Seal Kit to ensure a proper seal. Refer to **Figure 3-14**. This is also the recommended method for irregular holes in existing walls.

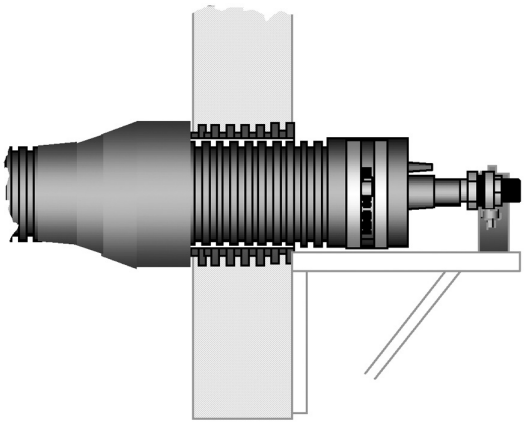


Figure 3-14: Routing pipe through the Wall Sleeve with Heat Shrink Seal Kit

New Concrete Wall — When a watertight penetration of a new concrete wall is required, the installer can cut the Wall Sleeve with Heat Shrink Seal Kit in the field for a proper fit between the concrete forms. The Compression Wall Seal is a mechanical expansion device installed over the pipe and into the Wall Sleeve with Heat Shrink Seal Kit to provide a watertight seal.

Note: This type of wall penetration requires:
- Wall Sleeve with Heat Shrink Seal Kit, 1 each
- Compression Wall Seal, 1 each

Existing Wall with Field Core Drill — The Compression Wall Seal creates a watertight seal between the core drill surface and the outer jacket of the Ecoflex pipe (see **Figure 3-15**).

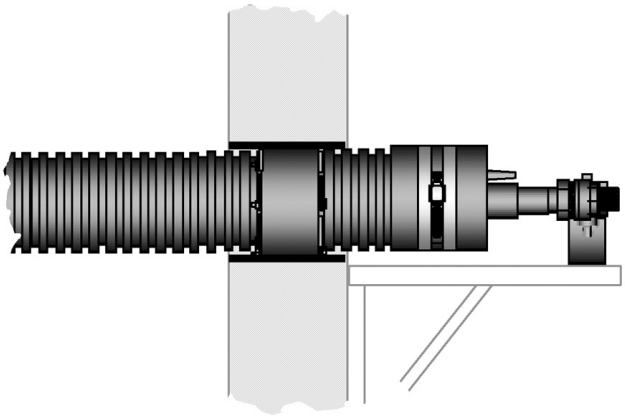


Figure 3-15: Using the Compression Wall Seal

Note: This type of wall penetration requires:
- Core drill, 1 each
- Compression Wall Seal, 1 each

Piping Layout

The underground piping layout can affect the overall cost for materials and labor. Most typical multi-building projects use either a daisy-chain piping layout or a connection vault. If a suitable space exists inside each building to make all piping connections, using the daisy chain piping strategy is the most cost-effective as it avoids the cost of insulation kits.

Items to Consider in Designing Piping Layout

Piping Distance — The longer the distance between buildings, the higher the pressure loss. This is due to the friction of the fluid passing through the service pipe. Use the shortest possible route, while keeping obstructions and hard soil conditions in mind.

Elevation Changes — Changes in elevation on the project site can dramatically change the length of pipe required. Pay close attention to topographical details on the site plan. In open systems, such as many outdoor furnace installations, circulator placement can have a direct impact on pump cavitation and poor system operation, so it deserves careful consideration. Review the installation suggestions of the manufacturer in this situation. In a closed-loop system, the elevation change does not affect the pressure drop experienced by the circulator.

Moist Soil or High Water Table — Although Ecoflex products are watertight when properly installed, it is best to avoid making connections in areas of highly saturated soil whenever possible. Highly saturated soil offers little insulating quality, and can negatively affect system-operating efficiency.

Heavy Traffic or Roadways — When installing Ecoflex under roadways, take special notice of pipe depth, soil and compaction practices. For H-20 load requirements, install Ecoflex pipe 16" below the designed roadbed with proper compaction. It is also acceptable to install Ecoflex pipe in an approved culvert or conduit for this application.

Installation at Buildings

Uponor recommends avoiding piping connections below grade or in inaccessible areas. The recommendations listed in this section offer solutions for typical installation types.

Slab-on-Grade Installation

In most cases, Ecoflex piping makes slab-on-grade installations easy. Ecoflex pipe jackets are safe for direct contact with concrete or mortar. Occasionally, the trench will require additional depth adjacent to the building to accommodate the bend radius of the Ecoflex pipe. To secure the pipe radius during construction, simply use a suitable strap to tie the end of the pipe back a short distance upon itself. Place a reinforcement bar in the soil and secure the pipe to it to avoid lateral movement during construction, as illustrated in **Figure 3-16**.

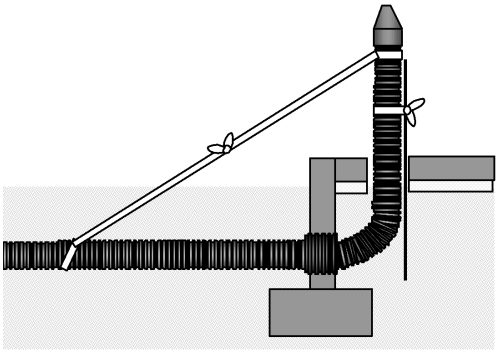


Figure 3-16: Slab-on-grade installation example

See Figures 3-17, 3-18, and 3-19 for other variations of slab-on-grade installation methods.

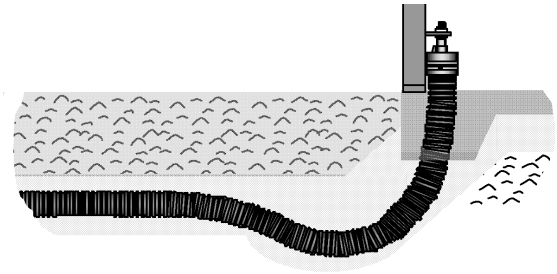


Figure 3-17: Slab-on-grade installation example

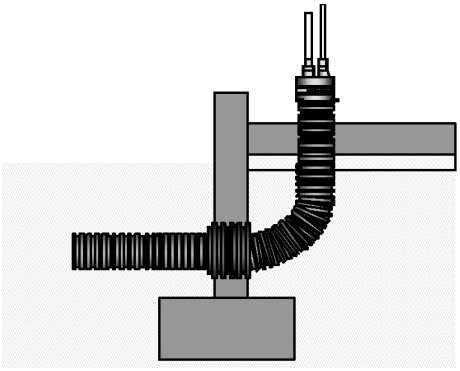


Figure 3-18: Slab-on-grade installation example

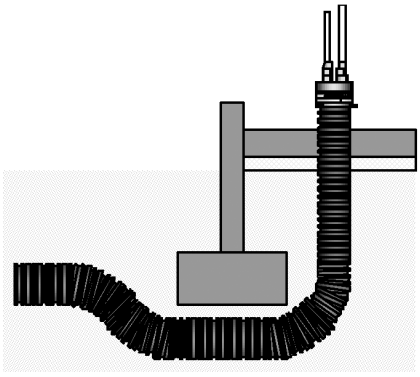


Figure 3-19: Slab-on-grade installation example

Dry Well

If you cannot achieve a suitable trench depth to allow for the bend radius, construct a concrete dry well to provide accessible space for fitting connections (see **Figure 3-20**).

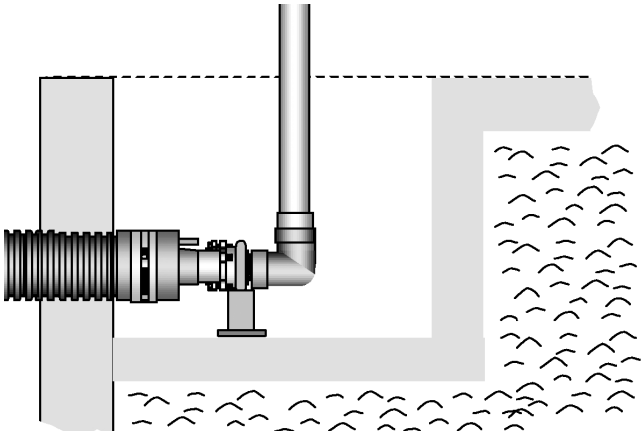


Figure 3-20: Dry well

Anchoring

When you join Ecoflex products to other systems, such as mechanical room equipment or existing metal piping, it is important to secure the service pipe properly. Plastic pipes expand and contract with changes in temperature. To avoid damage to the Pre-insulated Pipe system and the pipe components adjoined, install a typical bracket and clamp arrangement as illustrated in **Figure 3-21**.

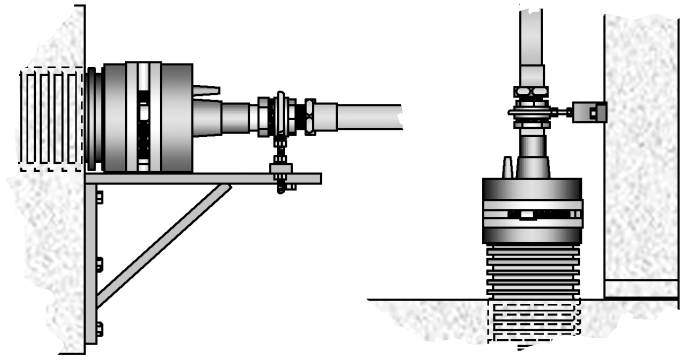


Figure 3-21: Anchoring

Note: Ensure the outer jacket always extends at least 6" beyond the finished wall or floor to allow room for installation of the Rubber End Cap.

Piping Selection

Uponor Pre-insulated Piping systems offer a variety of pipe types and styles designed for specific applications. Refer to **Table 3-2** to determine the best product for your application.

Application	Thermal Single	Thermal Twin	Potable PEX Single	Potable PEX Twin
Service pipe	Wirsbo hePEX	Wirsbo hePEX	Uponor AquaPEX	Uponor AquaPEX
Oxygen barrier	Yes	Yes	No	No
Service pipe sizes	¾" – 4"	1" – 2½"	¾" – 3"	1" – 2"
Custom cut lengths available	Yes	Yes	Yes	Yes
Suitable for fluid temperatures up to 200°F (93°C)*	Yes	Yes	No	No
Suitable for fluid temperatures up to 140°F (60°C)*	Yes	Yes	Yes	Yes
Approved for heating	Yes	Yes	No	No
Approved for cooling	Yes	Yes	No	No
Approved for potable	Yes	Yes	Yes	Yes

Table 3-2: Ecoflex applications

*For system pressures, refer to the service pipe properties tables in **Chapter 2**.

In a heating or cooling system, it is important to understand the heating and cooling load for each structure. Insufficient or excessive fluid flow can affect overall system performance. If this information is unknown, you should have a trained HVAC professional perform a complete heat loss or cooling load calculation for each structure. For potable water systems, refer to local code requirements based on the type, size and purpose of structure.

The following steps outline a simple procedure to determine the required service pipe size:

1. Select a basic layout design format (direct run, building-to-building, or a combination).
2. Determine the flow requirements — gallons per minute (gpm) — for each leg of the piping layout.
3. Determine the fluid temperature (°F) of the system supply.
4. Determine the fluid mix that is required (e.g., 100% water or a glycol mixture).
5. From the Uponor PEX Friction Loss Tables (see **Appendix A**), determine the service pipe required using the following criteria.
   a. Flow in gallons per minute for the segment of pipe selected
   b. Supply fluid temperature
   c. Type of fluid — percentage of glycol in the system or pure water

Note: For fluid velocity information, refer to the product tables in **Chapter 2**.

   d. Total pressure loss should meet design criteria for circulating pump(s).

Note: It may be necessary to adjust Ecoflex pipe sizes or circulating pumps to achieve the designed performance criteria.

Calculate Ecoflex pipe energy loss by referring to the charts in **Appendix B**. Determine the estimated soil temperature and average fluid temperature during design conditions. The temperature differential (ΔT) is the difference between the fluid and the ground temperatures.

Estimating Labor

One of the greatest benefits of using Ecoflex products is the savings in installation time. Long coil length means fewer connections in a properly designed system. The flexibility of Ecoflex lets you avoid obstacles, such as boulders and landscaping — not to mention hidden obstacles below the surface that might otherwise require extensive cost and time.

You can also save time by using unique Uponor products made for Ecoflex, such as the Piping Uncoiler, which will multiply your cost benefits. **Refer to the tables below** for an estimate of the time required to install Ecoflex products. The quick learning curve associated with Ecoflex products will enhance this estimate dramatically.

Estimated Installation Time for Ecoflex Thermal Single, Potable PEX, and Potable PEX Plus		
Pipe Size	**Number of Installers**	**Time in Minutes**
¾"	2	0.60/ft.
1"	2	0.60/ft.
1¼"	2	0.60/ft.
1½"	2	0.60/ft.
2"	2	0.60/ft.
2½"	2	0.60/ft.
3"	3	0.90/ft.
4"	3	0.90/ft.

Table 3-3: Time estimate for single service pipe

Estimated Installation Time for Ecoflex Thermal Twin and Potable PEX Twin		
Pipe Size	**Number of Installers**	**Time in Minutes**
1"	2	0.70/ft.
1¼"	2	0.70/ft.
1½"	2	0.70/ft.
2"	2	0.70/ft.
2½"	3	0.70/ft.

Table 3-4: Time estimate for twin service pipe

Estimated Installation Time for Ecoflex Accessories		
Part	**Number of Installers**	**Time in Minutes**
Male Threaded Adapter	1	15 / ea.
Rubber End Cap	1	10 / ea.
Straight Insulation Kit	1	30 / ea.
Tee Insulation Kit	1	40 / ea.
90-degree Insulation Kit	1	30 / ea.
H-connection Insulation Kit	1	50 / ea.
Connection Vault	1	10 / ea.
Wall Sleeve with Heat Shrink Seal Kit	1	10 / ea.
ProPEX Connection	1	3 to 5 / ea.

Table 3-5: Time estimate for accessories

Chapter 4

Installation Guide

Handling and Storing Pipe Coils

Uponor Pre-insulated Ecoflex Piping is available in coils. Verify that the contents of the Ecoflex delivery match the packing list. Contact your local Uponor representative for any discrepancies.

Delivery Contents

- Pipe coil wrapping material
- Product label
- Protective end covers
- Packing straps
- Unloading and handling instructions
- Quality control sticker

Make sure protective end caps are in place. If not, install protective end covers on pipe ends to protect the pipe from dirt, debris and other damage. Keep these protective end covers on the pipe until making final piping connections.

CAUTION: Protect the pipe coil from sharp objects during transport and storage.

Unloading

Before unloading, thoroughly inspect all material for shipping damage. Pipe damage is difficult to see, and occasionally occurs on the inside radius of the coil — typically in the form of a rip or tear in the outer jacket.

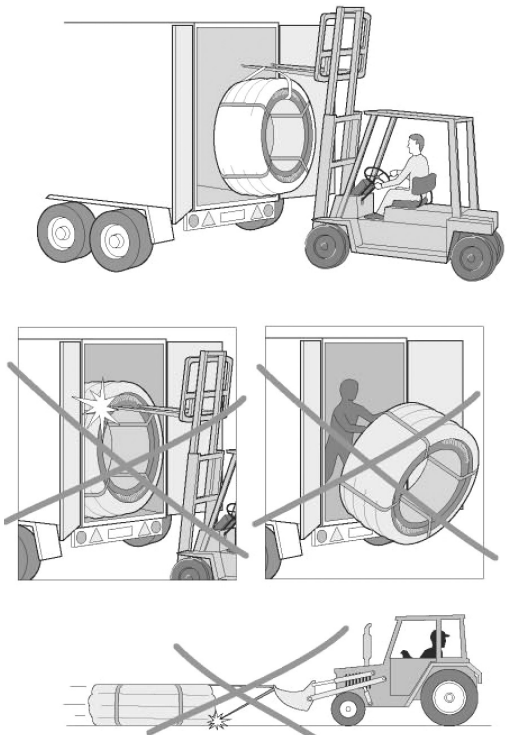


Figure 4-1: Unloading the pipe

Note: Refuse any shipment that has product damage and contact Uponor immediately. Review the product label to verify the type of product and coil length.

Do not remove outer plastic wrap or nylon straps before you are ready to install. See **Uncoiling the Pipe** on **page 30**.

Always lift coils from the transport vehicle using a wide 2" strap around the coil. To avoid damage, do not drop from truck bed or from similar elevation, or drag the coils over coarse or sharp surfaces. You can move coils over short distances by rolling.

Do not lift coils with any sharp object (including equipment forks) unless wrapped with foam rubber or other material (see **Figure 4-1**).

Storage

To ensure coils are not bent or flattened during storage, store the coils in an upright position (see **Figure 4-2**). You may store pipe coils outside. Store all other system parts in a cool, dry area.

Figure 4-2: Store in upright position

Pipe Installation

Uncoiling the Pipe

Ecoflex pipe may be uncoiled and installed directly into the trench depending upon the service pipe, jacket size and ambient temperature.

For best results, uncoil the pipe in advance of installation to allow the pipe to relax and become more manageable during the installation process. If room permits, uncoil pipes adjacent to trenches and allow them to relax for 24 hours. In cold climates, the relaxing period may take longer. Uponor recommends allowing at least two extra feet on each end before cutting.

Note: Inspect the pipe for any damage before uncoiling, and contact your Uponor representative if damaged.

Uncoiling Small Dimension and Short Lengths

To install small dimension or short lengths of Ecoflex pipe, simply remove the nylon straps and uncoil, beginning with the innermost end and unrolling adjacent to the trench.

Figure 4-3: Uncoiling short lengths

Do not remove the exterior plastic wrap during the uncoiling process.

Do not remove the protective end covers until you make the final connection. The covers protect the pipe ends from dirt, debris and damage.

Avoid unrolling or dragging the coil over sharp objects.

Uncoiling Large Dimension and Long Coils

Use a mechanical uncoiler to uncoil larger dimension and long coils of Ecoflex.

1. With the coil in its upright position, adjust the coil so the outermost pipe end is in the opposite direction of the uncoiling path and is located at ground level.
2. Insert the uncoiler core into the center of the coil, adjusting the core to ensure the fit is as tight as possible to the coil.
3. Attach the vertical stabilizing bar to the uncoiler core. Then, attach the assembly to the center.
4. Tie the inner pipe end to the center bar of the uncoiler to prevent the uncoiler from rotating while uncoiling.

WARNING: This step prevents the pipe from whipping out and rotating on the uncoiler, which has potential to cause bodily harm.

5. With the coil in its upright position, remove half the outer wrap completely from the coil, leaving on the ties and straps.

Note: Keeping half the coil wrapped will limit pipe unraveling in the coil.

Caution: When finished uncoiling or moving to a new location, always retie the straps as loose pipe may cause injury. Do not remove the protective end covers until you make the final connection. The covers protect the pipe ends from dirt, debris, and damage.

Inspect Pipe for Damage

Carefully inspect the jacket pipe for any damage. Refer to the repair sections on **pages 33-35** for information about repairing the jacket pipe. Call Uponor if you discover damage to the service pipe.

Note: To ensure system integrity, do not install damaged pipe. Installing damaged product may void the manufacturer's warranty.

Pipe Bending Radius

Refer to **Table 3-1** for bend radius guidelines. Never bend the pipe beyond the recommended radius. The bending radius corresponds to values achieved in normal job-site conditions in 68°F (20°C) weather during manual installation.

Installation in Cold Climates

Uponor does not recommend installing Ecoflex piping when temperatures fall below 5°F (-15°C). In cold weather, installation becomes easier if you allow the coil to warm in advance by storing in a heated area or using hot air fans.

CAUTION: Do not heat the pipe with a torch or open flame.

Using a Stationary Uncoiler

Important! Before starting, verify the inner pipe end is attached to the center bar of the uncoiler, and be sure to read the **Pulling Ecoflex** section on the following page to retain the integrity of the pipe.

1. Adjust the coil so the outermost pipe end is opposite the direction of the uncoiling path and is located at ground level.
2. Pull the outer pipe end from the bottom of the uncoiler.
3. Pull the pipe from the uncoiler in a straight line while ensuring there is a constant slow rate of rotation.
4. Untie one strap at a time while slowly uncoiling until all but one strap is left.

Note: Leaving one strap will prevent the coil from unraveling.

CAUTION: While uncoiling, keep a safe distance from the uncoiler to prevent injury.

CAUTION: When finished uncoiling or moving to a new location, always retie the straps as loose pipe may cause injury. Do not remove the protective end covers until you make the final connection. The covers protect the pipe ends from dirt, debris, and damage.

Figure 4-4: Stationary uncoiler

Using a Mobile Uncoiler

Important! Before starting, verify the inner pipe end is attached to the center bar of the uncoiler, and be sure to read the **Pulling Ecoflex** section on the following page to retain the integrity of the pipe.

1. Adjust the coil so the outermost pipe end is opposite the direction of the uncoiling path and is located at ground level.
2. Secure the Ecoflex pipe to a fixed point (such as a tree, building, or concrete block).
3. Slowly (at a pulling pace) start driving the equipment (tractor, forklift, loader, etc.) away from the fixed end.

CAUTION: While uncoiling, keep a safe distance from the uncoiler to prevent injury.

Note: While uncoiling, verify there is a constant and controlled rate of rotation.

4. Untie one strap at a time while slowly uncoiling until all but one strap is left.

Note: Leaving one strap will prevent the coil from unraveling.

CAUTION: When finished uncoiling or moving to a new location, always retie the straps as loose pipe may cause injury.

Do not remove the protective end covers until you make the final connection. The covers protect the pipe ends from dirt, debris and damage.

Figure 4-5: Mobile uncoiler

Pulling Ecoflex

Ecoflex pipe, if improperly pulled, can diminish the integrity of the coil. Stretching of the jacket is one of the main issues when Ecoflex is pulled improperly.

Figure 4-6: Remove cone

1. Remove the cone end from the Ecoflex pipe end. Verify that the carrier pipe is visible.

Figure 4-7: Drill hole in pipe

2. Using a drill, drill a hole vertically through the Ecoflex pipe 6" from the end. The hole only needs to be from the top of the jacket to the center of the pipe.

Figure 4-8: Drill hole in cone

3. Drill a hole through the top of the cone.

Figure 4-9: Thread web sling

4. Thread one end of the web sling through the top of the jacket and out through the carrying pipe.

Figure 4-10: Wrap web sling

5. Using the end from the top of jacket, wrap the web sling around the outer jacket and thread through the eye of the sling.

6. Thread the end of the web sling through the inside of the cone.

7. Place the cone back on the end of the Ecoflex pipe and tape in place.

Note: The rating of the web sling should be one and a half times the weight of the coil.

Example:
Coil is 1,000 lbs. Web sling is rated for 1,500 lbs.
1,000 x 1.5 = 1,500

Repairing Puncture Holes Using Rubberized Sealing Tape

IMPORTANT: All punctures made to Ecoflex pipe must be repaired immediately. Failure to do so can result in the Ecoflex procuring water and the system becoming compromised.

1. **Locate the hole:** Determine where the Ecoflex needs repair.
2. **Clean the pipe:** Before the pipe can be repaired it must be cleaned. There should be no dirt, debris or water on the pipe. This is done so the hole can be effectively sealed.

Figure 4-11: Seal pipe with black tape

3. **Seal the pipe (part one):** Using the black 3" rubberized sealing tape, carefully cover the hole, black side down, making sure to center it over the puncture and to continue to wrap it around the entirety of the pipe. The sealing tape is very moldable and should be applied meticulously so that there are no wrinkles, air bubbles, gaps, or raised edges. Be sure to press firmly around every ridge along to the outer jacket to provide a strong seal. Once finished, remove the clear protected layer from the tape.

Figure 4-12: Seal pipe with blue tape

Figure 4-13: Seal with black outer tape

4. **Seal the pipe (part two):** Using the blue 9" rubberized tape, carefully apply it, black side down, over the previously placed 3" black rubberized sealing tape in part one. Be sure to center the blue tape over the black to ensure a proper seal. Take your time making sure that there are no air pockets, wrinkles, gaps, or raised edges, pressing firmly around every ridge of the outer jacket. The blue tape should run smoothly across the top of every ridge, and this too should extend around the entirety of the pipe.

Note: The blue tape has stretch to it, so be sure to slightly pull while taping to ensure a tight seal.

5. **Seal the pipe (part three):** Using the small 2" black outer tape, completely cover the blue 9" rubberized tape working from one end to the other. Like in parts one and two, press firmly throughout the application, ensuring a tight smooth finish with no wrinkles, air bubbles, gaps, or raised edges. Once done, the Ecoflex has now been repaired and the pipe can be reinstalled.

Note: It is always a good idea to mark where the pipe has been repaired for future reference.

Jacket Repair Using Uponor Shrinkable Tape

Tools Required

- Uponor Shrinkable Tape (1018378)
- Sealing caulk or sealing mastic
- Sharp razor knife
- Brush (scrub/utility)
- Clean rag
- Torch (medium flame)
- Soap (non-caustic)

Note: Do not attempt to repair a hole larger than 9 square inches. If severely damaged, contact Uponor.

1. Repair holes immediately. It is best to repair jacket damage outside of the trench in a clean, dry environment as soon as possible.
2. Using a sharp razor knife, trim all sharp edges and protruding plastic from the damaged area.

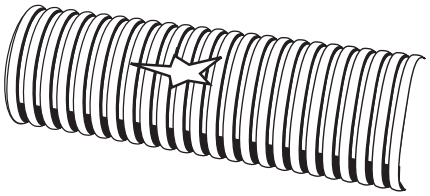


Figure 4-14: Trimming

3. Prepare the surface by loosening and scrubbing off debris with a dry scrub brush. Using a dry rag, clean area of all foreign debris in the full circumference of the area to be repaired (at least 6" on both sides of the damaged area). Uponor recommends using soap or non-caustic cleanser to ensure the damaged area is completely clean prior to repair. Ensure the area is thoroughly dry after cleaning.

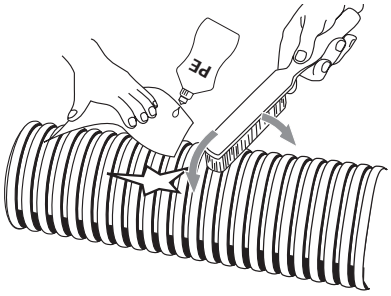


Figure 4-15: Preparation and cleaning

4. Torch the area with a medium flame, using continuous movement over the entire area to ensure an even heat. Do not apply direct flame to the tubing. Keep flame 1 to 2" away from pipe jacket. The temperature of the pipe jacket should not exceed 158°F (70°C).

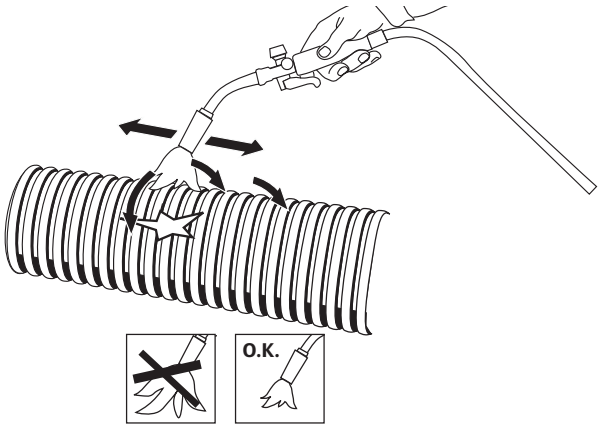


Figure 4-16: Applying heat to pipe

5. Use Uponor Shrinkable Tape (1018378). Position the repair tape directly over the damaged area. Ensure that the repair tape covers the area completely and extends beyond the damaged area on both sides by at least 6" (15 cm).

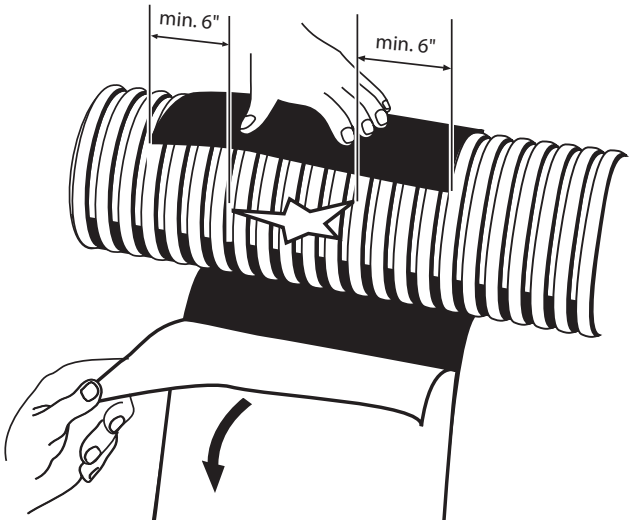


Figure 4-17: Positioning repair tape

6. Apply gentle heat with continuous movement to the inside of the repair tape using a medium torch flame — the temperature of the repair tape should not exceed 158°F (70°C).

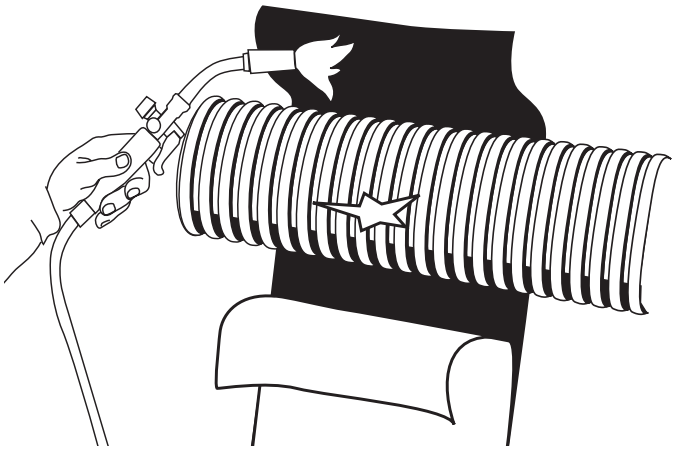


Figure 4-18: Torch inside of repair tape

7. Wrap the repair tape around the jacket circumference continuously to 6" (15 cm) in one direction. Continue taping over the damaged area to 6" (15 cm) in the opposite direction. To seal the repair, apply heat over the installed tape using a medium torch flame. Remember to use continuous movements with the torch and never apply direct flame to the surface of the tape or pipe jacket. The temperature of the surface should not exceed 158°F (70°C).

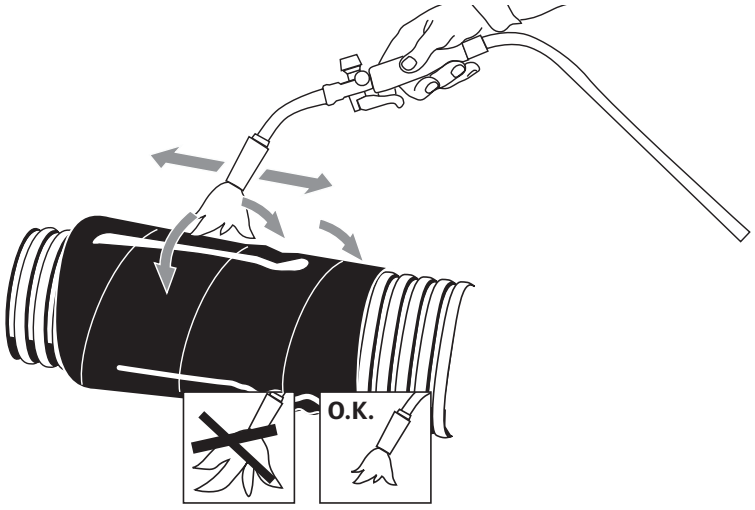


Figure 4-19: Torch inside of repair tape

8. Backfill by hand. Fill and compact the trench around repaired area manually, taking care not to damage the repair.

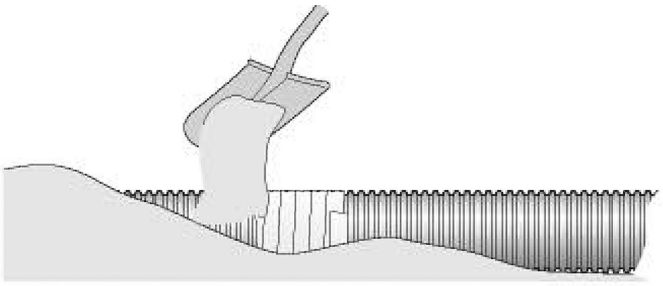


Figure 4-20: Backfilling

Trench Preparation

Place all excavation material on one side of the trench to allow space for uncoiling the pipe on the other side.

Determine the trench depth and width by the jacket size and the quantity of the Ecoflex pipes:

- The recommended burial depth of Ecoflex pipe is a minimum of 12" above the top of the pipe.
- Allow for 4" of clearance between the jacket and the bottom edge of the excavated trench. When you are installing multiple pipes, allow at least 2" of clearance between the pipes for adequate compaction.

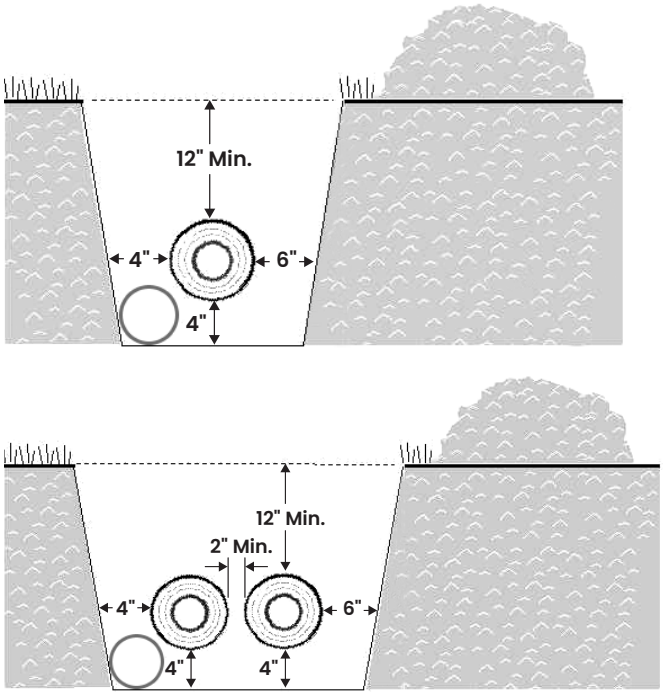


Figure 4-21: Trench preparation

To achieve the highest energy-efficiency, bury Ecoflex piping at a depth that will avoid severe temperature differentials between fluid temperature and ambient soil temperature.

The greater the difference between fluid temperature 180°F/82°C and ambient soil temperature 50°F/10°C, the greater the heat loss. For example, if the pipe is buried too shallow in freezing ground 35°F/1.7°C, the heat loss will be greater than if buried below the frost line 50°F/10°C.

The following steps and illustrations indicate recommended trench dimensions based on the number and configurations of the piping installed.

When installing Ecoflex in areas with high water table or when wet soil conditions may occur Uponor always recommends installing a drain pipe in the sandbed below the Ecoflex pipe(s).

Note: Consult with local building inspectors to determine if proper trench shoring is required for worker safety.

1. Install 4" of sand (or other suitable fill) into the excavation site for bedding material. Ensure the fill is free of sharp objects.

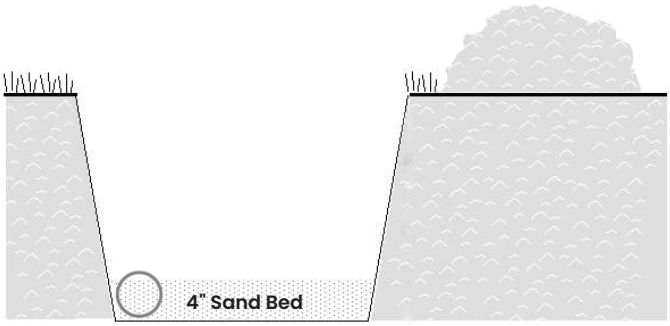


Figure 4-22: Trench preparation

2. Install Ecoflex pipes, maintaining proper clearance between the trench wall and other pipes.

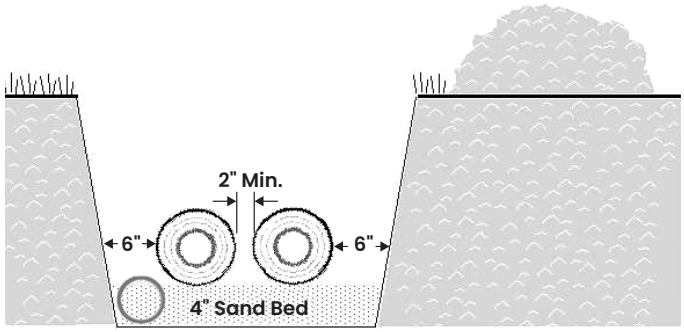


Figure 4-23: Trench preparation

3. Fill the trench, free of sharp objects, halfway up the Ecoflex pipes, and manually compact.

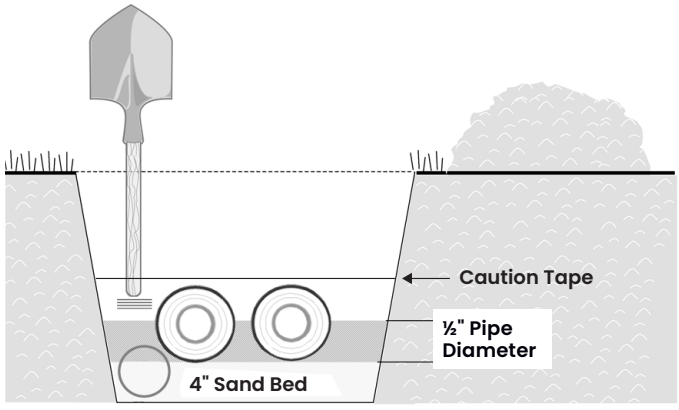


Figure 4-24: Trench preparation

4. Before installing the final fill, perform the **pressure test**. After successfully completing the pressure test, install the final fill. Ensure the fill is free of sharp objects, frozen lumps or any object that could damage the outer jacket, to 12" above the top of the pipe, and compact using mechanical compaction equipment.

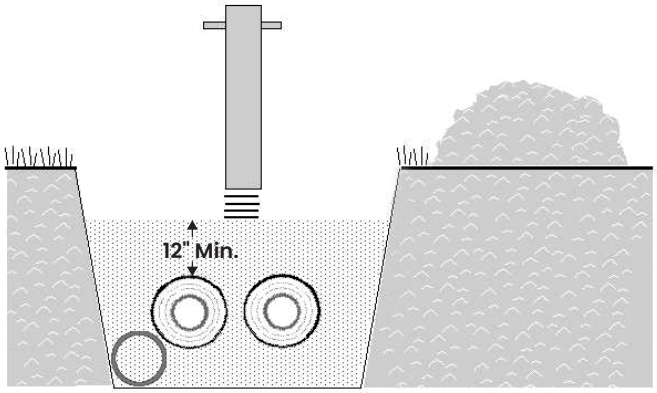


Figure 4-25: Trench preparation

Pressure Test Instructions

1. Visually confirm all connections are properly made per Uponor's installation guidelines.
2. Ensure that all components, fixtures and equipment not rated for the test pressure are isolated from the test system.
3. Ensure that all other thermoplastic piping materials are isolated from the test system.
4. Fill the system with potable water, air or a mixture of both.
5. Condition the system at 1.5 times the required test pressure for 30 minutes. This will require constant pumping or cycling the valve and compressor to maintain a pressure of 1.5 times the test pressure. If cycling the valve and compressor, apply additional pressure once the psi has dropped 10 lbs.
6. After conditioning the system for 30 minutes, quickly relieve excess pressure by opening the valve. Close the valve when the system has reached the desired test pressure.

Note: Uponor recommends a test pressure of 80 psi (unless local code dictates higher pressures).

7. Once the valve is closed, confirm a slight rise in pressure (3 to 6 psi). This will occur since the pipe's internal diameter (ID) is shrinking from its conditioned state to equalize at the lower pressure.
8. Visually check for leakage and monitor the pressure for the duration specified by local code. (A typical pressure test can range from 2 to 24 hours.)
9. If there is no reduction in pressure, the system is regarded as leak tight.

Note: Slight fluctuations of pressure are normal due to ambient temperature changes, especially during long durations (e.g., 24 hours).

10. Flush the system as required by code.

Important! If using water to pressure test the system, purge all water from the system prior to the ambient air temperatures falling to 32°F (0°C). Failing to remove the water from the system can result in damage to the piping and associated equipment.

5. Refill the trench with native soil. Then compact the soil for final cover.

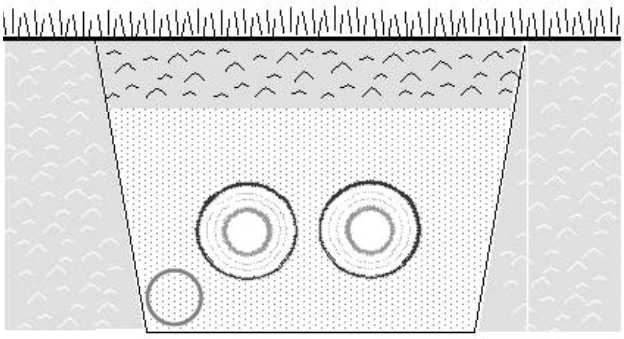


Figure 4-26: Trench preparation

Note: When installing Ecoflex pipes under a roadway, follow the same procedure as indicated previously, with the following exception: Ensure the top of the piping is 16" below the bottom of the roadbed material as specified. You can also use a suitable steel or structural conduit to sleeve the Ecoflex pipe.

Note: Due to smoke and fire restrictions, Uponor does not approve Ecoflex piping for installation within occupied buildings.

Note: Remove the outer jacket and insulation to ensure only the PEX piping enters the building.

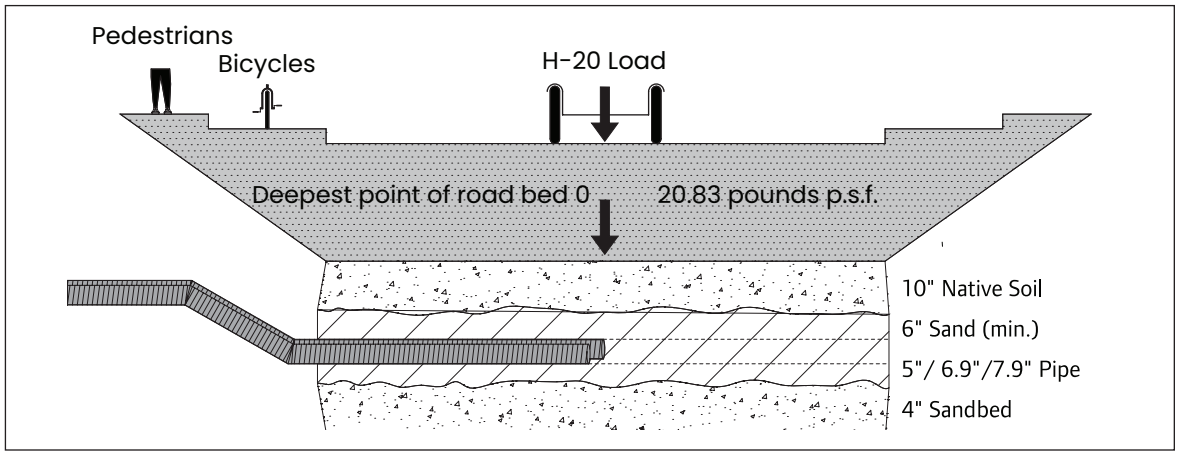


Figure 4-27: Traffic load

Ecoflex Pipe Preparation

Always inspect the starting pipe end before final cutting. Remove the protective pipe cover to ensure adequate service pipe length and desired size. We recommend allowing at least 24" of extra pipe on each end.

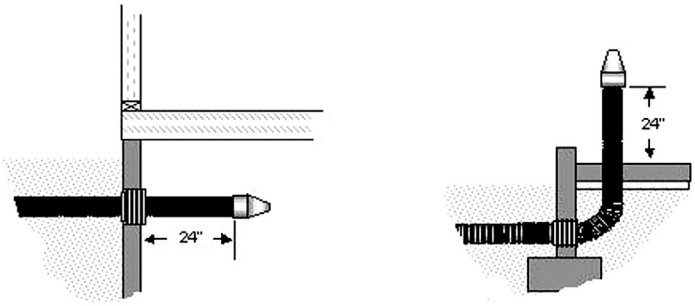


Figure 4-28: Allow 24" of extra pipe at ends

When installing in a concrete slab, always leave at least 6" of the jacket above the finished floor elevation to allow for accessory installation and to protect against water contamination in the event of a flood or mechanical equipment failure.

Tools Required

- Hand saw
- Tape measure
- Sharp razor knife
- Clean rag

1. Using a handsaw or similar tool cut the Ecoflex pipe.

Note: Allow two extra feet of pipe at each end.

Figure 4-29: Cutting pipe

Caution: When preparing a pipe end for installation using an insulation kit, see the insulation kit instructions for cutting details.

2. Measure 8" from end of the pipe, and using a sharp razor knife, slice through the jacket around the circumference and remove. It may be necessary to continue by cutting the jacket from the circumference to the rough end of the pipe as shown in **Figure 4-30.**

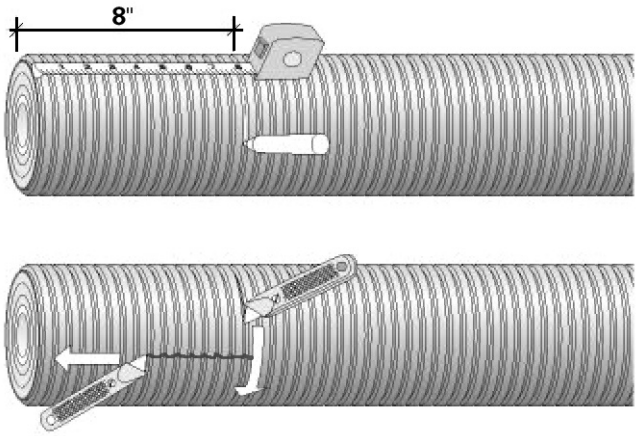


Figure 4-30: Measure and cut outer jacket

3. Pull jacket apart and remove to expose the insulation layers.

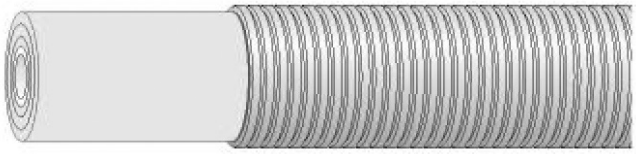


Figure 4-31: Remove jacket

4. Using a sharp razor knife carefully cut away insulation layers.

Caution: Avoid cutting or scratching the service pipe.

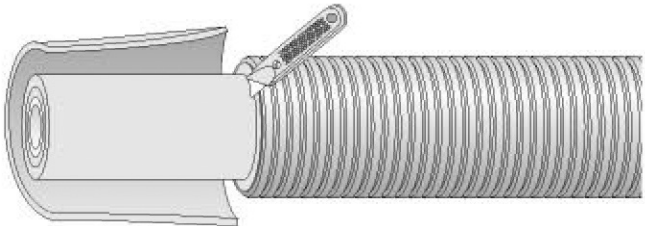


Figure 4-32: Remove insulation

5. Using a clean rag, remove all dirt and debris from the service pipe.

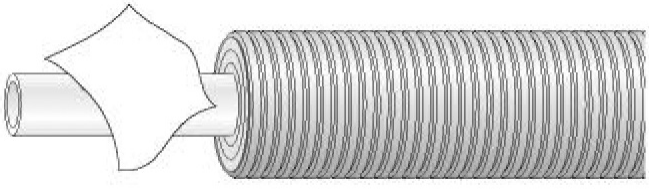


Figure 4-33: Clean the service pipe

Rubber End Caps

Uponor Pre-insulated Pipe Systems feature EPDM Rubber End Caps. EPDM Rubber End Caps seal the exposed insulation between the jacket and service pipe when cut to make a connection.

Designed for maximum flexibility and durability, this end cap includes an EPDM o-ring and stainless steel clamp for a watertight connection. End caps are required at all ends of the piping system, above or below grade, to ensure insulation integrity in the Pre-insulated Pipe system.

Tools Required

- Sharp scissors
- Pipe lubricant (soap)
- Screwdriver
- Clean rag

Installation

1. Prepare pipe end.
   a. Inspect starting pipe end before final cutting.
   b. Remove the protective pipe cover to ensure adequate service pipe length and desired size.

   Note: Uponor recommends at least 24" of extra pipe on each end.

   c. Cut the pipe using a handsaw or similar tool, allowing two extra feet at each end.
   d. Measure 8" from the end and cut the outer jacket.
   e. Remove the jacket.
   f. Remove the insulation carefully, using a sharp razor knife.

Note: If an insulation kit is required, refer to the instructions included with the insulation kit and disregard the following steps.

2. Wipe all dirt and debris from service pipe and jacket with a clean rag.
3. Verify the service pipe size and cut off the unneeded portion of the Rubber End Cap with sharp scissors. Refer to the figure and table on the following page to identify where to make the cut.

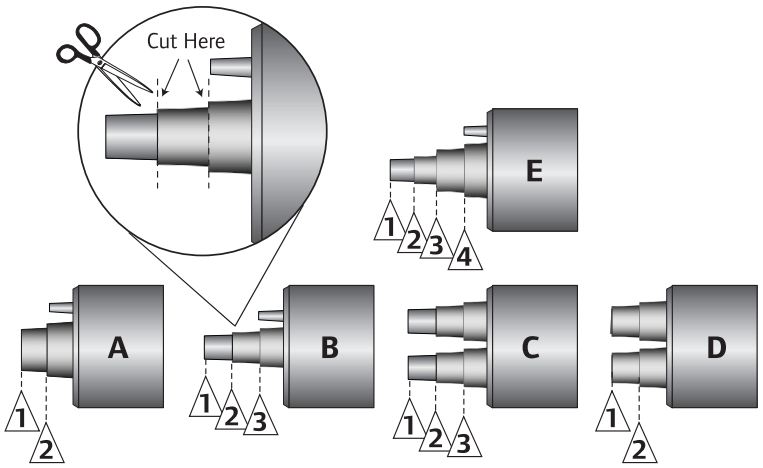


Figure 4-34: Rubber End Cap cut locations

Rubber End Cap Cut Locations						
Part Number	**Description**	**Service Pipe**	**Jacket Diameter**	**End Cap Part Number**	**End Cap Style**	**Cut Location**
5012775	Thermal Single	¾	2.7	5852710	A	1
5012710	Thermal Single	1	2.7	5852710	A	2
5015510	Thermal Single	1	5.5	5855513	A	1
5015513	Thermal Single	1¼	5.5	5855513	A	2
5016915	Thermal Single	1½	6.9	5856930	E	1
5016920	Thermal Single	2	6.9	5856930	E	2
5016925	Thermal Single	2½	6.9	5856930	E	3
5017930	Thermal Single	3	7.9	5857940	E	1
5017940	Thermal Single	4	7.9	5857940	E	3
5026910	Thermal Twin	1	6.9	5956915	C	1
5025513	Thermal Twin Jr.	1	5.5	5955513	C	2
5026913	Thermal Twin	1¼	6.9	5956915	C	2
5026915	Thermal Twin	1½	6.9	5956915	C	3
5027920	Thermal Twin	2	7.9	5957925	D	1
5027925	Thermal Twin	2½	7.9	5957925	D	2
5212775	Potable PEX	¾	2.7	5852710	A	1
5212710	Potable PEX	1	2.7	5852710	A	2
5215510	Potable PEX	1	5.5	5855513	A	1
5215513	Potable PEX	1¼	5.5	5855513	A	2
54555513	Potable PEX Plus	1¼	5.5	5855513	A	2
5216915	Potable PEX	1½	6.9	5856930	E	1
5216920	Potable PEX	2	6.9	5856930	E	2
5217930	Potable PEX	3	7.9	5857940	E	1
5226910	Potable PEX Twin	1	6.9	5956915	C	1
5226913	Potable PEX Twin	1¼	6.9	5956915	C	2
5226915	Potable PEX Twin	1½	6.9	5956915	C	3
5227920	Potable PEX Twin	2	7.9	5957925	D	1

Table 4-1: Rubber End Cap cut locations

4. Lubricate the service pipe and jacket with soap or similar material. Lubricate the inside of the end cap.

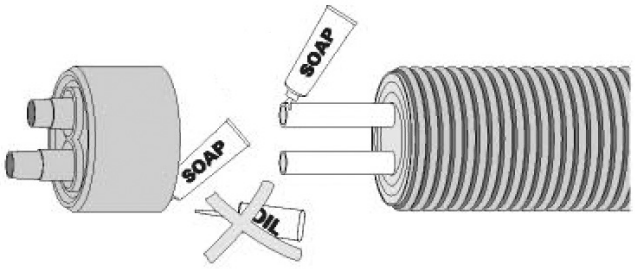


Figure 4-35: Lubricate pipe

Caution: Do not use oil-based lubricants.

5. Pull the Rubber End Cap over the service pipe and jacket until the end cap base is flush with the end of the jacket material.

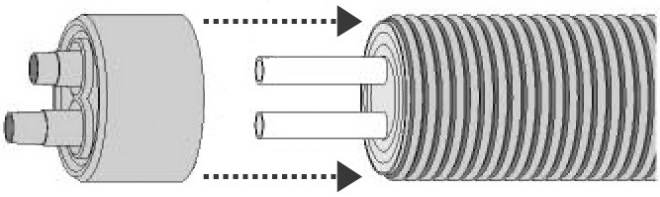


Figure 4-36: Install End Cap

6. From the end of the jacket, install the EPDM o-ring in the second groove just past the second full

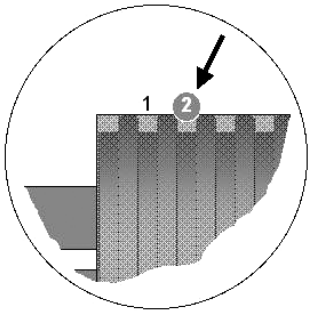


Figure 4-37: Install O-ring

7. Install the stainless steel strap over the center of the EPDM o-ring, and tighten using screwdriver until stainless steel shields butt together.

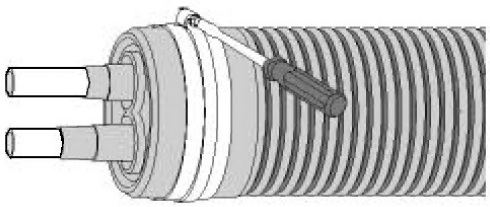


Figure 4-38: Install steel strap

WIPEX Fittings

Uponor WIPEX compression fittings are manufactured from dezincification-resistant brass and are designed for use with 4" Wirsbo hePEX pipe. The unique design of the WIPEX fitting features an eccentric outer sleeve for easier grip and an even force when inserting the pipe. The inner sleeve features a threaded profile and includes an o-ring to ensure a secure, tight seal (see **Figure 4-39**). The maximum operating pressure and temperature for WIPEX fittings is 200°F (93°C) at 80 psi (5.5 bar).

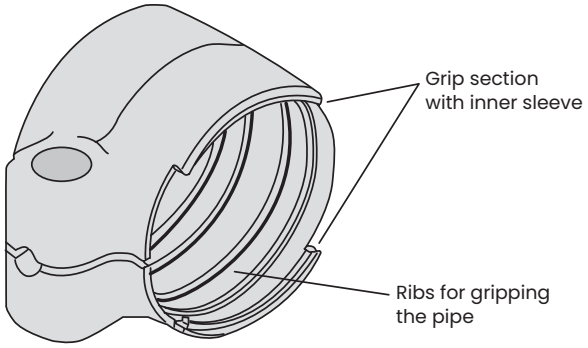


Figure 4-39: Eccentric design of the WIPEX fitting

Check the contents of this package. For damaged or missing contents, please contact your Uponor sales representative or distributor for assistance.

Package includes:

- WIPEX fitting(s)
- O-rings
- Bolts, washers and nuts
- WIPEX Fittings Instruction Sheet

Tools and Parts Required

- Plastic pipe cutter
- Low-friction lubrication (MoS2)
- De-burring tool or knife
- FD 2 – 24mm wrench

Installation

Important: Read these instructions completely before beginning installation. If you have any questions about these instructions, please contact your Uponor sales representative or distributor for assistance.

1. Cut the tubing with an appropriate plastic-pipe cutter. If using another method for cutting the tubing, make sure you remove the shavings inside the pipe before installing the fitting to avoid blocking valves.

Figure 4-40: Cut the pipe

2. Chamfer the tubing bore with a de-burring tool or knife and remove any external burrs. This prevents the o-ring from damage or dislodging from its groove after installation.

Figure 4-41: Chamfering

3. Use a suitable pair of pliers to dismount the outer sleeve. For an example of suitable pliers, see **Figure 4-43**.

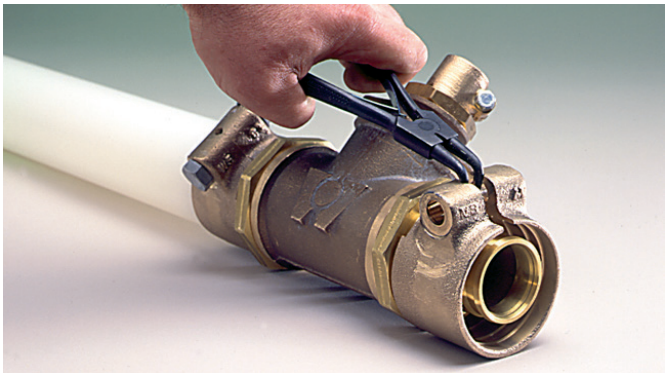


Figure 4-42: Dismounting outer sleeve

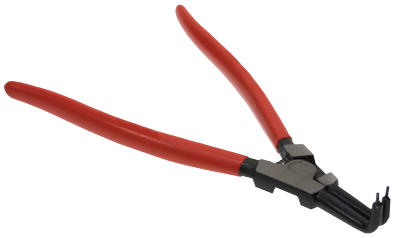


Figure 4-43: Example of suitable pliers

4. Place a bolt head between the pads and remove the outer sleeve.

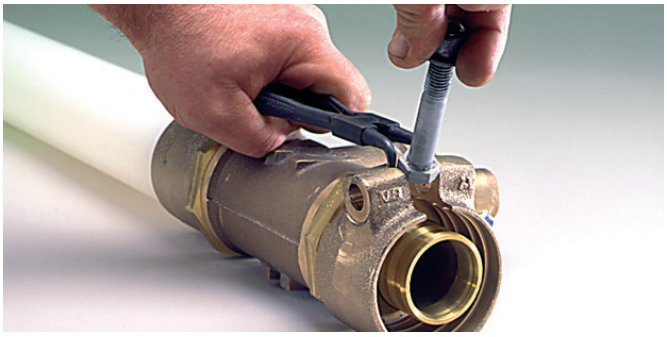


Figure 4-44: Insert bolt head

5. Mount the outer sleeve onto the tubing. Make sure you position the outer sleeve correctly toward the inner sleeve so the locking grooves engage.

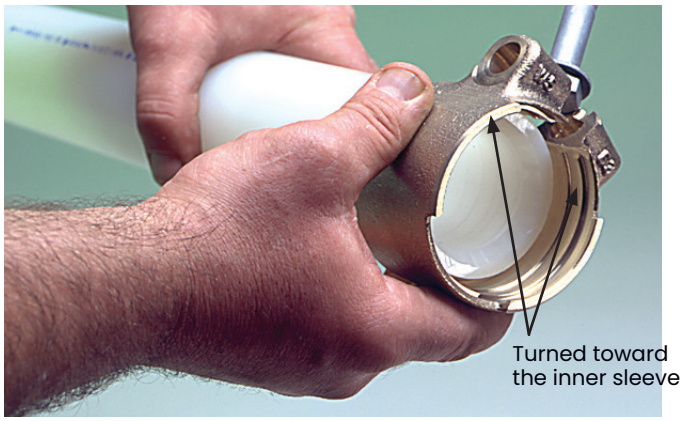


Figure 4-45: Mount the outer sleeve

6. To ensure easy mounting of the pipe onto the inner sleeve, lubricate the o-ring, preferably with an environmentally friendly silicone spray or soap.

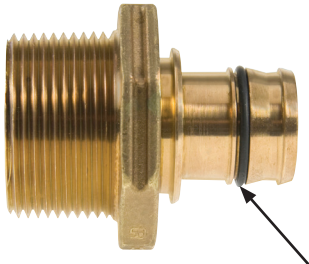


Figure 4-46: Lubricate the O-ring

7. Mount the pipe on the insert sleeve and push the outer sleeve until you reach the stop support for the pipe.

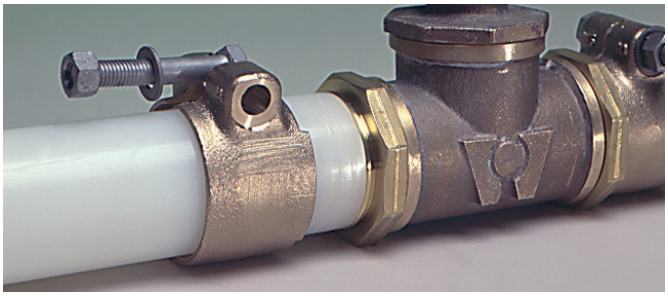


Figure 4-47: Push outer sleeve to stop support

Important: Lubricate the bolt threads and washer with suitable low friction lubrication (MoS2) before tightening.

8. Tighten the WIPEX fitting slowly by hand to avoid thread problems when assembling acid-resistant stainless steel bolts in a screw joint. If using a tightening machine, only use a low number of revolutions. Use open-ended or ring spanners and slowly tighten until the pads of the clamping sleeve are in contact with one another (see **Figure 4-48**).

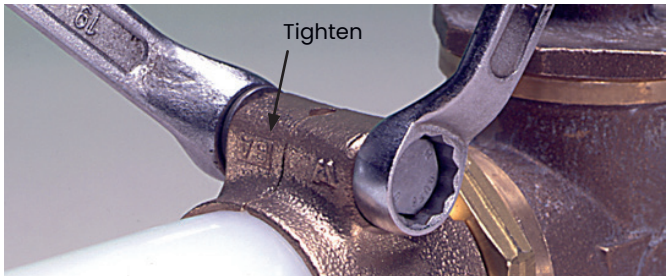


Figure 4-48: Tighten the fitting

Caution: If the pads do not come in contact, wait at least 30 minutes and tighten until the pads are in contact with one another (see **Figure 4-49**).

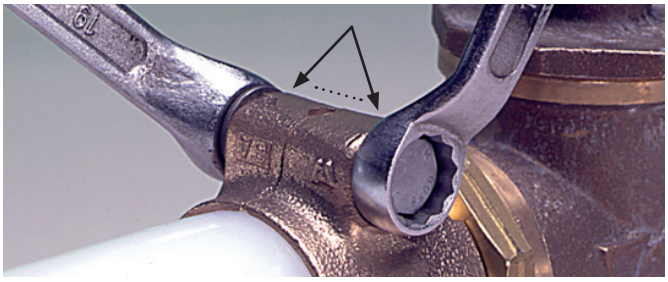


Figure 4-49: Grip and seal between fitting and pipe

9. Perform tightness testing according to current norms prior to using the system. If standards for tightness testing are not available, refer to the following instructions.
   a. Vent all air from the system and apply 1½ times the normal operating pressure.
   b. Maintain this pressure for 30 minutes and visually inspect the joints.
   c. Quickly drain off water until the pressure falls to half the operating pressure, and close the drain valve.
   d. If the pressure rises to a constant level higher than half the normal operating pressure, the system is tight.
   e. Maintain this pressure for 90 minutes and visually inspect the fittings during this time. A drop in pressure indicates leakage in the system.

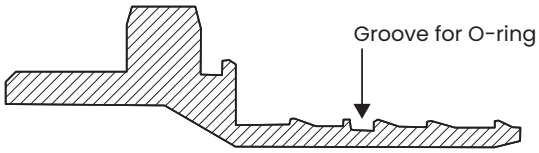


Figure 4-50: Grooves for O-ring placement

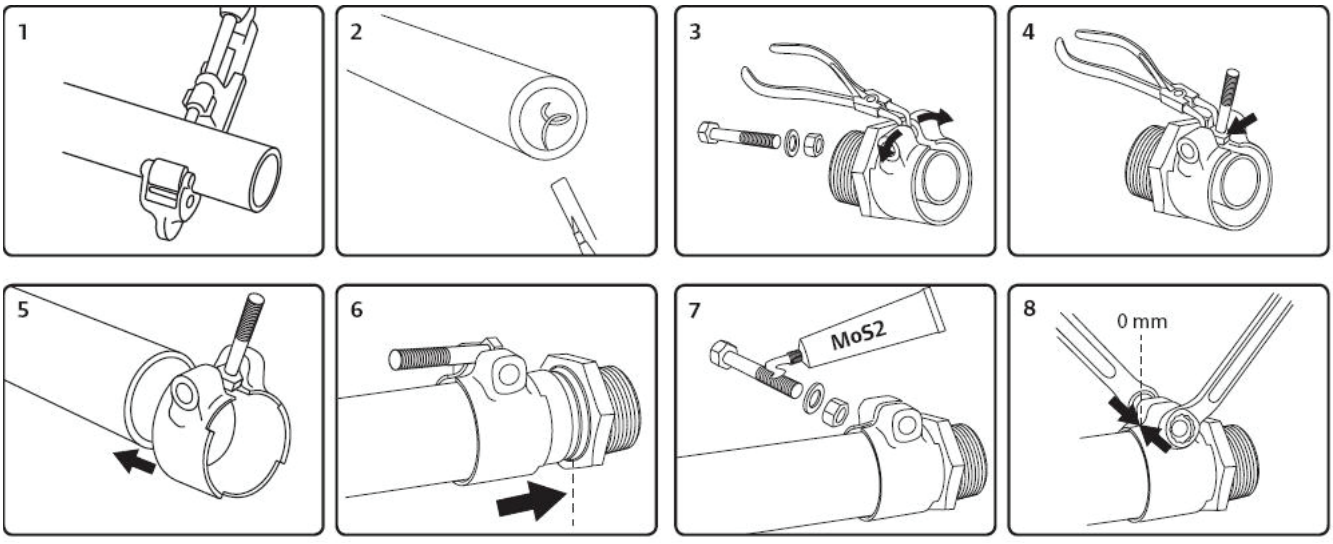


Figure 4-51: Visual summary of installation steps

Connection Vault

Tools Required

- Soft-flame torch
- Abrasive cloth
- Hand saw
- Mastic tape

Installation

Use the following steps to install the Connection Vault.

1. The unique design of the Connection Vault makes it perfect for burial underground. Locate an area that allows easy access in the event of future excavation (modifications or inspection). Position the Connection Vault in the trench to achieve proper pipe alignment.

Note: If being installed in area of high water table, install and secure a concrete anchoring pad below the vault.

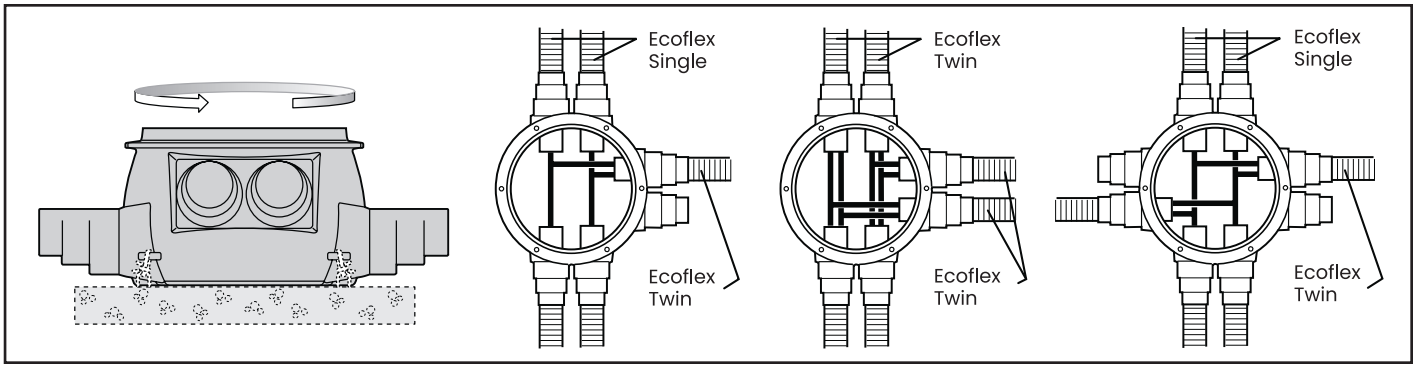


Figure 4-52: Locate and position the Connection Vault

2. Using a hand saw, cut away end of the outlet suitable for the outside diameter of the Ecoflex jacket — only cut what is necessary to ensure a full-sized opening — typically ½" (see **Figure 4-53**).

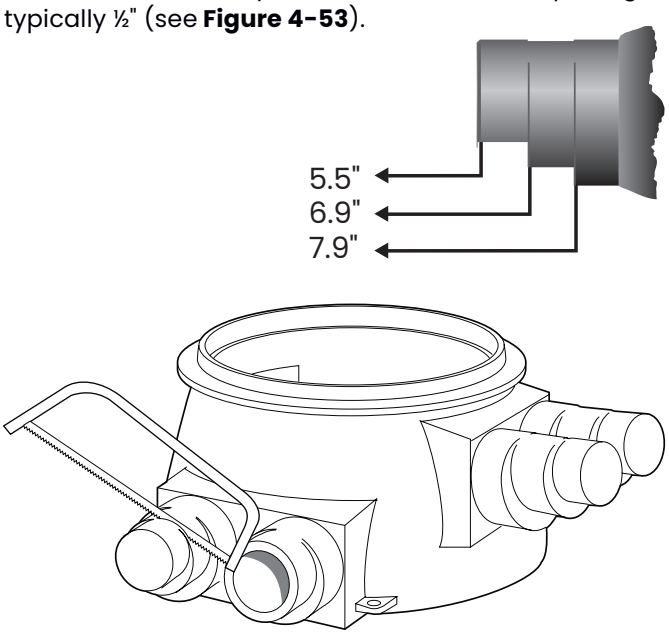


Figure 4-53: Cut the outlet

3. Install the Rubber End Cap and Male Adapter Fitting before installing into the Connection Vault. Slide the Connection Vault Heat Shrink Sleeve over the pipe before sliding into outlet opening.

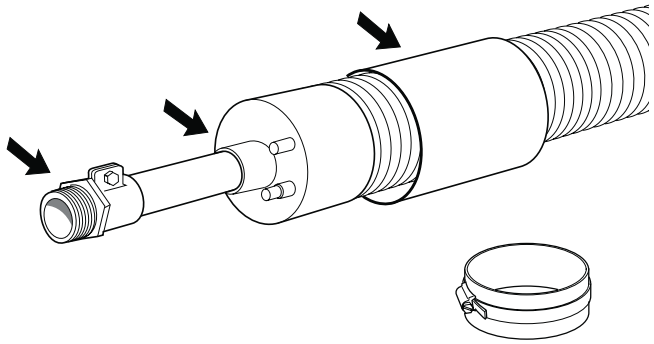


Figure 4-54: Prepare the pipe

4. Insert all pipes into the Connection Vault and make all service pipe connections, as shown in **Figure 4-55**; then perform a pressure test.

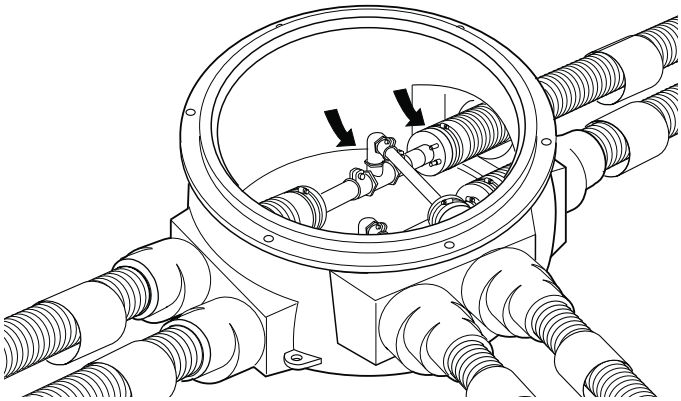


Figure 4-55: Final connections

Important: Pressure test the connections before proceeding.

5. Using an abrasive cloth, lightly sand the surface of the Connection Vault and corresponding pipe jacket to provide a rough surface for proper adhering.

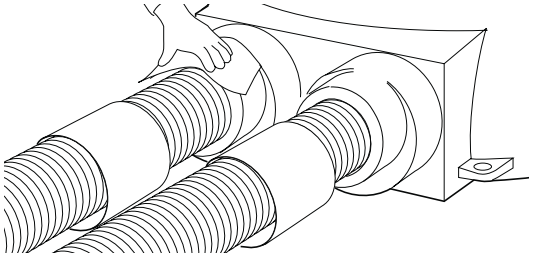


Figure 4-56: Lightly sand connection Vault surface

6. Apply mastic tape to the pipe 2" from the vault outlet. Using a soft-flame torch, preheat the vault outlet, being careful not to overheat.

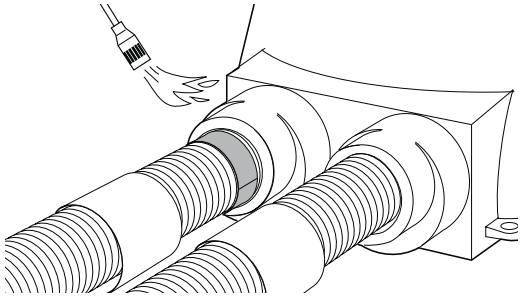


Figure 4-57: Apply mastic tape

Caution: Keep flame in constant motion. Do not overheat.

7. Remove the protective backing from the Heat Shrink Sleeve and slide over the Wall Sleeve at least 4". Using a soft-flame torch, evenly apply heat to the heat shrink sleeve only on the Connection Vault outlet.

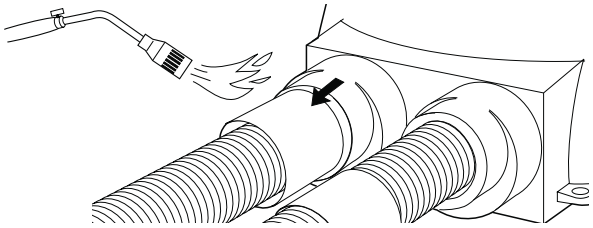


Figure 4-58: Secure Heat Shrink Sleeve

8. Wait five minutes for the seal to cool. Secure Heat Shrink Seal to pipe jacket following the same procedures as in Step 7.

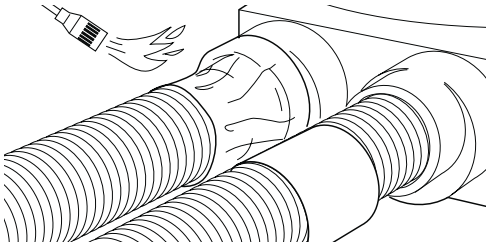


Figure 4-59: Heat Shrink Seal

Caution: Keep flame in constant motion. Do not overheat.

9. Clean the rubber lid gasket, ensuring it is free from dirt and debris. Secure lid. Manually place backfill around the Connection Vault. Be careful not to damage the Heat Shrink Seal connections. Verify that the Connection Vault remains in position during the backfill. Compact the soil in layers of 8" to 12". Do not use mechanical compaction directly over the Connection Vault lid.

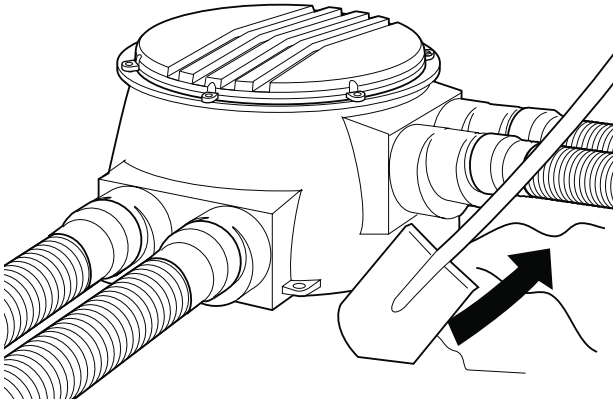


Figure 4-60: Protecting the Connection Vault

Note: Protect the Connection Vault from traffic loads with a concrete slab. If a load-distributing slab is not used, a Connection Vault covered with 20" of sand will withstand an occasional momentary load of 6,600 lbs. (e.g., a tractor passing over). The maximum stationary load permitted is 1,100 lbs. (e.g., a car parked above).

Insulation Kits

Uponor features a variety of insulation kits designed for specific applications:

- Straight Insulation Kit
- Tee Insulation Kit
- 90-degree Insulation Kit
- H-insulation Kit

For a description of these products, refer to **Chapter 2: Products and Hardware**.

Tools Required

- Hand saw
- Tape measure
- Chamfering tool
- Sharp razor knife
- Permanent ink marker
- Sharp scissors
- Torque wrench
- Pipe lubricant
- Clean rag

The following figure shows examples of insulation kits for an H connection and a tee connection. Refer to **Table 4-2** for dimensions.

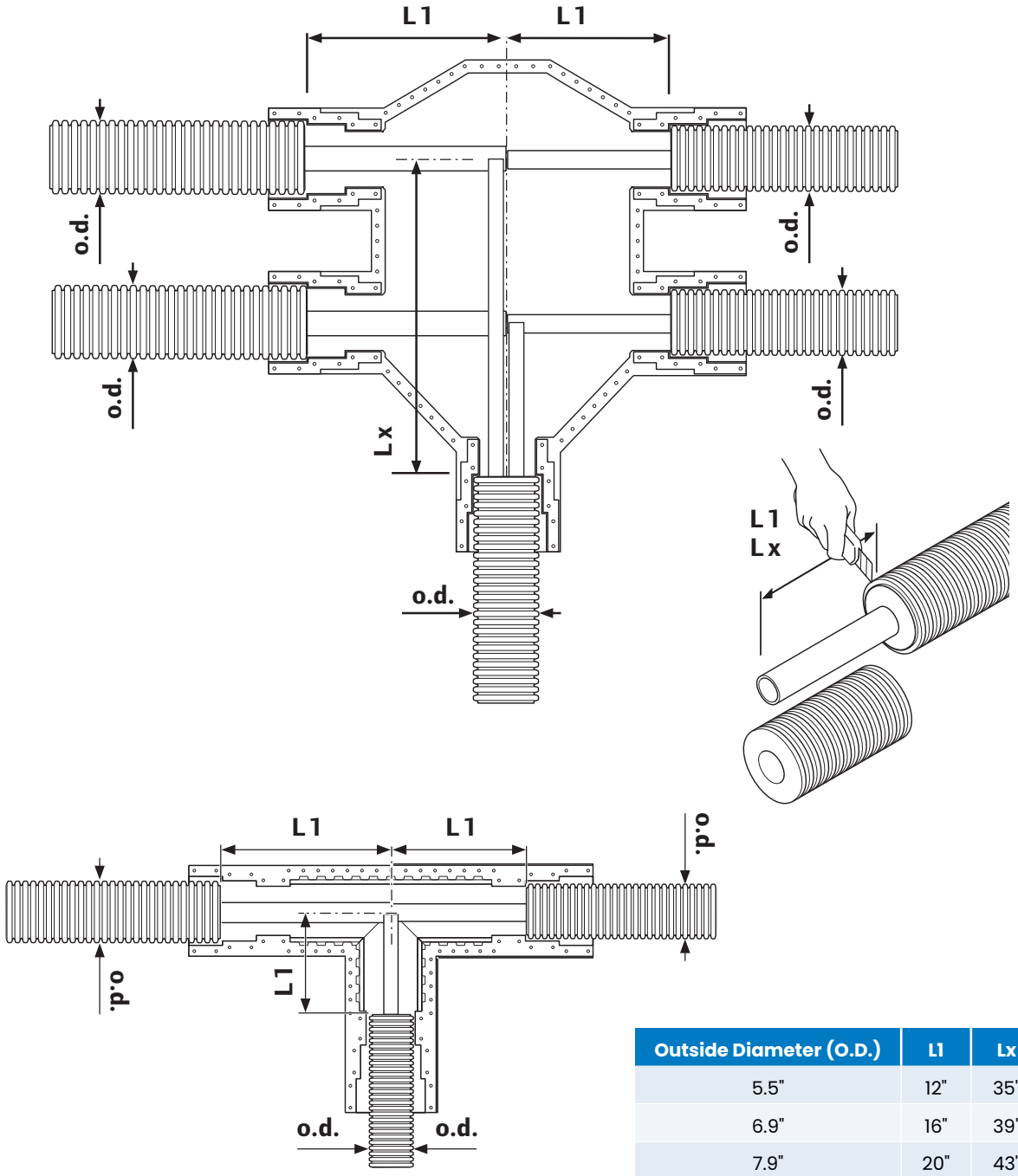


Figure 4-61: Insulation Kit examples

Outside Diameter (O.D.)	L1	Lx
5.5"	12"	35"
6.9"	16"	39"
7.9"	20"	43"

Table 4-2: Pipe diameter and cut measurements

Installation

The following outlines the basic steps for pipe installation using insulation kits. It is helpful to become familiar with the previous installation instructions for the Rubber End Cap and the WIPEX Fittings or ProPEX Fittings when following these instructions for connecting pipe using insulation kits.

Uponor offers several types of insulation kits depending on specific application requirements. Refer to **Figure 4-62** for configurations of these insulation kits.

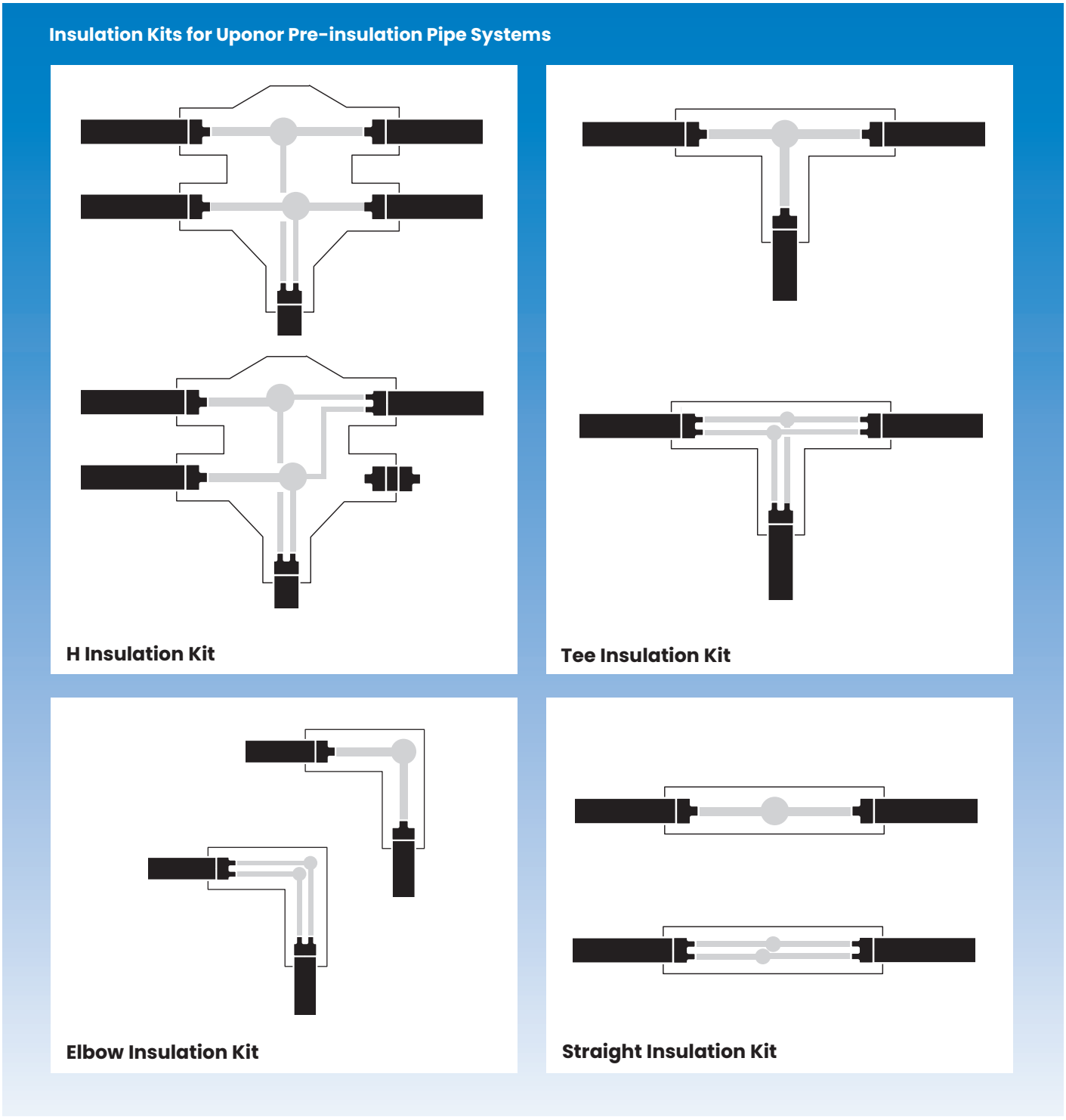
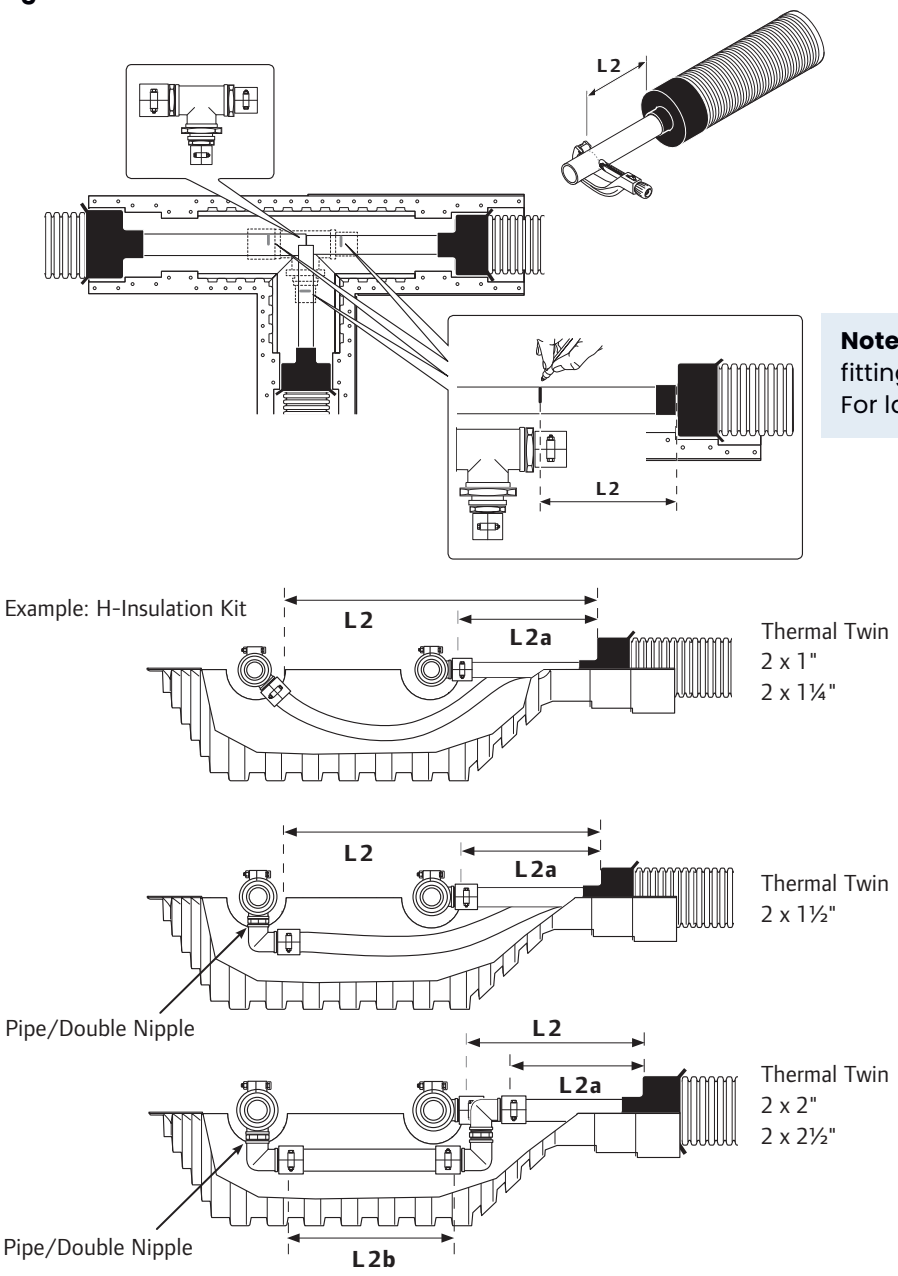


Figure 4-62: Insulation Kit configurations

1. Determine pipe lengths for the pipe assembly, measure the amount of pipe needed for the assembly. Refer to **Figure 4-63.**



Note: Use Uponor ProPEX fittings for pipe sizes up to 3". For larger pipe, use WIPEX fittings.

Figure 4-63: Determining lengths for assembly and pipe styles

2. Remove casing and insulation. Peel off the casing and remove the required amount of insulation (taking into account the length of the End Cap). Only peel off what is absolutely required in order to connect the pipe.
3. Install Rubber End Cap. Refer to **the installation instructions on pages 39-40**.

Important: Don't apply the stainless steel clamp when installing into an insulation kit.

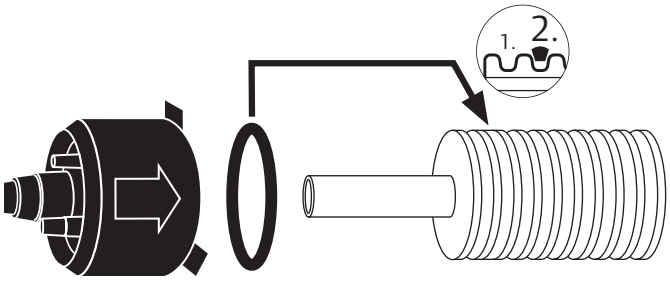


Figure 4-64: Install Rubber End Cap

4. Assemble the connection. See **Figure 4-65** for an example of a tee connection, and refer to **WIPEX Fittings** on **pages 41-43**.

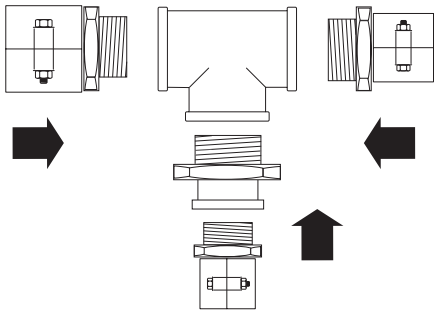


Figure 4-65: Assemble the connection

5. Join the pipes with fittings. Refer to **WIPEX Fittings** on **page 41-43** for details.
6. Pressure test the system. Refer to **page 37** for pressure testing instructions.

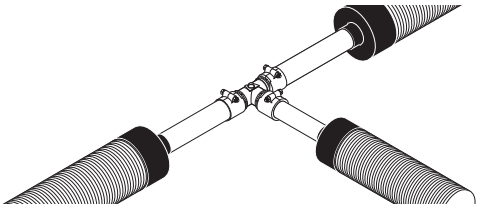


Figure 4-66: Pressure test

7. Apply sealant compound in the bottom of the insulation shell. **Figure 4-67** illustrates a Tee-connection.

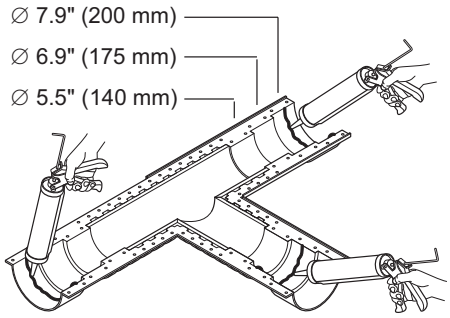


Figure 4-67: Apply sealant

8. Place the connected pipes into the insulation shell as shown (**Figure 4-68**).

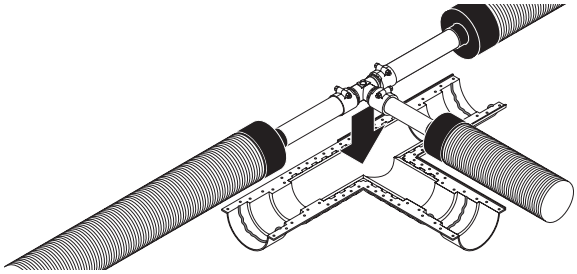


Figure 4-68: Placing the pipes

9. Apply sealant compound to end caps and shell as shown (**Figure 4-69**).

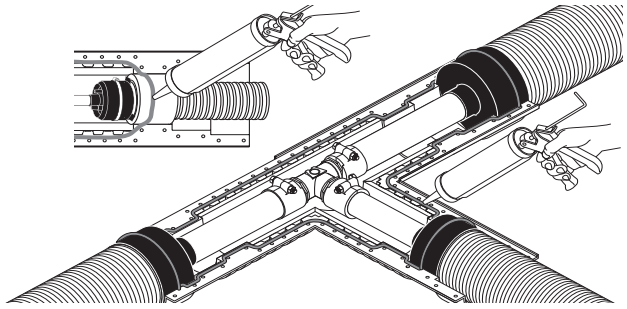


Figure 4-69: Sealant compound

10. Place the top part of the insulation shell into place over the piping.

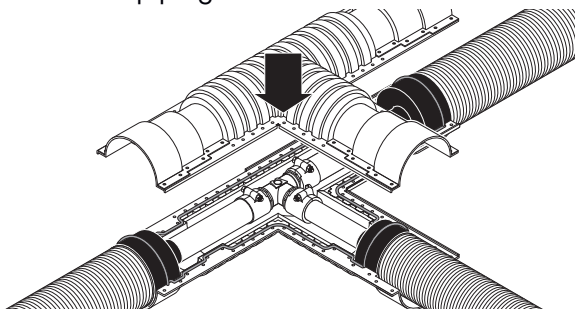


Figure 4-70: Top shell of Insulation Kit

11. Tighten all bolts and screws of the outer shell, and hammer in all rivets.

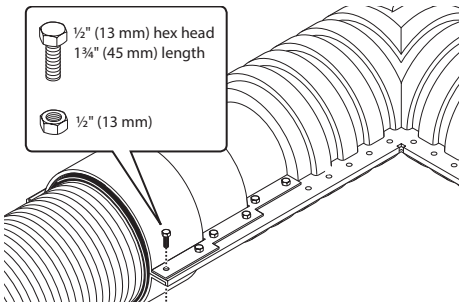


Figure 4-71: Fastening the outer shell

12. Tighten all bolts and screws and hammer rivets on the inner shell as shown.

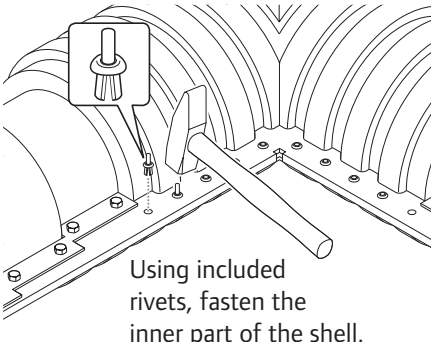


Figure 4-72: Fastening the inner shell

Compression Wall Seal

This section illustrates the various Wall Seal installation applications. Typical examples show procedures for use. Applications vary depending on installation design requirements.

Tools Required

Tools and components needed for this installation include the following.

- Compression Wall Seal and included hardware (nuts, bolts, etc.)
- Epoxy resin
- Wall Sleeve (optional)
- Protective End Caps or plastic covering
- Pipe clamp (optional)
- Cutting tools
- Drill (optional)

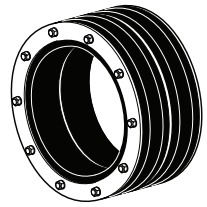


Figure 4-73: Wall Seal, pressure waterproof up to 7.0 psi (0.5 bar)

Use the Uponor Wall Seal to provide sealing against high-pressure water. The installer inserts the Wall Seal into the core hole or casing pipe on the outside wall. When installing, insert Wall Seal with nuts of the seal facing towards the inside wall or basement side.

You can use the Compression Wall Seal with the Wall Sleeve or alone in applications where a field core drill is preferred. Refer to **Table 4-3 on the following page** for the required core drill size.

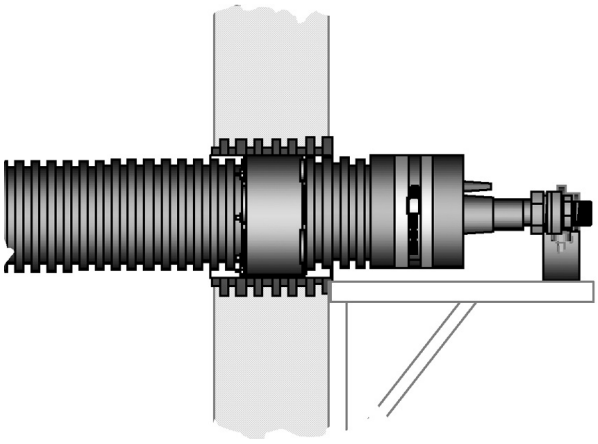


Figure 4-74: Wall Sleeve, pressure waterproof up to 7.0 psi (0.5 bar)

For new concrete walls, use the Wall Sleeve with the Compression Wall Seal to simplify the installation process. It is easy to cut for proper fit within concrete forms. The Wall Sleeve offers an extra convenience for the installer. The Wall Sleeve provides a tight seal under pressurized water — easy to cast when pouring new cement walls.

Wall Sleeve Installation Example

If you are installing piping without bends so that it lies straight, all you need is the Wall Seal. Tension-free installations do not require a supplementary set.

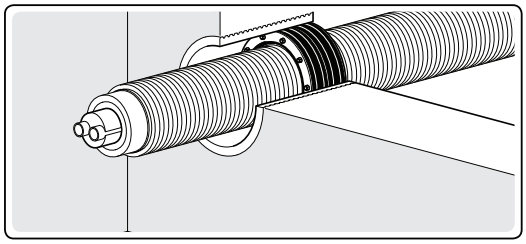


Figure 4-75: Tension-free installation

Core Holes in Water-impermeable Concrete

At the designated area, bore through the wall with an appropriate cement drill.

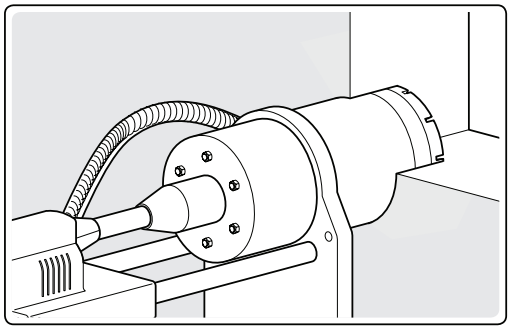


Figure 4-76: Drilling the core hole

After drilling, protect the bore wall with Epoxy Resin. Wearing protective gloves, cover the inside cut of the core hole according to the directions on the resin container.

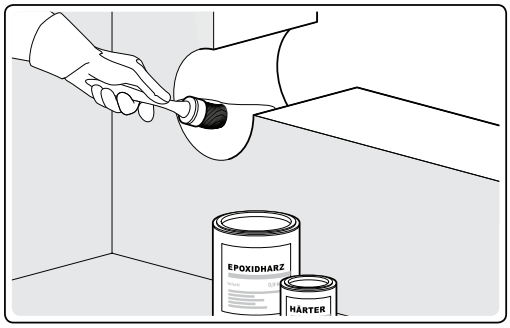


Figure 4-77: Protect the bore wall with epoxy resin

Protect the bore from contamination and moisture during the unfinished phase of the installation. Tape plastic over the core hole on both sides of the wall, or insert protective end caps (supplied by installer) onto both sides of the core hole as shown in **Figure 4-78**.

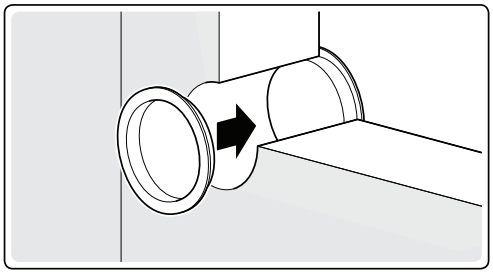


Figure 4-78: Protect the bore during installation

Uponor Ecoflex Jacket Pipe	Core Hole
2.7"	4.75"
5.5"	8"
6.9"	10"
7.9"	10"

Table 4-3: Installation parameters (core hole)

Wall Sleeve

If pouring new walls, you can cast the Uponor Wall Sleeve at the same time. The special pipe casing in combination with the Wall Seal ensures a tight seal under pressurized water.

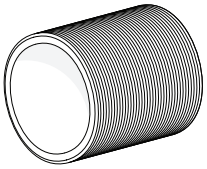


Figure 4-79: Wall Sleeve

You can install the Wall Sleeve either flush with the casing or projected out from the wall casing (see **Figures 4-80**).

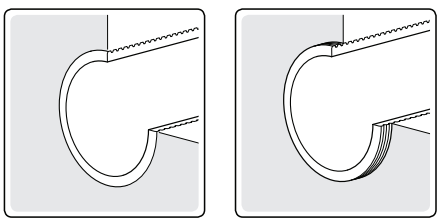


Figure 4-80: Flush with casing and projected from casing

You can fasten a steel framework to the Wall Sleeve so that it is either flush with or protruding from welded joints or with a pipe clamp (supplied by the installer).

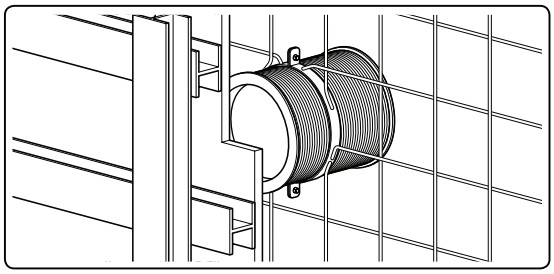
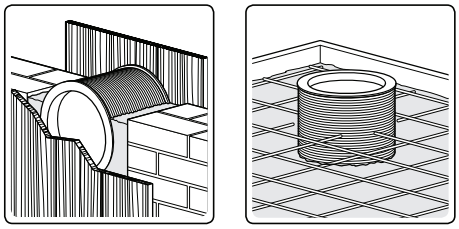


Figure 4-81: Fasten in steel framework

You can also build the Wall Sleeve directly into walls or install them into floors and ceilings as shown in **Figure 4-82**.



Figures 4-82: Built into a wall and installed into a floor or ceiling

When installing Wall Sleeves, be sure to compact the cement around the seams of the pipe casing thoroughly as shown.

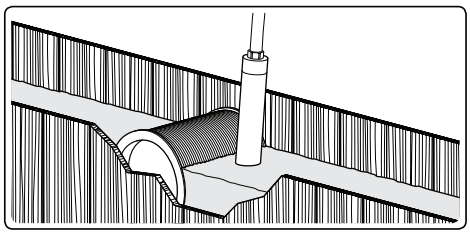


Figure 4-83: Compacting the cement

Protect the bore openings from contamination and moisture during the unfinished phase by inserting protective end caps or securely covering (taping) the bore with plastic.

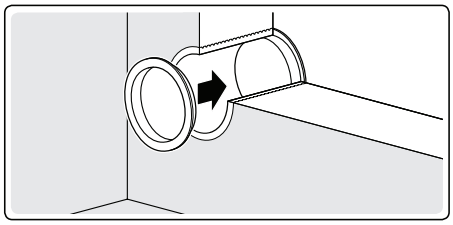


Figure 4-84: Protect core openings

Table 4-4 shows the required Wall Sleeve with Heat Shrink Seal Kit for specific sizes of Uponor Ecoflex pipe.

Uponor Ecoflex Jacket Pipe	Wall Sleeve with Heat Shrink Seal Kit Part Number
2.7"	1018266
5.5"	1018269
6.9"	1018268
7.9"	1018268

Table 4-4: Wall Sleeve with Heat Shrink Seal Kits

Installing the Wall Seal into the Core Hole or Wall Sleeve

Note: The following illustrations show the basement on the left side of the wall.

Insert the Wall Seal flush with the end of the core hole on the side of the outside wall (the water side) — nuts face toward the inside walls (the basement).

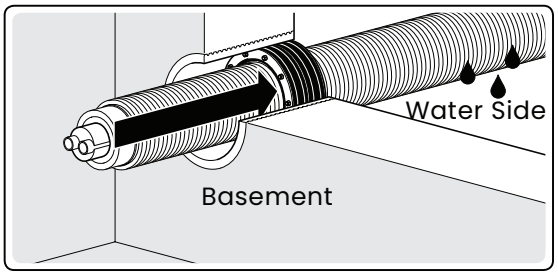


Figure 4-85: Wall Seal installed flush with outside wall opening

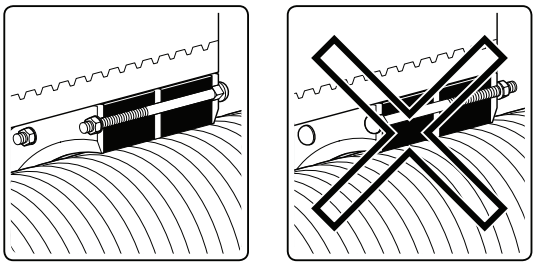


Figure 4-86: Correct vs. incorrect Wall Seal installations

Caution: Make sure the nuts are facing toward the basement when inserting the Wall Seal.

Install the Wall Seal pipe at right angles to the pipe as shown.

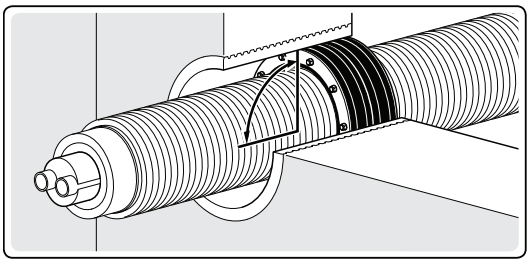


Figure 4-87: Install Wall Seal pipe at right angles to pipe

When tightening to the maximum torque, keep the following in mind.

- During final assembly, successively tighten each nut with a torque-wrench clockwise until the maximum torque M_{max} is reached (M_{max} = 5 Nm (M6)/3.7 lbf·ft; M_{max} = 8 Nm (M8)/5.9 lbf·ft).
- Tighten the nuts several times.
- Repeat this procedure after two hours.
- To ensure no damage to the Ecoflex jacket, tighten the nuts of the Uponor Wall Seal until the rubber seal wraps around the Ecoflex jacket pipe and the core hole, or if used, the Wall Sleeve. **Figure 4-86** illustrates the correct way versus the incorrect way of installing the Wall Seal.
- The house lead-ins are neither fixed points nor supports and serve solely to provide an elastic seal for the jacket pipes of Ecoflex.
- The installer can gently turn the Ecoflex jacket pipes in an axial motion.
- Before filling in the pipe trench, place compressed, stoneless sand under the Ecoflex piping so that no additional stress can affect the seal.

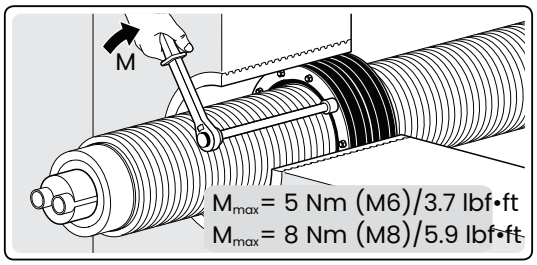


Figure 4-88: Tighten to maximum torque

Chapter 5
System Design Parameters

The Uponor Advantage

Designing a domestic water or hydronic distribution system with Uponor PEX pipe and ProPEX fittings offers many advantages, including reliability, corrosion-resistance, cost-effectiveness, greater resiliency in freezing conditions, heat-kink repairability, code-compliance, and superior thermal and acoustical properties, all backed by a 25-year transferable limited warranty.

Domestic Water Systems

For domestic water systems, the smaller inside diameter of SDR9 Uponor AquaPEX piping allows decreased system volume to provide hot water to fixtures in a shorter amount of time while still meeting end-use fixture requirements. This provides an efficient system that can meet peak flow demands while conserving water and energy use.

Additionally, designing with multiport tees and small-dimension (½" to 1") coiled piping reduces the number of behind-the-wall connections in a unit application by 70 percent for greater system performance.

Hydronic Piping Systems

For hydronic piping systems, Wirsbo hePEX is manufactured with an oxygen barrier to protect ferrous components in hydronic heating hot-water or chilled-water applications, providing a durable, reliable, corrosion-resistant solution that offers greater system longevity and performance.

Standard Dimension Ratio (SDR)

Standard dimension ratio (SDR) is a term used in describing the size of PEX piping — it is the conceptual equivalent of a pipe schedule. Dimension ratio (DR) is the average outside diameter (OD) of PEX piping divided by its minimum wall thickness.

ISO Equation 2S/P = R-1
Where S = HDS,
P = psi, R = SDR

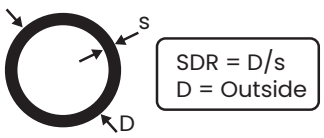


Figure 5-1: ISO Equation

Temperature and Pressure Ratings

Temperature and pressure ratings for PEX piping are determined by the Plastics Pipe Institute (PPI) as required by the ASTM F876 standard. It is important to understand the hydrostatic strength (ratings) on Uponor PEX piping does NOT take into account environmental or system factors which could affect system life. These factors could include, but are not limited to, water temperature and quality, use patterns, chlorine type and level, UV exposure, installation methods, etc. See **Table 5-1** for recommended design parameters. Additional system design recommendations can be found in PPI TR-4. The minimum burst pressure per ASTM F876 is 480 psi at 73°F (22.7°C) for ½" PEX and 475 psi at 73°F (22.7°C) for ¾" and larger PEX.

Note that Uponor PEX pipe can withstand burst pressures up to 800 psi at 73°F (22.7°C) without failure, so designers can feel comfortable designing Uponor PEX pipe up to its maximum temperature and pressure limits based on the intended applications. See **Table 5-1 on the following page.** Additional supporting information can be found in PPI TN-53, *Guide to Chlorine Resistance Ratings of PEX Pipes and Tubing for Potable Water Applications*, regarding the recommended design parameters.

Hydrostatic Design Basis (HDB)

Through scientific research and historical experience, hydrostatic design basis (HDB) ratings have been shown to be useful indicators of relative long-term strength of thermoplastic materials when tested under the conditions specified in test method ASTM D2837. The HDB is used to determine the temperature and pressure ratings of a specific material. These temperature and pressure ratings are based on an extrapolated life of 50 years.

Standard PPI TR-3 defines the policies and procedures for developing HDB ratings for thermoplastic piping materials or pipe. Uponor maintains standard grade ratings for Uponor PEX piping as tested in accordance with TR-3. Uponor piping products carry the following temperature and pressure ratings shown in **Table 5-1**.

To start the evaluation, pipes of all sizes are empirically tested to ASTM D2837 to determine the hydrostatic design basis (HDB); this test method is used for all polyethylene-based piping. That data is then multiplied by 0.5 design factor to determine the hydrostatic design stress (HDS). The HDS is then run through an ISO equation (ISO R-161-1690) to determine the temperature and pressure limits of the pipe.

System Type	Uponor PEX Maximum Recommended Design Parameters		
	Temperature	Pressure	Velocity
Domestic cold-water piping	See **Table 5-2**		10 ft./sec.
Domestic hot-water piping	140°F (60°C)	80 psi (5.5 bar)	8 ft./sec.
Domestic hot-water recirculation piping (dedicated)[1]	140°F (60°C)	80 psi (5.5 bar)	2 ft./sec.
Heating hot-water piping	See **Table 5-2**		8 ft./sec.
Chilled-water piping	See **Table 5-2**		8 ft./sec.

Table 5-1: Maximum recommended design parameters for Uponor PEX piping systems

[1] Sized per the requirements stated in ASPE Plumbing Engineering Design Handbook (PEDH), Volume 2, Plumbing Systems

Note: For systems requiring pressures and/or temperatures beyond the recommended values, please contact Uponor Technical Services at 888.594.7726.

Excessive Temperature and Pressure Capability

In the event of an equipment or system malfunction, Uponor PEX is capable of withstanding temperatures of up to 210°F at 150 psi (99°C at 10 bar) for a maximum of 48 hours until repairs can be made.

Note: Excessive temperature and pressure requirements are meant solely to demonstrate that PEX piping can temporarily withstand intermittent elevated values and shall not be used as system design parameters.

Hydrostatic Temperature and Pressure Ratings	
°F/°C	psi/bar
200.0/93.3	**80/5.5**
190.0/87.8	90/6.2
180.0/82.2	**100/6.9**
170.0/76.7	106/7.3
160.0/71.1	111/7.7
150.0/65.6	117.8.0
140.0/60.0	123/8.5
130.0/54.4	128/8.8
120.0/48.9	134/9.2
110.0/43.3	139/9.6
100.0/37.8	145/10.0
90.0/32.2	151/10.4
80.0/26.7	156/10.8
73.4/23.0	**160/11.0**
60.0/15.6	168/11.6
50.0/10.0	173/11.9
40.0/4.4	179/12.3

Table 5-2: Interpolated hydrostatic temperature and pressure ratings of Uponor PEX for hydronic and domestic cold-water systems

ASTM F876 Hydrostatic Temperature and Pressure Ratings for SDR9 PEX		
Rated Temp. (°F)	Hydrostatic Design Stress (psi)	Pressure Rating for Water (psi)
73.4	630	160
180	400	100
200	315	80

Table 5-3: ASTM F876 hydrostatic temperature and pressure ratings for SDR9 PEX

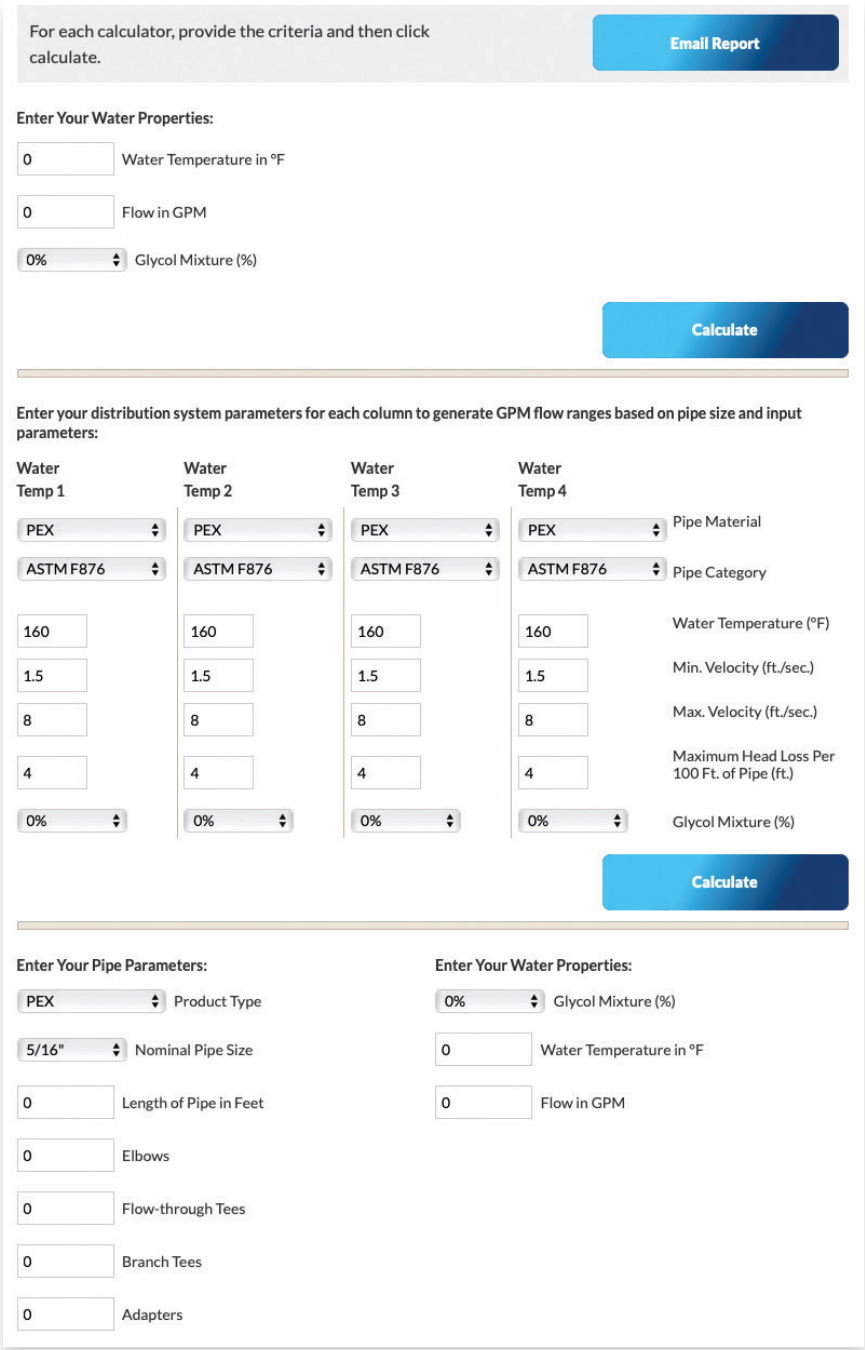
Appendix A

Uponor Online Pipe Sizing Calculator

Accurate Pipe Sizing, Friction Loss, and Heat Loss Calculations

Use the Uponor Online Calculator at **uponor.com/calculator** for quick, accurate pipe sizing, friction loss, and heat loss calculations.

Hydronic Calculator



Pipe Heat Loss Calculator

The Uponor pipe heat-loss calculator uses cylindrical thermal resistance methodology, as supported in ASHRAE handbooks, to determine the pipe heat loss and surface temperature for aboveground building applications.

Provide the following criteria and then click calculate below. **Email Report**

Enter Your Pipe Parameters:

1	Combined heat transfer coefficient (h) Btu/(hr·ft²·°F)
0.0208	Insulation conductivity (k) Btu/(hr·ft·°F)
PEX	Product Type
1/2"	Nominal Pipe Size
1	Insulation thickness in inches

Enter Your Temperature Properties:

50	Air Temperature in °F
180	Water Temperature in °F

Results:

Heat Loss per Foot = Btu/(hr·ft)

Skin Temperature = °F

Plumbing Calculator

Provide the following criteria and then click calculate below. **Email Report**

Enter Your Domestic Water Supply Parameters:

			Calculation:	
0	Pressure Available at Building		+	PSI
0	Min. Fixture Working Pressure		-	PSI
0	Static Loss - System Height (ft.)	x 0.433	-	PSI
0	Additional Component Loss		-	PSI

Available Pressure For Friction Loss = PSI

Enter Your Piping Supply Information:

		Calculation:	
0	Longest Run to Fixture (ft.)	+	FT
25	Fitting Allowance (% of number above)	+	FT

Total Developed Length = FT

Friction Loss Rate Per Foot (Friction Loss / TDL) = PSI/FT

Friction Loss Rate per 100 Feet (Friction Loss / TDL * 100) = PSI/100FT

Enter Your System Parameters for Each Table:

A	B	C	
60	125	110	Water Size Table Temperature (°F)
10	8	2	PEX Max. Velocity Per Water Temp (ft./sec.)
8	8	2	PP-RCT Max. Velocity Per Water Temp (ft./sec.)
FT	FT	FT	WSFU Predominant Fixture Curve

UPC

Choose the code that your state or local AHJ has adopted. State specific codes are only listed if the fixture unit to gpm conversion differs from a model code.

Appendix B
Energy/Heat Loss Charts

Uponor provides charts in this section to our customers as general guidelines for calculating energy loss expected with the use of different pre-insulated piping. For precise calculations, we recommend consulting with a professional engineer as various factors can affect energy or heat loss.

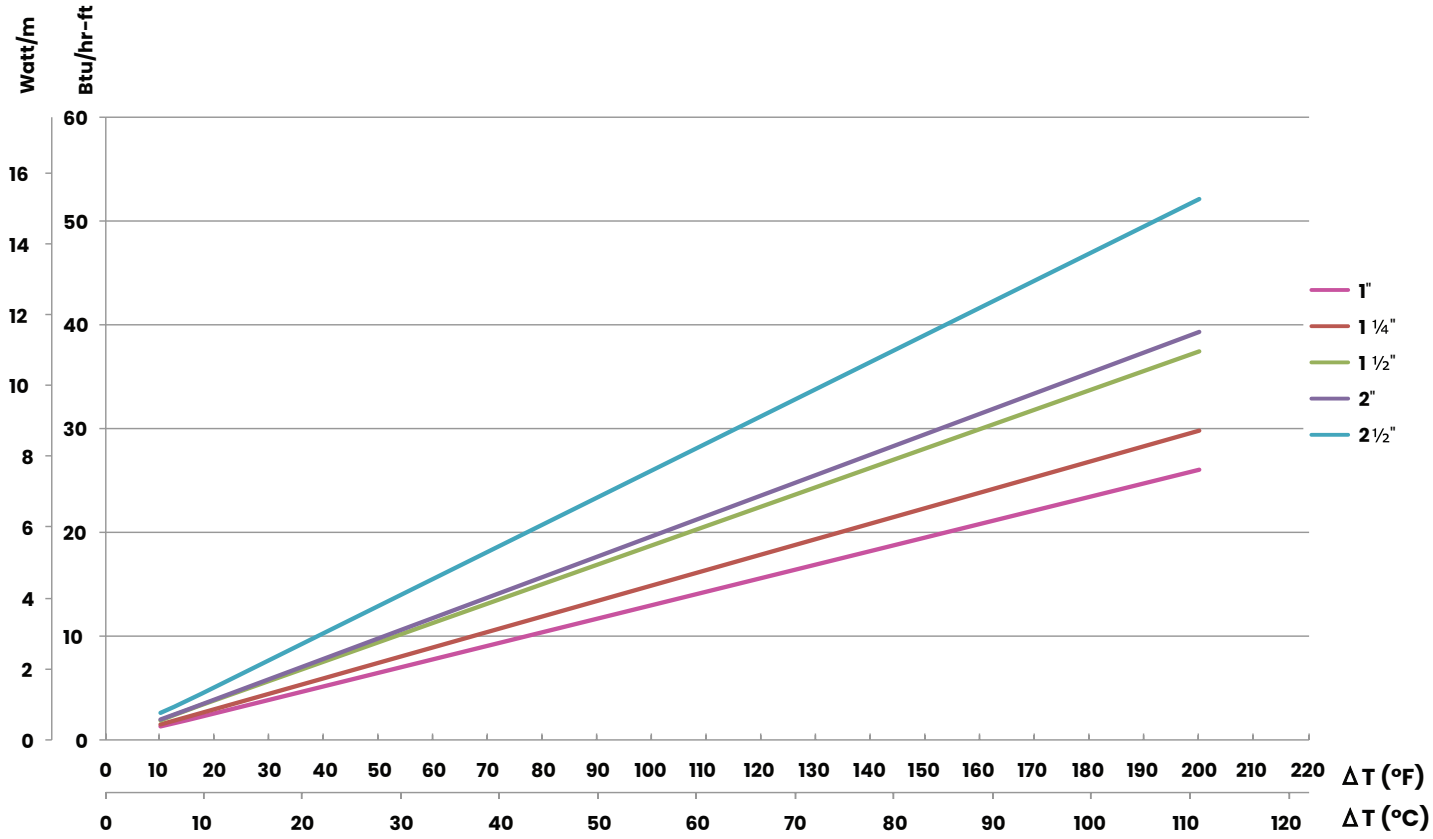


Table A-1: Ecoflex Twin pipes

The following parameters determine energy-loss calculations:

- Fluid supply temperature of 180°F with 20°F ΔT (170°F average temperature)*
- Soil K factor = 12
- Depth from surface = 24"
- Calculation variable = ambient soil temperature

*Note that maximum operating temperature for Uponor AquaPEX pipe is 140°F (60°C).

Caution: Energy losses can vary dramatically based on soil temperature, moisture content and soil type. Uponor provides these values as a courtesy to our customers to offer a general understanding of the estimated energy losses one may expect. If you require precise calculations, we recommend you consult a professional engineer for your particular project.

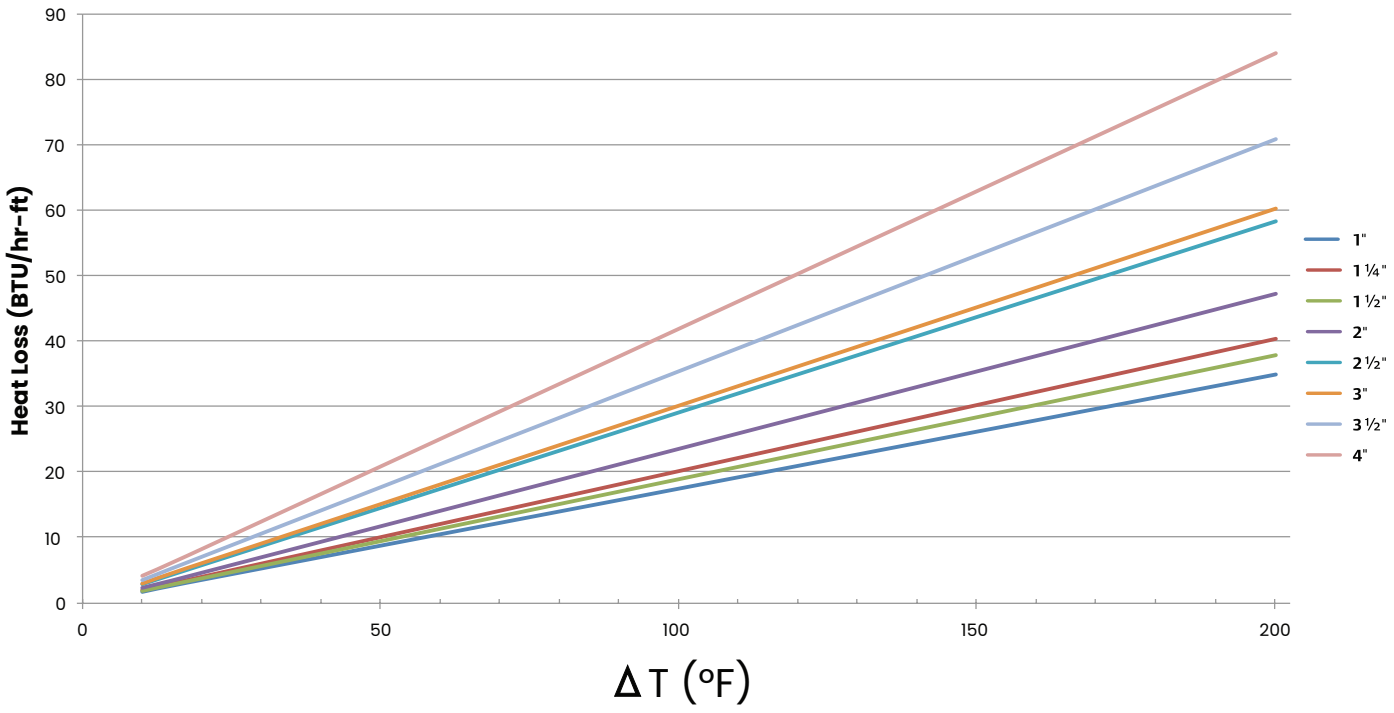


Table A-2: Ecoflex Single pipes

The following parameters determine energy-loss calculations.

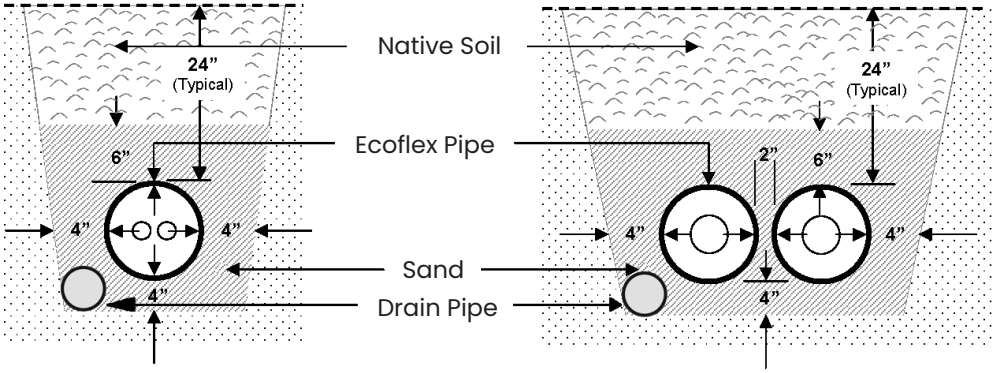
- Fluid supply temperature of 180°F with 20°F ΔT (170°F average temperature)*
- Soil K factor = 12
- Depth from surface = 24"
- Calculation variable = ambient soil temperature

*Note that maximum operating temperature for Uponor AquaPEX pipe is 140°F (60°C).

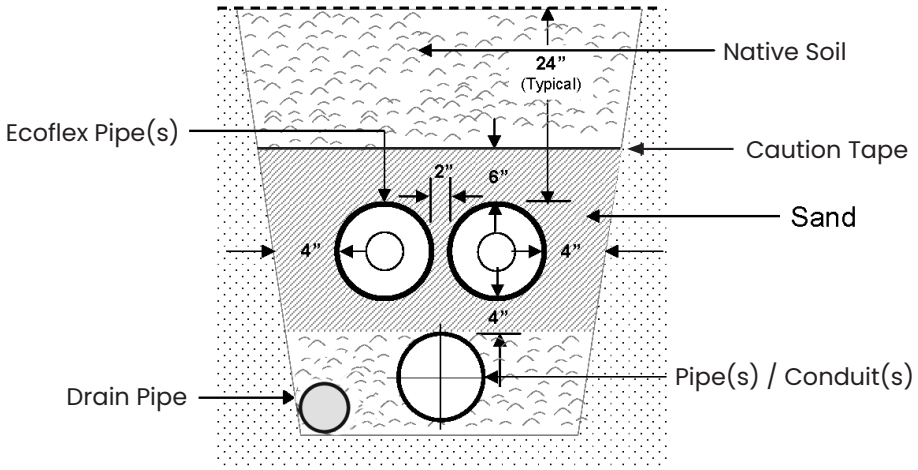
Caution: Energy losses can vary dramatically based on soil temperature, moisture content and soil type. Uponor provides these values as a courtesy to our customers to offer a general understanding of the estimated energy losses one may expect. If you require precise calculations, we recommend you consult a professional engineer for your particular project.

Appendix C
Detailed Drawings

Trench Detail — One Pipe and Multiple Pipes



Trench Detail — Ecoflex Pipes Above Other Pipe Systems



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