

Chapter 3:

Uponor piping products

PEX is an acronym for crosslinked polyethylene. The “PE” refers to the raw material used to make polyethylene, and the “X” refers to the crosslinking of the polyethylene across its molecular chains. The molecular chains are linked into a three-dimensional network that makes PEX remarkably durable within a wide range of temperatures and pressures.

Currently, three methods for producing PEX exist:

- Engel or peroxide method (PEX-a)
- Silane method (PEX-b)
- Electron beam (e-beam) or radiation method (PEX-c)

All three processes generate piping that is crosslinked to various degrees and that is acceptable for potable water-distribution applications according to ASTM F876 and F877 standards.

Engel method (PEX-a) — Uponor manufactures Engel-method PEX-a piping. The PEX piping industry considers this piping superior because the crosslinking is done during the manufacturing process when the polyethylene is in its amorphous state (above the crystalline melting point). Accordingly, the degree of crosslinking reaches approximately 85%, resulting in a more uniform product with no weak links in the molecular chain.

Silane method (PEX-b) — PEX-b piping is crosslinked after the extrusion process by placing the piping in a hot water bath or steam sauna. The degree of crosslinking for PEX-b is typically about 65% to 70%. This method produces PEX that is not as evenly crosslinked as that produced by the PEX-a method. In addition, PEX-b lacks the same degree of thermal memory, which allows kinked piping to be reshaped with the use of a heat gun.

Electron beam method (PEX-c) — PEX-c uses an e-beam to change the molecular structure of the piping (i.e., crosslink) after the extrusion process. The PEX-c method requires multiple passes of the piping under the beam to reach a 70% to 75% degree of crosslinking. This method produces PEX that is not as evenly crosslinked as that produced by the PEX-a method. Side effects of this process are discoloration due to oxidation (from natural white to yellow, unless other pigment is added), and a slightly stiffer product.

PEX-a distinctions

The properties of PEX-a piping make it the most flexible PEX on the market. This flexibility allows the tightest bend radius available — 6 times the outside diameter of the piping. Its flexibility also greatly reduces instances of kinked piping.

However, in the rare instance of a kink, that’s okay, because PEX-a piping has thermal memory. Thermal memory allows kink repairs by applying heat from a heat gun. The shape memory of PEX-a piping offers the unique opportunity for ProPEX® fitting connections. Shape memory allows PEX-a to expand and then shrink back to normal size — creating strong, durable and reliable fitting connections.

Finally, PEX-a piping offers more resistance to crack propagation (how a crack grows) than PEX-b or PEX-c piping. A crack that occurs in PEX-a piping is the least likely to grow over time and cause leaks or damage.

Stress resistance

Piping installed in radiant floor, wall and ceiling applications must be capable of withstanding the extreme stresses that result from installation within a concrete slab or a structural wood floor. Typical stresses include:

- Expansion and contraction that result from repeated heating and subsequent cooling of the heat-transfer fluid
- Mechanical abrasion, shearing, and stretching that occurs as a result of installation, normal structural movement, and heating and cooling from seasonal weather changes

Uponor PEX provides the durability and reliability that’s needed for these applications and currently holds the unofficial world record for long-term testing at elevated temperature and pressure. From 1973 to 2009, the piping was subjected to ongoing testing at 203°F/175 psi by Studvik in Sweden and BASF in Germany. The resulting data indicates a life expectancy of well over 100 years.

Chemical resistance

Crosslinked polyethylene has greatly enhanced resistance to chemical-dissolving agents. The unique molecular structure is stable, inert and unaffected by chemicals commonly found in plumbing and heating systems. PEX is also resistant to many other chemical-dissolving agents, making it suitable for many applications. Please contact Uponor Technical Services at technical.services@uponor.com or 888.594.7726 regarding questions about chemical compatibility.



Oxygen diffusion

Oxygen diffusion can cause corrosion problems in a heating system. All non-metallic (plastic or rubber) piping is permeable to the passage of dissolved oxygen molecules through its walls. Permeability allows these dissolved oxygen molecules to enter an otherwise closed hydronic heating system.

In any new hydronic heating installation, dissolved oxygen molecules exist in the new, fresh water. The large bubbles are purged from the system prior to initial start-up. The dissolved oxygen, however, remains. This dissolved oxygen is not visible in the form of bubbles, and cannot be eliminated by the use of an air vent or scoop.

As the heating system brings the water up to temperature, these dissolved oxygen molecules increasingly bond with ferrous components in the system. The result is corrosion or rust. After a few years of operation, a layer of rust on all ferrous components becomes apparent.

In a typical hydronic system using metallic pipe, almost all dissolved oxygen molecules are used up and cause a non-aggressive rust called "ferrous oxide" usually within the first 72 hours. That's the end of the corrosion process.

However, in a non-metallic system using plastic or rubber piping, oxygen continues to enter the system through the permeable piping. Accordingly, the corrosion process continues. Left unchecked, this corrosion will cause considerable damage to the ferrous components of the radiant heating system.

Damage may include:

- Circulator failures
- Pinhole leaks at expansion tanks
- A red, sludgy build-up inside the system piping (reducing flow)
- Eventual boiler failure (if a cast-iron or steel boiler is used)

Here are four ways to manage oxygen-diffusion corrosion.

Option 1 — Use piping that limits the oxygen diffusion into the heat-transfer fluid to a level consistent with established standards. Use Wirsbo hePEX™ for these applications.

Option 2 — Isolate the heat-transfer fluid from components likely to corrode (e.g., cast-iron pumps, boilers, expansion tanks, etc.) with a non-ferrous heat exchanger. Uponor AquaPEX® piping, without the oxygen-diffusion barrier, is available for those systems that isolate the heating loops from the heat plant and circulator components. All other components (e.g., expansion tanks, circulators and piping) on the floor heating side of the heat exchanger must be made of a non-ferrous material as well.

Option 3 — Eliminate all corrosive ferrous components from the system. Uponor AquaPEX is available for those systems that use non-ferrous components (e.g., bronze pumps, copper tube boilers with bronze headers, etc.).

Option 4 — Treat all heat-transfer fluid with corrosion inhibitors. Corrosion inhibitors require regular maintenance from the heat plant manager to maintain the correct inhibitor level. In the event the system mixture is allowed to lapse, corrosion damage may occur. For these reasons, Uponor does not recommend the use of corrosion inhibitors to counter the effects of oxygen diffusion.

Handling guidelines for PEX piping

The following list highlights the most common guidelines when handling Uponor PEX-a piping.

- Always install Uponor systems according to the installation instructions.
- Do not use PEX-a piping where temperatures and pressures exceed ratings.

- Do not use or store PEX-a piping where it will be exposed to direct sunlight for more than 30 days.
- Do not weld, glue or use adhesives with PEX-a piping.
- Do not apply open flame to PEX-a piping.
- Do not install PEX-a piping within 6 inches of any gas appliance vents, with the exception of double-wall B-vents, which have a minimum clearance of 1 inch.
- Do not install PEX-a piping within 12 inches (over or under) of any recessed light fixture unless the piping line is protected with suitable insulation.
- Do not solder within 18 inches of any PEX-a piping in the same water line. Sweat connections must be made prior to making a ProPEX connection.
- Do not spray on or allow organic chemicals, pesticides, strong acids or strong bases to come into contact with PEX-a piping without checking chemical compatibility.
- Do not use petroleum or solvent-based paints, greases or sealants on PEX-a piping.
- During remodeling or ceiling repair, implement appropriate precautions to protect the piping from damage.
- Do not install PEX-a piping in soil environments contaminated with solvents, fuels, organic compounds, pesticides or other detrimental materials that may cause permeation, corrosion, degradation or structural failure of the piping. Where such conditions are suspected, perform a chemical analysis of the soil or groundwater to ascertain the acceptability of PEX-a piping for the specific installation. Check local codes for additional requirements.

Reforming kinked piping

If the piping is kinked and hinders flow, repairs can be made easily.

1. Make sure the system is not pressurized.
2. Straighten the kinked portion of the piping.
3. Heat the kinked area to approximately 265°F with an electric heat gun (approximately 450 watts of power). Apply the heat evenly until the piping returns to its original size and shape. Do not use an open flame.
4. Let the repaired piping cool undisturbed to room temperature. When the piping returns to its opaque appearance, the repair is complete.



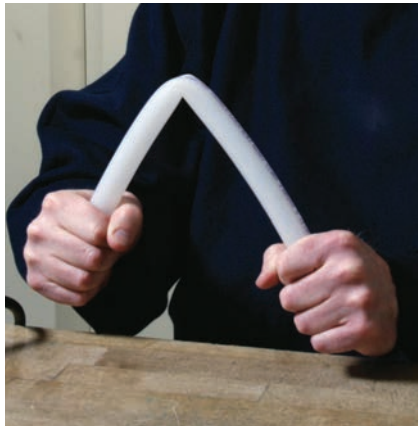
Caution: Temperature of the piping surface must not exceed 338°F. Do not apply direct flame to the piping. Uponor PEX-a piping repaired according to these recommendations will return to its original shape and strength. If the piping is sliced, punctured or otherwise damaged beyond the capacity of the crosslinked memory, install a ProPEX coupling. PEX piping cannot be welded or repaired with adhesives.

Thawing frozen piping

Uponor PEX-a piping can withstand extreme freeze/thaw cycles better than other piping or pipe. The crosslinking of the piping allows it to expand and absorb much of the expansion energy from the freezing process. No piping product is freeze-proof, but Uponor PEX-a piping is extremely resistant to freeze damage.

If freezing occurs, the contractor should advise the end user to correct the lack of insulation or heat to eliminate the problem from reoccurring. Should Uponor PEX-a piping experience an ice blockage, thaw the piping using these methods:

1. Pour hot water over the piping's affected area.
2. Wrap hot towels around the piping's affected area.



Kinks in Uponor PEX are easily repaired with a heat gun.

3. Place a small portable heating unit in the area to heat the space and thaw the ice blockage from the piping.
4. Slowly heat the affected area with a heat gun. Rub a hand over the area while heating to ensure the piping does not get too hot.

Note: Use Wirsbo hePEX when an oxygen-diffusion barrier piping is required.

Uponor piping

With more than 35 years of service — longer than any other PEX manufacturer in North America — Uponor is the leader in PEX piping for radiant heating, plumbing and fire-protection systems. More than two billion feet of Uponor PEX piping is in service in North America alone, and more than 17 billion feet of piping is installed worldwide. With that kind of history, you can count on Uponor PEX to offer the highest-quality piping for all your application needs.

The Uponor ProPEX fitting system (ASTM F1960) was tested with various components provided by Uponor, including the PEX-a pipe, PEX-a ring and ProPEX fitting, and the assembly was listed by CSA. The testing program included sustained pressure testing, bent-tube pressure testing, excessive temperature and pressure capability testing as well as several other tests with weekly and yearly follow-up procedures. Uponor's unique cold-expansion fitting system is highly reliant on the elastic memory of the product and the unique material properties in its formulation. CSA will only provide a system certification if warranted; properties of each component are proven to be required to form a fully functional system.

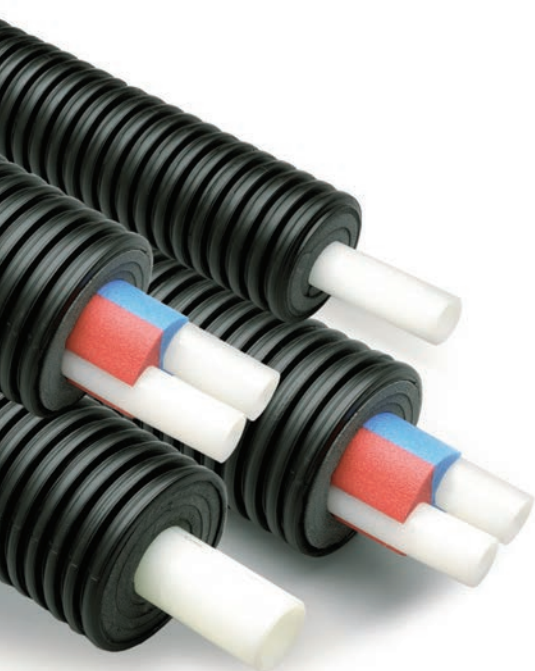
Selecting an Uponor piping product

Uponor offers Wirsbo hePEX, Uponor AquaPEX and Ecoflex® for distribution piping in radiant applications.

Refer to the following pages for details about each piping product.

Uponor piping	Application and design considerations	Standards, listings and ratings
<p>Wirsbo hePEX Wirsbo hePEX is Engel-method PEX-a piping with an oxygen-diffusion barrier.</p> 	<p>Application — Wirsbo hePEX is designed for use in closed-loop hydronic radiant heating systems operating at sustained temperatures up to 200°F. Corrodible or ferrous components may be used in hot- water heating systems designed with Wirsbo hePEX piping.</p>	<p>Wirsbo hePEX is manufactured to meet ASTM F876 and ASTM F877 standards. Wirsbo hePEX has a Standard Grade Hydrostatic Design Stresses and Pressure Rating in accordance with all three temperatures and pressures listed in Table 1 of ASTM F876. Wirsbo hePEX piping is tested in accordance with PPI TR-3 and listed in PPI TR-4.</p> <p>The Standard Grade hydrostatic ratings are:</p> <ul style="list-style-type: none"> • 200°F at 80 psi • 180°F at 100 psi • 73°F at 160 psi <p>The Hydrostatic Design Stress Board of the Plastics Pipe Institute (PPI) issues these pressure and temperature ratings. These values listed are ratings, not limitations. If the designer stays within these parameters during design, there should not be a problem with the product. Burst pressures are values used only in manufacturing the product, not for the system specification or design.</p> <p>For the complete codes, standards and listings for Wirsbo hePEX, refer to the submittal on uponor-usa.com or uponor.ca.</p>
<p>Uponor AquaPEX Uponor AquaPEX is a registered trade name for the company's hot and cold potable-water piping. It is essentially the same product as Wirsbo hePEX, but without the oxygen-diffusion barrier.</p> 	<p>Application — Uponor AquaPEX can be used in closed-loop hydronic heating systems operating at sustained temperatures up to 200°F, provided any issues concerning oxygen diffusion are properly addressed. Corrodible or ferrous components may not be used in a system designed with Uponor AquaPEX unless these components are isolated from the piping.</p> <p>Design considerations — Uponor AquaPEX is permeable to oxygen at a rate up to 13.6 grams per cubic meter per day at 158°F. Radiant floor systems using Uponor AquaPEX piping must be designed to accept oxygen permeation.</p>	<p>Uponor AquaPEX is manufactured to meet: ASTM F876, ASTM F877 and CAN/CSA B137.5. Uponor AquaPEX has a Standard Grade Hydrostatic Design Stresses and Pressure Rating in accordance with all three temperatures and pressures listed in Table 1 of ASTM F876. Uponor AquaPEX piping is tested in accordance with PPI TR-3 and listed in PPI TR-4.</p> <p>The Standard Grade hydrostatic ratings are:</p> <ul style="list-style-type: none"> • 200°F at 80 psi • 180°F at 100 psi • 73°F at 160 psi <p>The Hydrostatic Design Stress Board of PPI issues these pressure and temperature ratings. These values listed are ratings, not limitations. If the designer stays within these parameters during design, there should not be a problem with the product. Burst pressures are values used only in manufacturing of the product, not for the system specification or design.</p> <p>For the complete codes, standards and listings for Uponor AquaPEX, refer to the submittal on uponor-usa.com or uponor.ca.</p>

	Barrier information	Linear expansion rate	Dimensions	Coil lengths
	<p>Wirsbo hePEX is sealed with a special polymer barrier to prevent the diffusion of oxygen through the piping wall and to protect the ferrous components of a closed-loop hydronic heating system from corrosion damage. The barrier consists of an ethylene vinyl alcohol (EVOH) layer co-extruded onto the piping during the manufacturing process. Uponor applies another thin polyethylene layer over the EVOH barrier on the piping to reduce possible onsite damage to the oxygen-diffusion barrier. This polyethylene layer also provides protection for the EVOH barrier if the piping is immersed in high-moisture applications. The Wirsbo hePEX barrier meets the requirements of the German DIN Standard 4726 for oxygen-diffusion prevention. The amount of oxygen that enters the system must be less than 0.10 grams per cubic meter per day at 104°F.</p>	<p>The unrestrained linear (thermal) expansion rate for Wirsbo hePEX piping is approximately 1.1 inches per 10°F temperature change per 100 feet of piping.</p>	<ul style="list-style-type: none"> • 5/16" nominal inside diameter (contains 0.35 gallons/100' of piping) • 3/8" nominal inside diameter (contains 0.50 gallons/100' of piping) • 1/2" nominal inside diameter (contains 0.92 gallons/100' of piping) • 5/8" nominal inside diameter (contains 1.34 gallons/100' of piping) • 3/4" nominal inside diameter (contains 1.84 gallons/100' of piping) • 1" nominal inside diameter (contains 3.03 gallons/100' of piping) • 1 3/4" nominal inside diameter (contains 4.54 gallons/100' of piping) • 1 1/2" nominal inside diameter (contains 6.33 gallons/100' of piping) • 2" nominal inside diameter (contains 10.85 gallons/100' of piping) • 2 1/2" nominal inside diameter (contains 16.53 gallons/100' of piping) • 3" nominal inside diameter (contains 23.51 gallons/100' of piping) • 4" nominal inside diameter (contains 41.05 gallons/100' of piping) 	<p>Refer to the Uponor Product Catalog for available coil lengths. Custom coil lengths are also available for qualifying orders. Allow six weeks for delivery. Call Uponor Customer Service at 888.594.7726 for availability and pricing.</p>
	<p>Uponor AquaPEX is a non-barrier product.</p>	<p>The unrestrained linear expansion (thermal) rate for Uponor AquaPEX piping is approximately 1.1 inches per 10°F temperature change per 100 feet of piping.</p>	<ul style="list-style-type: none"> • 1/4" nominal inside diameter (contains 0.24 gallons/100' of piping) • 3/8" nominal inside diameter (contains 0.50 gallons/100' of piping) • 1/2" nominal inside diameter (contains 0.92 gallons/100' of piping) • 5/8" nominal inside diameter (contains 1.34 gallons/100' of piping) • 3/4" nominal inside diameter (contains 1.84 gallons/100' of piping) • 1" nominal inside diameter (contains 3.03 gallons/100' of piping) • 1 1/4" nominal inside diameter (contains 4.53 gallons/100' of piping) • 1 1/2" nominal inside diameter (contains 6.32 gallons/100' of piping) • 2" nominal inside diameter (contains 10.85 gallons/100' of piping) • 2 1/2" nominal inside diameter (contains 16.53 gallons/100' of piping) • 3" nominal inside diameter (contains 23.51 gallons/100' of piping) 	<p>Refer to the Uponor Product Catalog for available coil lengths. Custom coil lengths are also available for qualifying orders. Allow six weeks for delivery. Call Uponor Customer Service at 888.594.7726 for availability and pricing.</p>



Ecoflex pre-insulated pipe systems

Designed for fluid transfer in a variety of hydronic heating, cooling and potable-water applications, Ecoflex pre-insulated pipes are easy to install, dependable, cost-effective and energy-saving.

Lightweight and flexible, Ecoflex installs easily and quickly in commercial and residential applications — even over obstacles and around corners.

Recognized for its ability to stand up to harsh environments, Ecoflex is virtually maintenance-free. This feature is especially important since Ecoflex usually involves an underground installation. With coil lengths available up to 1,000 feet, Ecoflex practically eliminates the need for underground joints — resulting in seamless runs of piping.

Ecoflex thermal

ASTM Ecoflex Thermal is a pre-insulated pipe for buried or above-ground commercial and residential

hydronic radiant heating and cooling applications with single or twin pipe options. Service pipes are made from PEX-a Wirsbo hePEX (oxygen-diffusion barrier) piping, protected by multi-layer, PEX-foam insulation and covered by a corrugated, watertight, HDPE jacket. Use with ProPEX fittings (up to 3") or WIPEX dezincification-resistant (DZR) brass compression fittings.

Ecoflex potable PEX

Ideal for hot and cold potable-water applications, ASTM Ecoflex Potable PEX features Uponor AquaPEX (PEX-a) service pipe protected by multi-layer, PEX-foam insulation and covered by a corrugated, watertight HDPE jacket. Ecoflex Potable PEX uses ProPEX fittings (up to 3").

Ecoflex potable PEX plus

Ideal for direct-burial applications in freezing conditions, Ecoflex Potable PEX plus features a self-regulating heat-trace wire with a maximum output of 5 W/ft. to keep water inside the pipes from freezing.



Fire-resistant standards

National building codes, such as the IBC and UBC, require that products used in commercial construction meet specific standards. In addition to recognized product standards, PEX piping systems must meet fire-resistant construction standards. To ensure compliance with all national standards, Uponor commissioned Intertek Testing Services (formerly known as Warnock Hersey) to test and list Uponor AquaPEX and Wirsbo hePEX piping and systems. Uponor PEX achieved the following fire-resistant construction ratings when tested in accordance with the applicable standards:

- ANSI/UL 263 (ASTM E119, NFPA No. 251) "Standard for safety for fire tests of building construction and materials"
 - UL Design No. L557 rating applies to ½" to 2" Uponor AquaPEX and Wirsbo hePEX piping, fittings and manifolds installed in one-hour wood frame floor and ceiling assemblies.
- ASTM E84 "Standard test method for surface burning characteristics of building materials"
 - Certification of flame spread/smoke development rating of 25/50 in accordance with ASTM E84 for the following Uponor AquaPEX and Wirsbo hePEX piping sizes: 5/16", 3/8", 1/2", 5/8" and 3/4".
- UL Design No. K913 rating applies to ½" to 2" Uponor AquaPEX and Wirsbo hePEX piping, fittings and manifolds installed in one and two-hour concrete floor/ceiling unrestrained (and restrained) assemblies.
- UL Design No. V444 rating applies to ½" to 2" AquaPEX and Wirsbo hePEX piping, fittings and manifolds installed in one-hour steel stud/gypsum wallboard wall assemblies.

Firestop listings

Numerous firestop systems are listed with PEX piping in one- and two-hour through penetration assemblies. Several firestop manufacturers listed their products for use with PEX piping when installed in accordance with the listed construction assembly. Acceptable firestop systems are tested in accordance with the standard below.

- ASTM E814 (UL 1479) "Standard test method for fire tests of through-penetration fire stops"
 - 3M fire protection products
 - HILTI, Inc.
 - RectorSeal, Metacaulk



