Residential Radiant and Hydronics Installation Handbook

For installing Uponor PEX-a piping, fittings, manifolds, panels, and accessories for radiant floors, walls, and ceilings as well as baseboard and radiator supply systems

Uponor Residential Radiant and Hydronics Installation Handbook is published by Uponor.

Uponor Inc.
5925 148th Street West
Apple Valley, MN 55124 USA
T 800.321.4739
F 952.891.2008
uponor.com

Uponor Ltd.
6510 Kennedy Road
Mississauga, ON L5T 2X4 CANADA
T 888.994.7726
F 800.638.9517

Seventh edition December 2023
First publication 1999
Printed in the United States of America

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

Uponor is not liable for installation practices that deviate from this installation handbook or are not acceptable practices within the mechanical trades.

Read the entire contents of this handbook before installing an Uponor radiant floor, ceiling, or wall heating system or baseboard supply system. Refer to this handbook, as necessary, during all phases of installation.

Table of contents

Table of contents

Table of contents

Table of contents

Chapter 1: Beginning the Installation

The purpose of this handbook is to familiarize contractors, architects, engineers, and HVAC officials with Uponor's recommended methods of constructing and installing radiant floors, walls, and ceilings as well as baseboard and radiator supply systems.

Codes

Uponor systems should be installed by a hydronic heating installation technician after carefully reviewing all applicable building, heating, and mechanical codes. Any conflicts with the codes must be resolved before installation.

Uponor PEX piping products are manufactured to ASTM F876 - Standard Specification for Cross-Linked Polyethylene (PEX) Piping. The piping is listed to ASTM F876 and the piping and fitting system is listed to ASTM F877 and ASTM F1960 by a third-party independent testing laboratory.

Uponor radiant systems comply with the following codes.

2021, 2018, 2015, 2012, 2009, and 2006 *International Fuel Gas Code®* (IFGC)

2021, 2018, 2015, 2012, 2009, and 2006 *International Mechanical Code®* (IMC)

2021, 2018, 2015, 2012, 2009, and 2006 *International Residential Code®* (IRC)

2021, 2018, 2015, 2012, 2009, and 2006 *Uniform Mechanical Code®* (UMC)

2019, 2016, 2013, and 2010 *California Mechanical Code* (CMC)

2020 and 2017 *City of Los Angeles Mechanical Code*

2021 and 2017 *Massachusetts State Building Code 780 CMR Ninth Edition*: *Chapter 28*

*Copyrighted publication of the International Association of Plumbing and Mechanical Officials

Economic Design Information

In the residential market, there is a common misconception that radiant floor heating is only for high-end, custom homes. This simply is not true. Like any heating system, radiant floor systems can be designed to fit a wide array of applications and budgets. Uponor systems can be designed to be competitive with any heating alternative. Uponor systems can be ultra-basic or ultra-sophisticated, depending on the specific requirements of an application and the budget of a project.

There are many ways to achieve economic design. Here are some options:

Use the correct PEX product – If ferrous components (e.g., cast iron boiler and/or circulators) are used in the system, then Wirsbo hePEX with an oxygen diffusion barrier must be used. However, if there are no ferrous components in the system, Uponor AquaPEX® non-barrier piping may be used. Uponor AquaPEX is the same quality piping, but because it has no barrier, it is more cost effective.

Use the proper size piping – In nearly all residential applications, ½" Wirsbo hePEX or Uponor AquaPEX is perfectly acceptable. The ⅝" piping may also be used, but it is not as cost effective. There are lots of advantages to ½" piping besides cost. It is more flexible and easier to work with, making it easier and faster to install. The only advantage to using ⅝" piping over ½" piping is a lower pressure loss over the same loop length. Larger diameter PEX **will not** deliver more heat per square foot of radiant panel.

Use ⅜" PEX piping for joist heating – In joist applications, ⅜" piping may be used. It is even more flexible and easier to work with than ½" piping. However, because of the smaller diameter the pressure drop is significantly higher with ⅜" piping than with ½" piping, so maximum loop lengths will be shorter. Even so, 250 to 300 foot loop lengths can be done with ⅜" PEX, but refer back to the design information for loop pressure loss and pump sizing.

Use 5/16" PEX for Quik Trak®, Xpress Trak™, and Fast Trak™ 0.5 panels.

Use common-sense control strategies – There are many levels of control strategies for radiant floor heating systems, ranging from simple on/off control to weather-responsive reset packages. The higher the level of control sophistication, the higher the upfront cost. Keep in mind, however, that these costs are often offset by greater comfort and fuel economy.

A designer should carefully weigh the design options available, and choose the option that best fits an individual application. For instance, a small one or two-room job will perform just fine with a simple tempering valve (if necessary) and an on/off control. In fact, a tempering valve and intermittent control will be satisfactory in many larger applications as well. More elaborate reset controls are becoming affordable and may be used in appropriate jobs without impacting the budget.

Use common-sense zoning strategies – One of the great benefits of radiant floor heating is to provide complete room-by-room zoning with thermostats in every room. While this adds a high level of control, it can also add extra cost. Often, several rooms of similar design, use patterns, and proximity may be zoned together into a single zone without sacrificing comfort or efficiency. Zone valves or circulators used to zone a single manifold, rather than multiple actuators on a single manifold, can be used to help reduce cost.

Do not install any piping in zero heat loss areas – If the heat loss of a given area is zero, do not install piping. An example of this is a hallway that is surrounded by heated space. It may very well have a zero heat loss and therefore would not need piping installed. The exception to this would be any slab-on-grade or below-grade application where downward heat loss exists.

Use radiant walls and/or ceilings – Radiant wall and ceiling applications typically use less piping and fewer components than radiant floor applications. It also saves the cost of underlayment. Radiant walls and ceilings are perfect for retrofit and remodeling applications, supplemental heat situations, and can be used cost effectively in the specified housing market.

Install piping between the joists without plates – This application is used both in retrofit/remodel and new construction. Simply fasten the pipe between the floor joists using PEX clips. This is much less expensive than installations using plates. The only sacrifices are a higher required water temperature and a slightly slower response time. This method can also be more cost effective than a poured floor underlayment application. It uses more piping but saves on underlayment costs.

Use the most cost-effective heat plant – Because of its low water temperature requirements, radiant floor, wall, and ceiling systems can often use water heaters as heat sources. There are limitations in terms of output and water temperature, of course, but water heaters are less expensive than boilers and do not require a tempering device to achieve proper supply water temperature. *Consult your local codes before installing a water heater as a heat source.*

Parts inspection – Before beginning the installation, check to be sure you have received all the necessary components required to complete the project. Verify all components are in good working order and were not damaged during shipping. Report damaged or missing goods to your distributor or dealer as soon as possible to avoid unnecessary delays.

Note: The installation of a radiant floor, wall, or ceiling system is a permanent fixture of the structure. Improper installation, exceeding limitations and practical expectations of the system will be difficult, if not impossible, to correct once the installation is complete. Therefore, it is important to complete a room-by-room heat loss prior to installation. Uponor offers LoopCAD®, a software program designed specifically for radiant heating applications. In addition, Uponor offers the Complete Design Assistance Manual (CDAM), which provides detailed information about products, design, applications, and controls. Uponor Construction Services also offers custom design packages for projects. Email design.services@uponor.com for details or contact your local Uponor sales representative for availability.

Chapter 2: Uponor PEX Products

The term PEX refers to crosslinked polyethylene. Uponor offers two PEX products for radiant heating systems: Uponor AquaPEX and Wirsbo hePEX. They are similar in that they are both crosslinked polyethylene produced by the Engel method, but each has special features that make it more suitable for specific installations. In this handbook, the term PEX can refer to both Wirsbo hePEX and Uponor AquaPEX, depending on the system requirements.

Uponor AquaPEX

Uponor AquaPEX is a crosslinked polyethylene (PEX) heat-transfer piping without an oxygen-diffusion barrier. Only use Uponor AquaPEX in systems that isolate ferrous components from the circulating loop or in systems where all ferrous components have been eliminated. For connections, use Uponor ProPEX expansion or QS-style compression fittings. Refer to **Chapter 4: Fittings** for additional connection system information.

Figure 2-1: ½" Uponor AquaPEX Print String

Uponor AquaPEX is rated at 160 psi at 73.4°F (23°C), 100 psi at 180°F (82°C), and 80 psi at 200°F (93°C). These pressure and temperature ratings are issued by the Hydrostatic Design Stress Board of the Plastics Pipe Institute (PPI).

Uponor AquaPEX Product Information

Size	Nominal Outside Diameter (O.D.)	Gallons/100'	Coil Lengths
¼"	⅜"	0.24	100'
⅜"	½"	0.50	400', 1,000'
½"	⅝"	0.92	100', 300', 500', 1,000'
⅝"	¾"	1.34	300', 1,000'
¾"	⅞"	1.84	100', 300', 500'
1"	1⅛"	3.03	100', 300', 500'
1¼"	1⅜"	4.53	100', 300'
1½"	1⅝"	6.32	100', 300'
2"	2⅛"	10.83	100', 200', 300'
2½"	2⅝"	16.51	100', 300'
3"	3⅛"	23.51	100', 300'

Table 2-1: Uponor AquaPEX Product Information

Wirsbo hePEX

Wirsbo hePEX is crosslinked polyethylene (PEX) heat-transfer piping with an oxygen-diffusion barrier. The oxygen-diffusion barrier allows the use of Wirsbo hePEX in closed-loop systems with corrodible or ferrous components. For connections, use Uponor ProPEX expansion or QS-style compression fittings. Refer to **Chapter 4: Fittings** for additional connection system information.

Wirsbo hePEX is rated at 200°F (93°C) at 80 psi, 180°F (82°C) at 100 psi, and 73.4°F (23°C) at 160 psi. These temperature and pressure ratings are issued by the Hydrostatic Design Stress Board of the Plastics Pipe Institute (PPI).

Figure 2-2: ½" Wirsbo hePEX Print String

Wirsbo hePEX Product Information

Size	Nominal Outside Diameter (O.D.)	Gallons/100'	Coil Lengths
5/16"	14/32"	0.30	100', 250', 1,000'
3/8"	½"	0.50	100', 400', 1,000'
½"	5/8"	0.92	100', 300', 500', 1,000'
5/8"	¾"	1.34	100', 300', 400', 1,000'
¾"	7/8"	1.84	100', 300', 500', 1,000'
1"	1 1/8"	3.03	100', 300', 500'
1¼"	1 3/8"	4.53	100', 300'
1½"	1 5/8"	6.32	100', 300'
2"	2¼"	10.83	100', 300'
2½"	2 5/8"	16.51	100', 300'
3"	3 1/8"	23.51	100', 300'
4"	4 1/8"	41.01	100'

Table 2-2: Wirsbo hePEX Product Information

Notes

Chapter 3: Working with PEX

PEX piping is a flexible, durable product that is highly workable and forgiving in construction applications. Refer to the following guidelines for proper storage and installation procedures.

Storing Uponor PEX Piping

Store PEX piping under cover to avoid extended exposure to direct sunlight (diffused light does not pose a concern). Ultraviolet light can cause accelerated aging. Never install piping that is suspect of being exposed to direct sunlight for more than 30 days. Exposure to sunlight during normal installation is not harmful. Take care to avoid material abuse or mishandling.

Temperature

Uponor PEX piping is very flexible, however, it is more rigid to work with at temperatures below 40°F (4.4°C). Warming the pipe to temperatures above 60°F (15.6°C) will help simplify installations. Note that ProPEX connection sealing times take longer in temperatures below 40°F (4.4°C). Refer to the Cold-Weather Expansions section in **Chapter 4: Fittings** for further details about making ProPEX connections in cold weather.

Uncoiling

Use an Uponor Uncoiler (part numbers E6061000 and E6062000) to facilitate quick, easy uncoiling of PEX coils.

Figure 3-1: PEX Uncoiler

Cutting Uponor PEX Piping

Figure 3-2: Cutting Uponor PEX piping

Uponor PEX piping is manufactured to close dimensional tolerances and ProPEX fittings are designed to meet those tolerances. It is important that when the piping is cut, damage does not occur that adversely affects the fitting connection. Be sure to use a cutter designed specifically for PEX pipe (Uponor part numbers E6081125, E6081128, and E6083000). If one is not available, use an appropriate substitute that will not damage the piping. Piping should be square cut perpendicular to the length of the pipe. No excess material should remain that might affect the fitting connection.

Bending Uponor PEX Piping

Uponor PEX piping is very flexible (see table below for minimum bend radius). Avoid over-bending and possibly kinking the pipe (see **Figure 3-4** on **page 11** for instructions on how to reform kinks). Bend supports are available and should be used to make tight, 90-degree bends that are otherwise not supported (e.g., when the piping makes a 90-degree bend from the floor to the manifold).

Piping can be installed at lesser on center distances, by making the width of the turns larger than the on-center distance of the piping runs (see **Figure 3-3** on **page 11**).

Minimum Bend Radius for Uponor PEX Piping

Nominal Pipe Size	Inches
5/16"	2.58
3/8"	3
½"	3.75
5/8"	4.5
¾"	5.25
1"	6.75

Table 3-1: Minimum bend radius for Uponor PEX piping

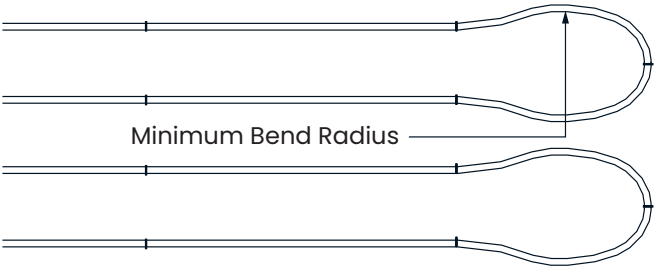


Figure 3-3: Minimum bend radius

Reforming Kinked Uponor PEX Piping

Uponor PEX piping is a crosslinked polyethylene product. As such, it can be described as "plastic with memory." In the event the PEX piping is kinked in a way that results in an obstruction to flow, make repairs using the following guidelines.

1. Straighten the kinked portion of the PEX pipe.
2. Heat the kinked area to approximately 265°F (129°C) (to the point where the PEX piping turns clear) with an electric heat gun. The temperature of the air must not exceed 338°F (170°C). Apply the heat evenly until the PEX piping turns clear around its circumference. **Do not use an open flame.**
3. Let the reformed pipe cool undisturbed to room temperature. It will soon return to its original opaque white appearance.

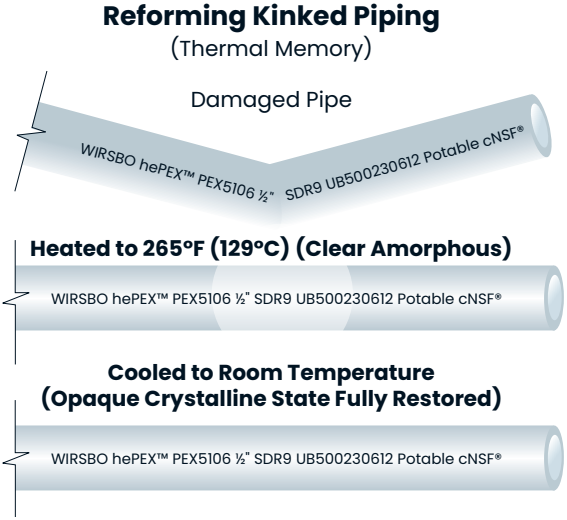


Figure 3-4: Reforming kinked piping

Fastening Uponor Piping with a PEX Foam Stapler

Figure 3-5: Uponor PEX Foam Stapler and 2" Blue Foam Staple

The Uponor piping stapler system is designed to fasten Uponor PEX piping products to foam surfaces.

Use the Uponor PEX Foam Stapler (part number E6025000) to staple Uponor ⅜", ½", and ⅝" PEX piping directly to high-density foam insulation using Uponor 2" Blue Foam Staples (part number A7012000).

Use Uponor galvanized fixing wire (A7031000) to secure Uponor PEX to wire mesh or rebar.

Refer to the floor construction methods (**Chapter 7**) for fastener spacing.

Uponor PEX Rails

PEX rails are another alternative for attaching the pipe to wood subfloors. The rails fasten to the subfloor with 1" screws, and the PEX snaps into the rails.

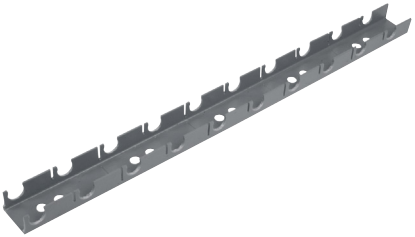


Figure 3-6: Uponor PEX rail

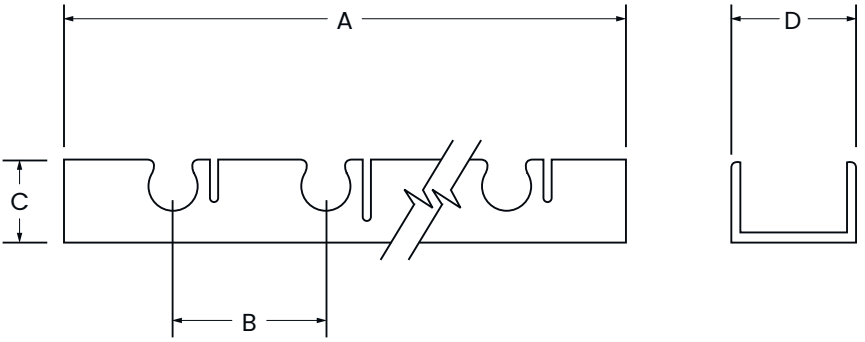


Figure 3-7: Uponor PEX rails dimensions

Part No.	A	B	C	D
A5700500	78"	2"	1"	1.5"
A5700625	78"	2"	1"	1.5"
A5700750	78"	2"	1"	1.5"

Table 3-2: Uponor PEX rails dimensions

Protecting PEX Piping from Freezing

Due to its thermal and shape memory, Uponor PEX-a is very resilient in freezing conditions, but it is not freeze-proof. Take precautions with PEX embedded in concrete. If the area experiences frequent power outages or is susceptible to freezing conditions, use a mixture of water and propylene glycol in the system. Also, when pressure testing with water, do not allow the water to freeze in the system.

Other Handling Precautions

- **Do not** use PEX piping where temperatures and pressures exceed product ratings.
- **Do not** apply an open flame to PEX piping.
- **Do not** solder within 18" of PEX piping in the same water line.
- **Do not** install PEX piping where it will come in direct contact with high concentrations of low molecular weight petroleum products, such as fuels or solvents.
- **Do not** install PEX piping in direct contact with sharp fill.
- **Do not** weld or glue Uponor PEX.
- **Do not** install Uponor PEX within 6" of any gas appliance vents or within 12" of any uninsulated recessed light fixtures.
- **Do not** use Uponor PEX to convey natural gas.
- **Do not** use Uponor PEX piping for an electrical ground.

Chapter 4: Fittings

Uponor QS-Style Compression Fittings

Uponor compression fittings and all components are made of brass. The QS-style fitting is designed and tested for use with Wirsbo hePEX and Uponor AquaPEX piping.

Using Uponor QS-Style Fittings

1. Square cut the end of the piping using an Uponor pipe cutter or other suitable plastic pipe cutter. Piping should be square cut perpendicular to the length of the pipe.
2. Slide the brass compression nut and compression ring over the piping.
3. Slide the barbed insert head into the end of the piping. Make sure the head is fully seated against the end of the piping (see diagram).
4. Tighten the compression nut to the manifold or fitting.

Note: All compression fittings must be retightened after initial installation. Wait 30 minutes to allow the pipe to fully relax, then retighten each fitting.

Uponor ProPEX Fitting Assemblies

As an alternative, ProPEX fittings can also be used when connecting radiant loops to the manifold(s). ProPEX fittings assemblies are similar to the QS-style fittings but will use the ProPEX ring versus a brass compression sleeve to seal the connection.

1. Square cut the end of the piping using a pipe cutter that will provide an even cut, perpendicular to the piping.
2. Slide the ProPEX ring over Uponor PEX piping.
3. Assemble the ProPEX end and the compression nut prior to expanding the piping.
4. Expand the piping using an approved expansion tool. Expand the piping the number of expansions based on the piping dimension.
5. Insert the ProPEX end along with the compression nut into the end of the piping.
6. Allow the piping to return to its original shape and cannot be removed.
7. Tighten the compression nut to the manifold (or fitting).

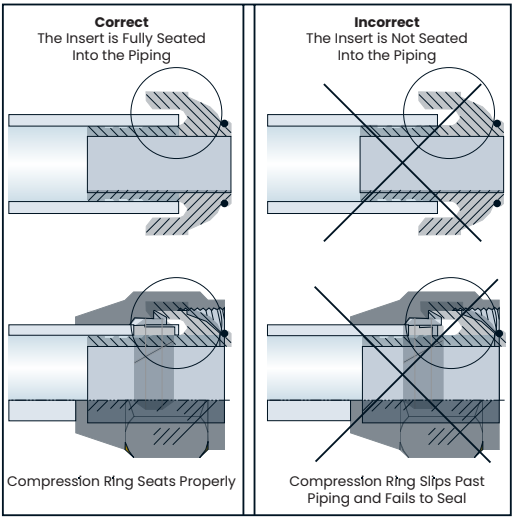


Figure 4-1: Compression fittings

Connecting QS-Style Fittings to the Uponor Manifold

1. Cut piping even with the bottom thread on the manifold nipple as shown in the diagram below.
2. Slide compression nut, compression ring, and QS-style barbed insert onto piping as described above.
3. Tighten compression nut securely onto the manifold nipple.

Note: When installing a fitting onto the manifold or a repair coupling, leave a little slack in the piping. This will allow the end of the piping to move inward toward the manifold or coupling when the fitting is tightened. If the piping is taut and can't move, the barbed insert head could pull out of the piping while the nut is being tightened and result in a leak.

Repair Couplings

If during installation, the Uponor piping is damaged or punctured, the affected section of piping will need to be removed. Uponor recommends using engineered polymer (EP) couplings when a repair is needed. Repairs can also be made using a repair coupling consisting of one R20 x R20 (A4322020) coupling nipple and two appropriately sized brass compression fittings. For ⅜", ½", and ⅝" piping, use an R20 x R20 coupling nipple.

Figure 4-2: Assembled connection

Important: Uponor does not recommend using mechanical couplings for repairs made in slab or concealed spaces. Use ProPEX couplings for repairs in these locations.

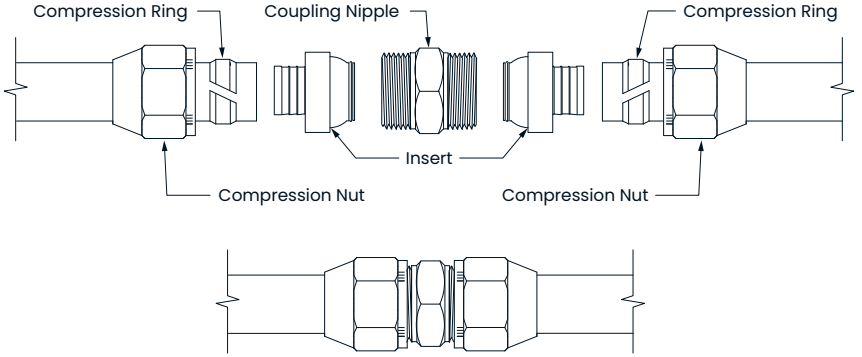


Figure 4-3: Repair couplings

1. Cut the damaged section of piping from the loop.
2. Slide the compression nuts and compression rings over the end of the piping.
3. Slide the QS-style barbed insert heads into each end of the piping.
4. Push O-ring inserts into the coupling nipple.
5. Tighten compression nut onto the coupling nipple. Use a wrench on both the compression nut and coupling nipple to avoid damage to fittings or piping.

Note: Uponor repair couplings will replace about 1" of piping. If the damaged section of piping is longer than 1", and you have no excess piping in the line, you will need to use two repair couplings and a length of PEX piping to replace the damaged section of pipe.

Caution: When tightening the compression nut onto the brass coupling nipple, always use two wrenches: one on the compression nut and one on the hex nut on the coupling nipple. Never tighten one compression nut against the other without securely holding the hex nut. This could damage both the fitting and the piping.

Important: All compression fittings must be retightened after initial installation. Wait at least 30 minutes to allow the piping to fully relax, and then retighten each fitting.

Note: Take reasonable measures to avoid couplings in a concrete slab. If it is necessary, only use Uponor ProPEX EP couplings to make the repair. Never use compression or mechanical fittings.

Uponor ProPEX Fittings and Tools

Uponor ProPEX fittings rely on the shape memory of Uponor AquaPEX and Wirsbo hePEX piping. The Milwaukee ProPEX expansion tools expand the piping enough to insert the ProPEX fitting. The piping then shrinks down around the fitting as it returns to its original shape.

Note: All standard Uponor expander heads are compatible with the M12 and M18 tools. Uponor expander heads will not auto-rotate on the Milwaukee tools (only Milwaukee expansion heads will auto-rotate on the M12 and M18). H-heads are not compatible with Milwaukee tools and Milwaukee heads are not compatible with Uponor tools. Milwaukee heads are easily distinguished by color coding and the Milwaukee logo.

Important! Making expansions are slightly different when using a tool that features auto rotation. When making a ProPEX connection, be sure to follow the guidelines for the tool you are using in your application.

Pipe size	Milwaukee ProPEX expansion tools					Uponor ProPEX expander tools		
	M12 with standard heads (2432)	M12 FUEL with RAPID SEAL™ heads (2532)	M18 (2632)	M18 FUEL 2" (2932)	M18 FORCE LOGIC (2633)	Manual	100/150	201
⅜"	6-7	6-10	5	5-7	—	5	7	—
½"	7-8	5-8	9	7-9	—	4	4	—
⅝"	9-10	6-10	9	8-9	—	9	9H	—
¾"	11-12	7-12	10	9-11	—	14	7H	—
1"	17-18	12-18	19	12-13 (or 7-8H)	—	—	7H	—
1¼"	—	—	9	9-10H	—	—	8H	—
1½"	—	—	10	8-9H	—	—	—	—
2"	—	—	—	9-10	4	—	—	5H
2½"	—	—	—	—	5	—	—	—
3"	—	—	—	—	7	—	—	—

Table 4-1: Recommended number of expansions for ⅜" to 3" piping at 73.4°F (23°C)

Note: "H" in the table refers to Uponor H-series expander heads.

Figure 4-4: ⅜", ⅝", and ½"

1. Square cut the PEX piping perpendicular to the length of the piping. Remove all excess material or burrs that might affect the fitting connection.
2. Slide the ProPEX ring over the end of the piping until it reaches the stop edge. If using a ProPEX ring without a stop edge, extend the ring over the end of the piping no more than 1/16" (1mm).

Important! If making a ⅜" ProPEX connection, first expand each side of the ring before placing it on the piping. Refer to the "Making ⅜" ProPEX connections" instructions on **page 25** for further information.

With Auto Rotation (Standard Milwaukee Heads)

3. Milwaukee ProPEX expansion tools come with built-in auto rotation. If using a Milwaukee expansion head, simply hold the piping and tool in place while holding the trigger to expand the piping. The head will automatically rotate to ensure the piping is evenly expanded. Continue expanding and rotating until the piping and ring are snug against the shoulder on the expander head. See **Table 4-1** for the recommended number of expansions for each piping size.

Note: Do not force the pipe onto the expander head. Ensure the expander head is rotating during each expansion.

Without Auto Rotation (Standard Uponor Heads)

4. Press the trigger to expand the piping.
5. Release the trigger, remove the head from the piping, rotate it ⅛ turn and slide the head back into the piping. Continue expanding and rotating until the piping and ring are snug against the shoulder on the expander head. See **Table 4-1** for the recommended number of expansions.

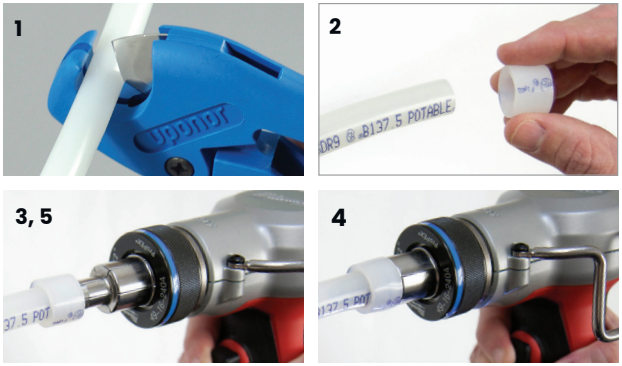


Figure 4-5: Expansion with Milwaukee M12, M12 FUEL, M18, and M18 FUEL 2" ProPEX expansion tools

Important! Rotating the tool between expansions will provide smooth, even expansion of the piping. Failure to rotate the tool will cause deep grooves in the piping which can result in potential leak paths.

6. After the final expansion, immediately remove the tool and insert the fitting. Ensure the piping and ring seat against the shoulder of the fitting.

Important! Only perform the necessary number of expansions. **Do not** over expand the pipe. You should feel some resistance as the fitting goes into the piping. If you do not feel any resistance, the piping may be over expanded and will require additional time to shrink over the fitting.

Figure 4-6: Inserting ProPEX fitting into ½" Uponor PEX piping

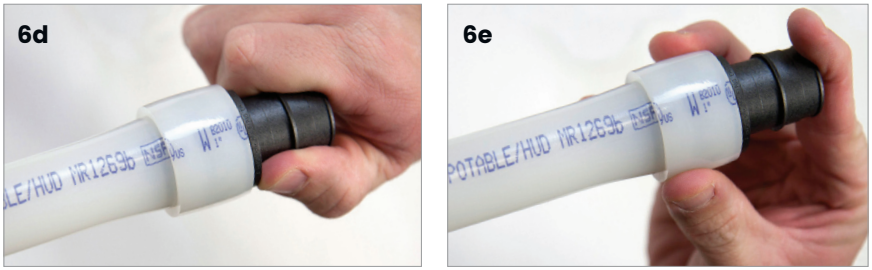


Figure 4-7: Inserting ProPEX fitting into 1" Uponor PEX piping

Figure 4-8: ProPEX tee

Figure 4-9: ProPEX coupling

Figure 4-10: Expansion with Milwaukee M18 ProPEX Expansion Tool

Making ProPEX Connections with Milwaukee M18 FORCE LOGIC ProPEX Expansion Tools

FORCE LOGIC Expansion Head Installation

The Milwaukee FORCE LOGIC ProPEX Expansion Tool for 2", 2½", and 3" Uponor PEX pipe features an auto-rotating head with specially designed alignment cogs. This requires slightly different head installation than the M12 and M18 ProPEX expansion tools for ⅜" to 1½" pipe sizes.

1. Remove the battery pack and place the FORCE LOGIC tool in the upright position (cone up).
2. Verify the expansion cone is fully retracted.
3. Screw the head onto the tool (clockwise). Hand-tighten securely. Do not over tighten. Ensure the expansion head fits flush against the tool.
4. Check the installation.
   a. Ensure the head segments do not “flower”.
   b. If the head flowers, correct the installation by loosening the head slightly and rotating the segments until they engage in the cogs. Re-tighten the head.
   c. Rotate the six expansion segments in the clockwise direction. They will rotate freely. They should not rotate counter clockwise.
   d. The expansion head collar will fit flush against the tool.

Figure 4-11: FORCE LOGIC expansion head installation

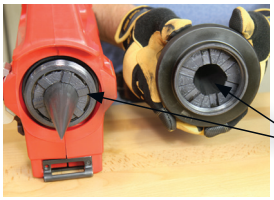


Figure 4-12: FORCE LOGIC expansion head auto-rotate teeth

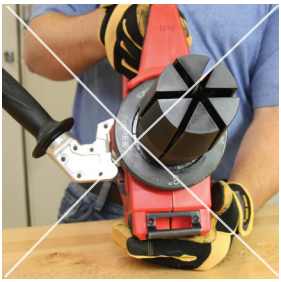


Figure 4-13: Incorrect expansion head “flowering”

Figure 4-14: Correct expansion head alignment

Making a ProPEX Connection

1. Square cut the pipe perpendicular to the length, and remove all excess material or burrs.
2. Slide the ProPEX ring over the end of the piping until it reaches the stop edge.
3. The tool features auto rotation so the head will automatically rotate to ensure the piping is evenly expanded.

Note: To cancel the expansion process quickly, pull and release the trigger.

4. Press the trigger to initiate the rotation of the head. A green light will turn on and the work light will blink. Insert the pipe and ring and release the trigger. When the expansion head has reached its maximum diameter, it will retract.

Important! Do not force the pipe and ring on the head during any expansion.

5. After the tool has retracted, the green indicator light blinks three times. Press the trigger and repeat the expansion process.
6. Repeat the process until the pipe and ring are snug against the shoulder of the expansion head. Repeat the expansion one or two more times depending on the ambient temperature.

Figure 4-15: Cut pipe

Figure 4-16: Add ring

Figure 4-17: Ensure ring reaches stop edge

Note: Colder temperatures require fewer expansions.

7. After final expansion, immediately remove the tool and insert the

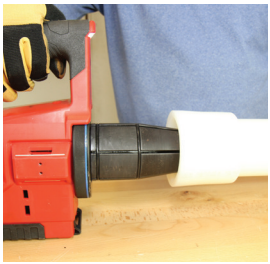


Figure 4-18: Begin expanding

Figure 4-19: Expand to shoulder

Figure 4-20: Insert fitting

Making 3/8" ProPEX Connections

When making a 3/8" ProPEX connection, expand the ring once on each side to properly fit over the piping. Refer to the following instructions to make a 3/8" ProPEX connection.

1. Square cut the PEX piping perpendicular to the length of the piping. Remove all excess material or burrs that might affect the fitting connection.

Figure 4-21: E6081128 pipe cutter (plastic)

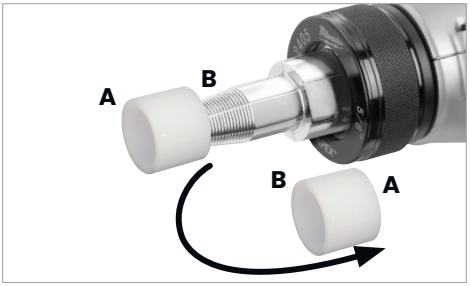


Figure 4-22: Expand each side of the ring

2. Expand each side of the ring once.
3. Slide the expanded ring over the end of the piping. Extend the end of the ring over the end of the piping no more than 1/16" (1 mm).
4. After the ring is on the piping, continue with the regular steps for making a proper connection with your specific tool.

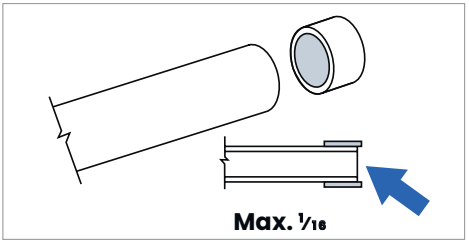


Figure 4-23: Slide the expanded ring over the end of the piping

Important tips for a proper 3/8" ProPEX connection

- **The thicker 3/8" ProPEX Ring shrinks over the fitting faster than larger-sized rings.**
- **When the temperature is below 40°F (4.4°C) , fewer expansions are required.**

Proper Expander Tool and Head Maintenance

- Use a lint-free cloth to apply a light coat of lubricant to the cone prior to making any ProPEX connections.
- If used regularly, apply the lubricant daily to the cone of the ProPEX expander tool. Failure to keep the tool lubricated may result in improper connections.

Caution: Excessive lubrication may result in improper connections. Only use a small amount of lubrication to keep the tool working properly.

- Keep all other parts of the tool free from lubricant.
- Once a month, soak the heads in degreasing agent to remove any grease from between the segments. Clean the cone using a clean, dry cloth.

Disconnecting a ProPEX Brass Fitting

ProPEX brass and EP fittings are manufactured connections that can be concealed in walls, ceilings, and floors. When necessary, ProPEX brass fittings can be disconnected.

Important! EP fittings cannot be reclaimed.

Refer to the following guidelines for disconnecting a ProPEX brass fitting.

1. Ensure the system is not pressurized.
2. Use a utility knife to carefully cut through the ProPEX ring.

   Important! Do not heat the ring prior to cutting it. Take care to cut only the ring and not the piping or fitting. Gouges in the fitting may result in leaks. If you accidentally damage the fitting, you must discard it.

Figure 4-24: Cut ring

3. Remove the ProPEX ring from the piping.

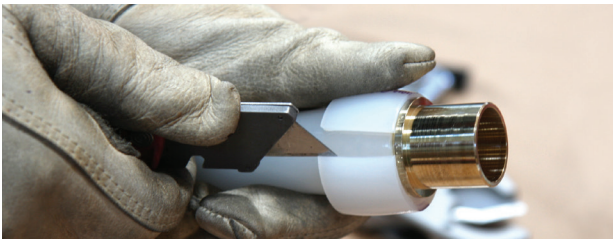


Figure 4-25: Remove ring

4. After removing the ring, apply heat directly around the fitting and piping connection. **Do not use open flame.** Gently work the piping back and forth while pulling slightly away from the fitting until the piping separates from the fitting.

Figure 4-26: Heat connection

Figure 4-27: Work piping back and forth

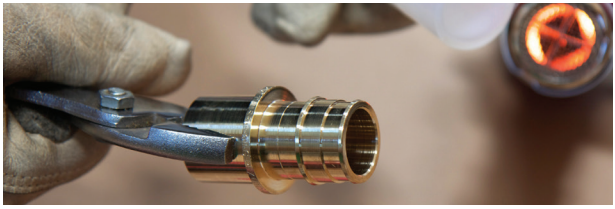


Figure 4-28: Remove fitting

5. After removing the fitting, measure:
   2" (50.8 mm) minimum for ⅜" to 1" pipe
   3" (76.2 mm) minimum for 1¼" to 2" pipe
   5" (127 mm) minimum for 2½" and 3" pipe

Figure 4-29: Measure from end of pipe

6. Square cut the piping at the proper marking.

Figure 4-30: Cut pipe at marking

7. Allow the fitting to cool before making the new connection.
8. Use a new ProPEX ring and follow the steps to make a new connection.

Troubleshooting ProPEX Connections

Trouble-free ProPEX installations begin with a tool that is maintained in proper working condition. If the tool or segment fingers are damaged, it is very difficult to make a proper connection. Refer to the following guidelines to assist with challenges in the field.

Fittings Won't Seal

- Make sure the expander head is securely tightened onto the tool.
- Ensure the segment fingers are not bent. If the head does not completely close when the drive unit is fully retracted or the handles of the manual tool are open, replace the head.
- Examine the tool for excess grease on the segment fingers. Remove excess grease prior to making connections.
- Check the fitting for damage. Nicks and gouges will cause the fitting to leak.
- Make sure the internal driver cone is not damaged or bent.
- Make sure the last expansion is not held in the expanded position before the fitting is inserted. You should feel some resistance as the fitting goes into the piping. If you do not feel any resistance, the piping may be over expanded and will require additional time to shrink over the fitting.
- Be sure to rotate the tool ⅛ turn after each expansion to avoid deep grooves in the piping which can result in potential leak paths.

Expansion is Difficult

- Make sure the internal cone is properly greased.

Expansion Head Slips Out of Piping When Making Expansions

- Ensure the piping and ProPEX ring are dry.
- Make sure that grease is not getting into the piping.
- Examine the segment fingers to ensure they are not damaged or bent.

ProPEX Ring Slides Down Piping During Expansion

- Ensure your hands are clean while handling the piping. Any sweat or oils on your hands can act as a lubricant. Due to the smoothness of PEX, any form of lubricant can cause the ProPEX ring to slide down the piping during expansion.
- If you anticipate the ProPEX ring may possibly slide down, position the ring slightly farther over the end of the piping and make the first couple of expansions slowly. Once the ring and the piping begin to expand together, continue with the normal number and type of expansions.
- Place your thumb against the ProPEX ring to help support it and feel for any movement. If caught early, you can slide the ring up the piping and expand as described in the previous bullet point.

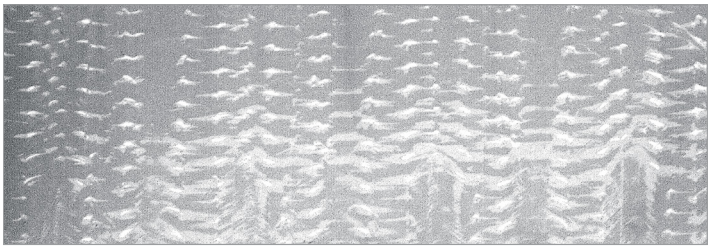


Figure 4-31: Expansion with proper rotation

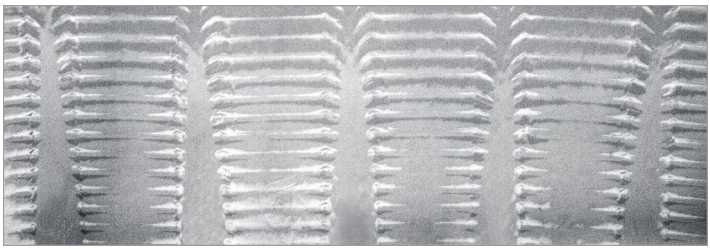


Figure 4-32: Expansion without proper rotation

More Than the Recommended Number of Expansions Are Needed to Make a Connection

- Ensure the head is hand-tightened to the expander tool.
- Examine the segment fingers for damage.
- Be sure to completely cycle the tool on each expansion (i.e., close the manual tool handle or release the trigger).

Cold-Weather Expansions

- Uponor recommends the use of the Milwaukee M12 FUEL ProPEX expansion tool with RAPID SEAL™ heads for cold-weather installation of ⅜" to 1" Uponor piping systems.
- Temperatures affect the time required for the piping and ring to shrink onto the fitting. The colder the temperature, the slower the contraction time.
- Warming ProPEX fittings and ProPEX rings reduces contraction time. Put fittings and rings in your pockets prior to installation to keep them warm.
- Fewer expansions are necessary in temperatures below 40°F (4.4°C).

Note: Do no use a heat gun on EP fittings to speed up the contraction time as this could result in damage to the fitting.

Figure 4-33: Milwaukee RAPID SEAL 1" head

Notes

Chapter 5: Uponor Radiant Manifolds

Plan Manifold Locations and Rough-in Requirements

1. Locate manifolds on an interior wall whenever possible. Mounting manifolds on exterior walls may result in additional heat loss. Installing a manifold on an interior wall makes it more accessible to the radiant space. On an interior wall, route piping to the floor in front of or behind the manifold.
2. Select a location that allows the use of hallways or large rooms as avenues for the leaders to run to and from distant rooms. The inside of a closet is an ideal manifold location.
3. Ensure the location allows easy connection to supply and return lines from the heat source.
4. Ensure the location allows for easy maintenance access.

Manifold Installation

Manifolds may be installed in either a horizontal or vertical position. The horizontal configuration may limit the length of a manifold to that of the space between the studs or require that the cavity be boxed off to accommodate the full width of the manifold. The vertical installation will require two additional bend supports per loop, but it facilitates the installation of a radiant floor/ceiling combination.

Uponor manifolds can also be mounted in an upside-down (or inverted) position. However, be aware that system leaks or condensation can drip on to the actuators (if installed) and cause damage.

Note: Manifold(s) should be located at least 16" above the floor.

Stainless-Steel Manifold Assemblies

Stainless-steel manifold assemblies feature isolation valves, balancing valves with flow meters, supply and return ball valves with temperature gauges, and come fully assembled, ready for installation. Targeted for commercial and residential heating and cooling applications, the manifolds are available in 1" and 1¼" sizes, with maximum flow rates of 14 gallons per minute (gpm) and 21 gpm, respectively. All manifold supply and return ball valves feature 1" NPT thread except for 1¼" manifold assemblies with 8, 10, and 12 loops which feature 1¼" NPT.

Note: The 1¼" manifolds with 2 through 7 loops are strategically designed with 1" NPT ball valves to avoid adding extra costs while maintaining the maximum flow of the manifold assembly.

Pressure and temperature ratings:

- 68°F (20°C) at 145 psi (10 bar)
- 158°F (70°C) at 87 psi (6 bar)
- 194°F (90°C) at 44 psi (3 bar)

Stainless-Steel Manifold Assembly, 1" with Flow Meter Opening Requirements

Number of Loops	Horizontal Installation	
	Height (in.)	Width (in.)
2	30	11.16
3	30	13.13
4	30	15.10
5	30	17.07
6	30	19.03
7	30	21.00
8	30	22.97
10	30	26.91
12	30	30.85

Table 5-1: Stainless-steel manifold assembly, 1" with flow meter opening requirements

Stainless-Steel Manifold Assembly, 1¼" with Flow Meter Opening Requirements

Number of Loops	Horizontal Installation	
	Height (in.)	Width (in.)
2	30	10.93
3	30	12.90
4	30	14.87
5	30	16.84
6	30	19.07
7	30	20.78
8	30	23.10
10	30	27.29
12	30	31.23

Table 5-2: Stainless-steel manifold assembly, 1¼" with flow meter opening requirements

Stainless-Steel Manifolds Exploded View

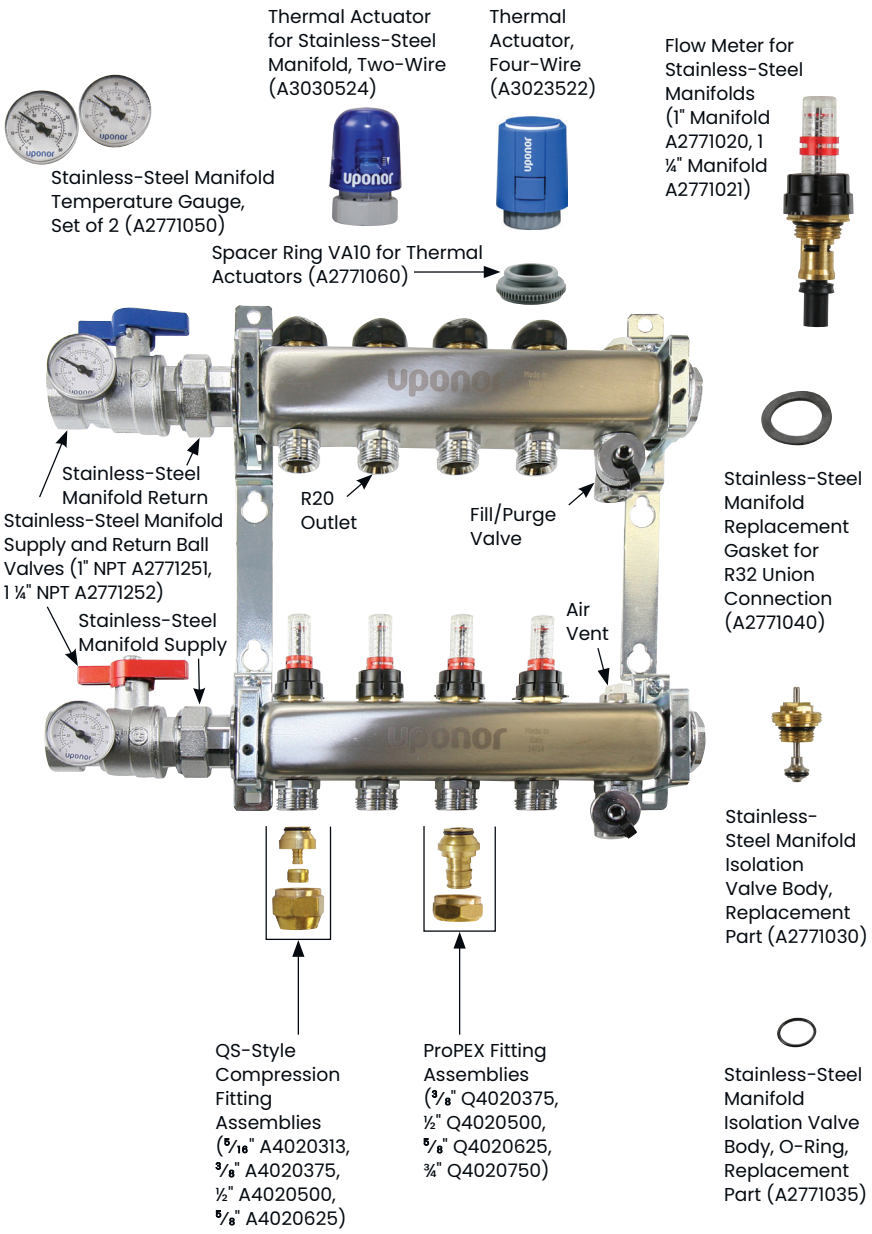


Figure 5-1: Stainless-steel manifolds exploded view

Manifold Wall Cabinets for Stainless-Steel Manifolds

The recessed-style manifold wall cabinets feature a removable door-trim package and are adjustable to accommodate stainless-steel manifolds mounted in either a 2x4 or 2x6 stud wall. Mount an Uponor Zone Control Module or wireless zoning base unit inside the cabinet for ease of wiring and protection from exposure or possible damage.

Note: When recessing the cabinet in a wall, add ½" to the height and width of the cabinet dimensions (shown in the part description) for easier installation. The adjustable door will cover the additional space surrounding the cabinet.

Note: When installing stainless-steel manifolds with 10 to 12 loops, the mounting bracket spacing must be adjusted for proper fit on the cabinet rail.

1" Stainless-Steel Manifolds	A2603524	A2603530	A2603539
2 to 5 loops	X		
6 to 8 loops		X	
10 to 12 loops			X
1¼" Stainless-Steel Manifolds	**A2603524**	**A2603530**	**A2603539**
2 to 5 loops	X		
6 to 8 loops		X	
10 to 12 loops			X

Table 5-3: Manifold wall cabinets for stainless-steel manifolds

Commercial Stainless-Steel Manifolds

The Commercial Stainless-Steel Manifold provides more than double the gallons per minute (gpm) of standard manifolds to meet the demanding applications of large commercial hydronic distribution, radiant heating and cooling, snow and ice melting, permafrost prevention (cold storage), and Radiant Rollout™ Mat systems. Designed for stronger capabilities, greater accuracy, and better performance, the Commercial Stainless-Steel Manifold handles 48 gpm total flow with up to 4 gpm flow meters, 1½" distribution ball valves, and 1" loop isolation ball valves that reduce loop pressure drops without impact to pump head pressure for improved system performance. The high-capacity manifold offering, which is available in loop configurations of 3-8, 10, and 12, improves installation productivity with quick, easy venting, purging, and filling to help save time on projects, and the preassembled system provides greater installation flexibility to eliminate design and fabrication requirements as well as special-order hassles that waste labor, time, and money. The manifold features R25 connections for outlet fittings available in ⅝" and ¾" compression or ⅝", ¾", and 1" ProPEX (sold separately).

Commercial Stainless-Steel Manifold Opening Requirements

Number of Loops	Horizontal Installation	
	Height (in.)	Width (in.)
3	30	15.56
4	30	18.71
5	30	21.85
6	30	25.00
7	30	28.15
8	30	31.30
10	30	37.60
12	30	43.90

Table 5-4: Commercial stainless-steel manifold opening requirements

Commercial Stainless-Steel Manifolds Exploded View

A2791050 Commercial Stainless-Steel Manifold Temperature Gauge (set of 2)

A2791501 Commercial Stainless-Steel Manifold, Mounting Clips, Supply

A2791502 Commercial Stainless-Steel Manifold, Mounting Clips, Return

Supply

Air vent fill/purge valve

A2740402 Commercial Stainless-Steel Manifold Assembly, 1½ with Flow Meter and Ball Valve, 4 loops (available in 3-8, 10, and 12 loops)

Return

Air vent fill/purge valve

A2791532 Commercial Stainless-Steel Manifold Ball Valve, Supply and Return, 1½ NPT x R32 (set of 2)

Side view placement of the mounting clips

A2791010 Commercial Stainless-Steel Manifold Loop Isolation Ball Valve

A2791004 Commercial Stainless-Steel Manifold Flow Meter, 0-4 gpm

Q4050625 ⅝" ProPEX x R25 Fitting
Q4050750 ¾" ProPEX x R25 Fitting
Q4051000 1" ProPEX x R25 Fitting

A4050625 ⅝" QS-style Compression x R25 Fitting
A4050750 ¾" QS-style Compression x R25 Fitting

A2791032 Commercial Stainless-Steel Manifold 2" Flat Gasket

A2791001 Commercial Stainless-Steel Manifold 1" Flat Gasket

Figure 5-2: Commercial stainless-steel manifolds exploded view

Engineered Polymer (EP) Heating Manifolds

EP heating manifold assemblies feature isolation valves and balancing valves with flow meters, and come fully assembled, ready for installation. The manifolds are available in 2- through 8-loop configurations and the modular design allows for additional loops to be added up to a maximum flow of 15.4 gpm. The body ends feature R32 unions and the loop outlets have R20 male threads. The manifold mounts on a bracket that comes with the assembly. Pressure and temperature ratings:

- 87 psi at 140°F (60°C)
- 58 psi at 176°F (80°C)
- 72 psi at 158°F (70°C)
- 44 psi at 194°F (90°C)

Note: When filling the radiant system with glycol, Uponor recommends using propylene glycol.

EP Heating Manifold Opening Requirements

Number of Loops	Horizontal Installation	
	Height (in.)	Width (in.)
2	30	9.88
3	30	11.85
4	30	13.82
5	30	15.79
6	30	17.76
7	30	19.72
8	30	21.69

Table 5-5: EP heating manifold opening requirements

EP Heating Manifolds Exploded View

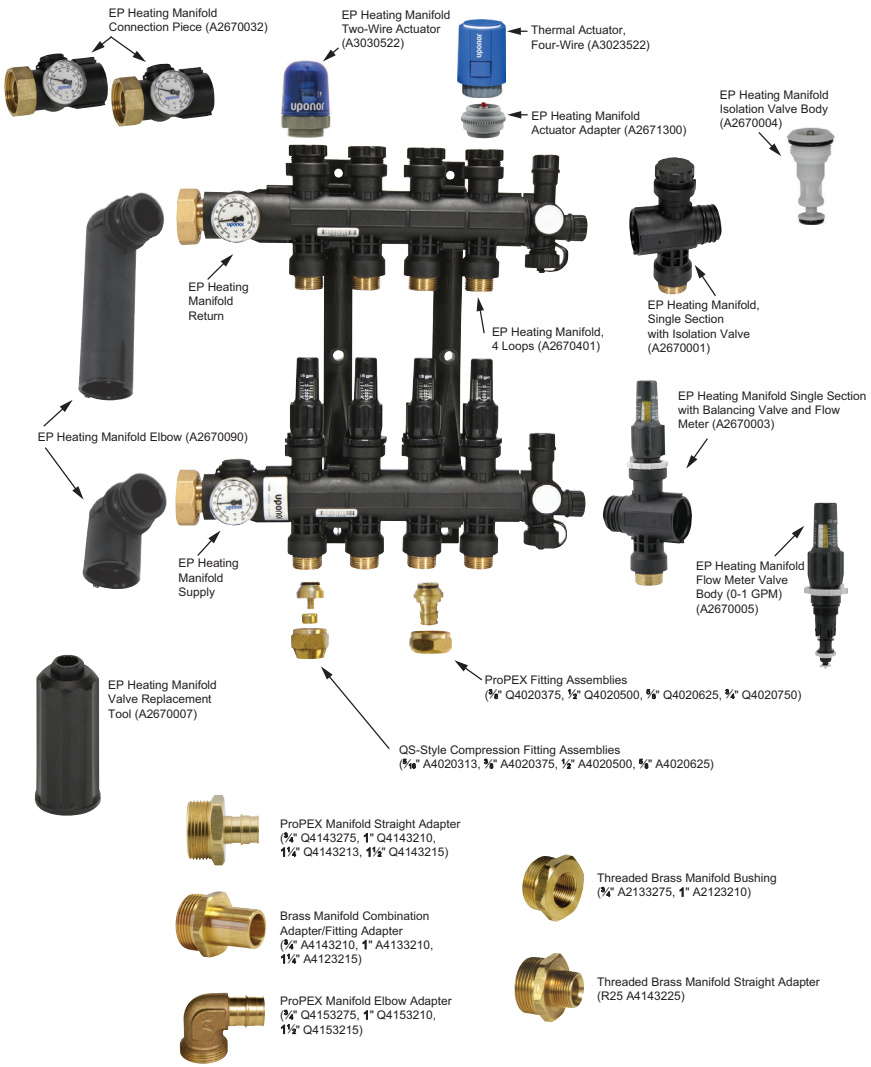


Figure 5-3: EP heating manifolds exploded view

Copper Manifolds

Copper valved manifolds with ProPEX ball valves are made of type L copper and feature ⅝" and ¾" nominal branches that are 4" on center. The manifolds are available in 12-outlet configurations. The maximum recommended flow to the manifold based on manifold body diameter is 45 gpm.

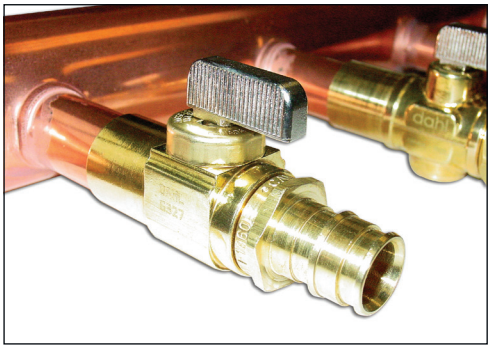


Figure 5-4: Copper valved manifold with ProPEX ball valves

Connecting Uponor PEX to the Manifold

1. Refer to **Chapter 4** for information about making Uponor QS-style fittings and Uponor ProPEX fittings.
2. To attach the pipe to the manifold properly, cut the pipe even with the bottom thread on the manifold nipple.

Notes

Chapter 6: Appropriate Piping Layout Pattern

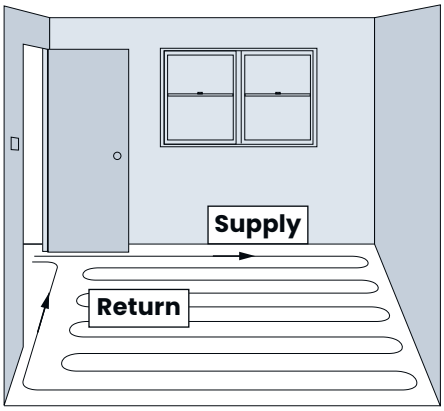


Figure 6-1: Single-wall serpentine — Use when a single wall represents the major heat loss of the zone. The supply is fed directly to the high heat loss wall and then serpentined toward the lower heat loss area. Start piping runs 6" from walls or nailing surfaces. A 6" on-center piping run is often installed along outside walls to improve response time.

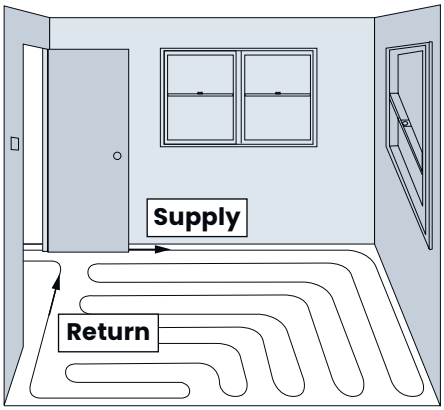


Figure 6-2: Double-wall serpentine — Use when there are two adjacent walls representing the major heat loss of the room. The supply is fed directly to either of the heat loss walls and then serpentined toward the lower heat loss area in an alternating pattern against the two heat loss walls. Start piping runs 6" from walls or nailing surfaces. A 6" on-center piping run is often installed along outside walls to improve response time.

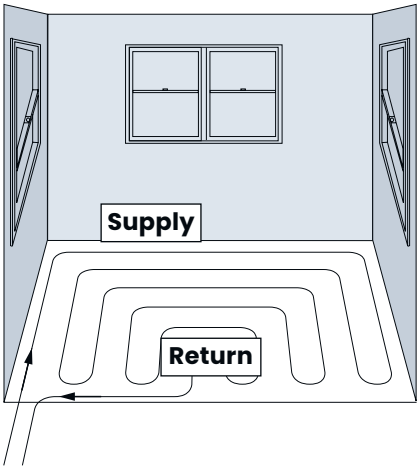


Figure 6-3: Triple-wall serpentine — Use when there are three walls representing the major heat loss of the room. The supply is fed along the heat loss walls in an alternating pattern and serpentined toward the lower heat loss area of the room. Start piping runs 6" from walls or nailing surfaces. A 6" on-center piping run is often installed along outside walls to improve response time.

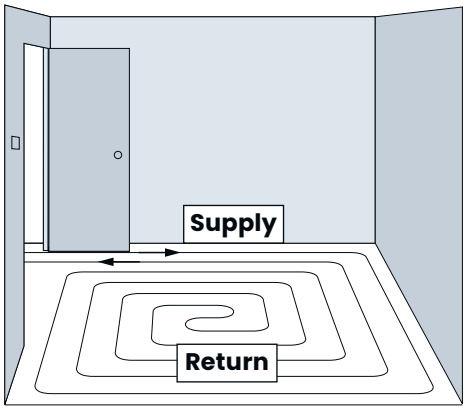


Figure 6-4: Counter flow — Use when the heat loss for the room is evenly distributed throughout the entire room or the major heat loss is to the floor. The supply is fed along the exterior of the room spiraling inward with the return paralleling it from the center of the room. Start piping runs 6" from walls or nailing surfaces. A 6" on-center piping run is often installed along outside walls to improve response time.

Chapter 7: Floor, Ceiling, and Wall Construction Methods

Uponor radiant floor piping may be installed in virtually any type of floor construction. The method of installation varies with the basic structure of the floor. For the two basic types of floor construction, slab on grade and suspended, there are several different variations of installation. The following pages contain detailed examples of different construction techniques. It is the responsibility of the contractor to assure compliance with local building codes.

Method A – Uponor PEX in a Slab or Overpour

Structural factors - Minimum cover for piping is detailed in the local building codes. Generally, a minimum of 1½" of concrete must be poured over the piping when the slab is exposed to the earth or weather. When the slab is not exposed to the earth or weather, a ¾" concrete pour over the piping is generally acceptable. Other types of slab constructions (e.g., pre-stressed concrete planking or post-tensioned concrete slabs) may have different requirements. Refer to local building codes for additional information.

Joints in concrete - Concrete slabs often require construction joints, control joints, or expansion joints. Details for these joints must be specified on the plan. Provisions must be made to control shear forces at the joints and eliminate damage to the piping.

Construction joints – Construction joints separate two pours of a slab completed at different times. Because it is difficult to construct a large slab in one pour, a bulkhead is installed to contain sections of the slab until the next phase is poured. It may be convenient to install the piping in an area just before the slab is poured. That makes it easier to move concrete equipment from place to place and reduces the chances that the piping will be damaged during installation. Typically, the piping is dropped below the control joint. See **Figure 7-1**.

Control joints, sometimes called contraction joints, are places where the concrete surface is scored to control cracking and relieve the stress created when concrete shrinks during the curing process. These joints eliminate the random cracks that would otherwise occur. Because control joints are often cut into the slab after it has set, the piping must be placed deep enough in the slab to avoid the blade used to score the concrete.

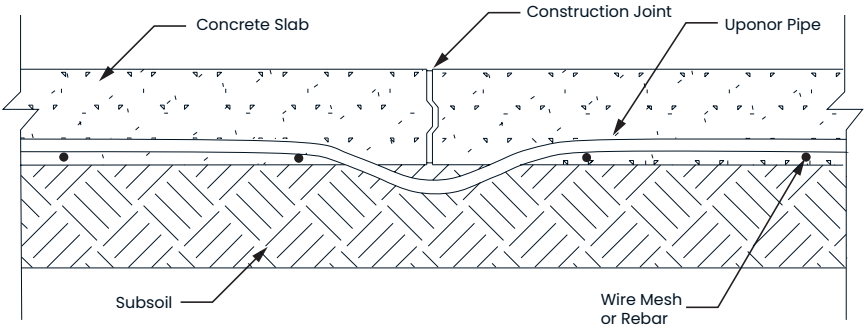


Figure 7-1: Construction joint – Two pours completed at different times

1. Dip piping under joint below the slab.

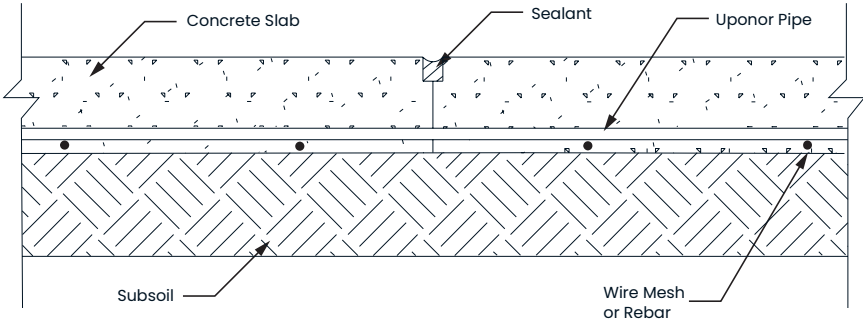


Figure 7-2: Control joint – Sawed or formed (allows concrete to crack in a predictable pattern)

1. Piping must be placed deep enough in the slab to be safe from the control joint (saw blade).
2. Piping must be secured tightly to prevent it from floating up into the slab.
3. Piping may be wrapped with insulation or pipe sleeve for 3" on both sides of the control joint.

Expansion joints – Sometimes called isolation joints, these joints are intended to absorb horizontal movement caused by drying shrinkage and the thermal expansion and contraction of the slab. Radiant heating systems generally reduce the severity of expansion and contraction because they limit the temperature range the slab experiences.

The coefficient of linear expansion for concrete is approximately 0.0000055 inch per inch per degree Fahrenheit. This means, roughly,

that for every 10°F (5°C) temperature rise, a 100-foot span of concrete is expected to expand about 1/16". When using foam insulation to accommodate minor shear action, take care to prevent floating during the pour. Also, determine the proper minimum cover on the basis of the outside surface of the foam.

There are two ways to install PEX piping in an expansion joint. See **Figures 7-3** and **7-4**.

1. Dip piping below slab into subsoil.

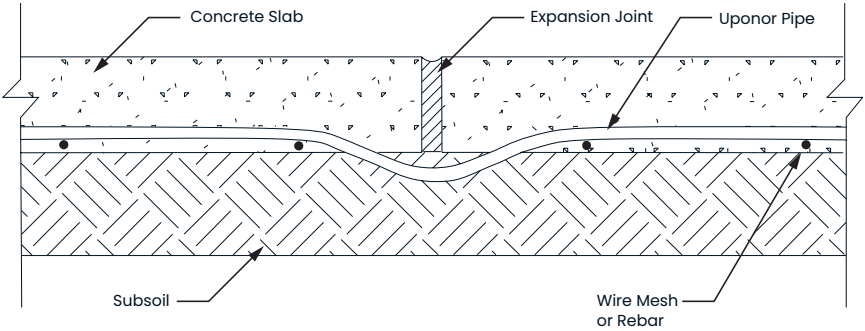


Figure 7-3: Dip piping below slab into subsoil

2. Wrap with a pipe sleeve or larger-diameter pipe for 6" on both sides of expansion joint.

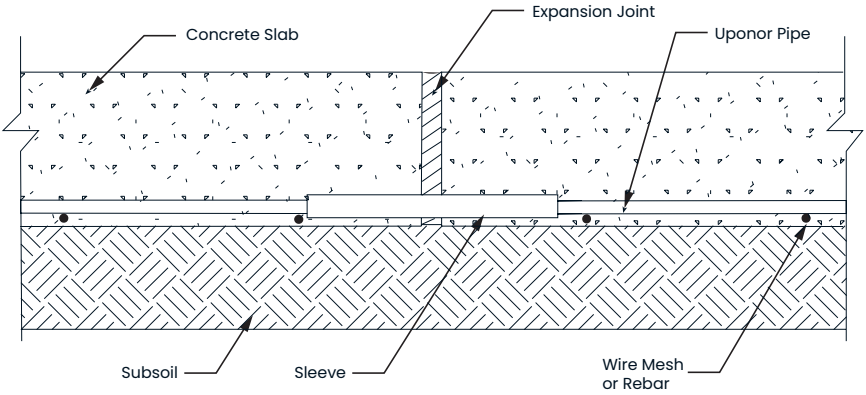


Figure 7-4: Wrap with a pipe sleeve or larger-diameter pipe

1. If the piping must remain in the slab, wrap the piping with a pipe sleeve or a larger diameter piping for 6" on both sides of the expansion joint.

The following "Method A" drawings illustrate nine methods of installing Uponor PEX in a slab or overpour.

Method A-1
Slab On or Below Grade with Edge Insulation Only

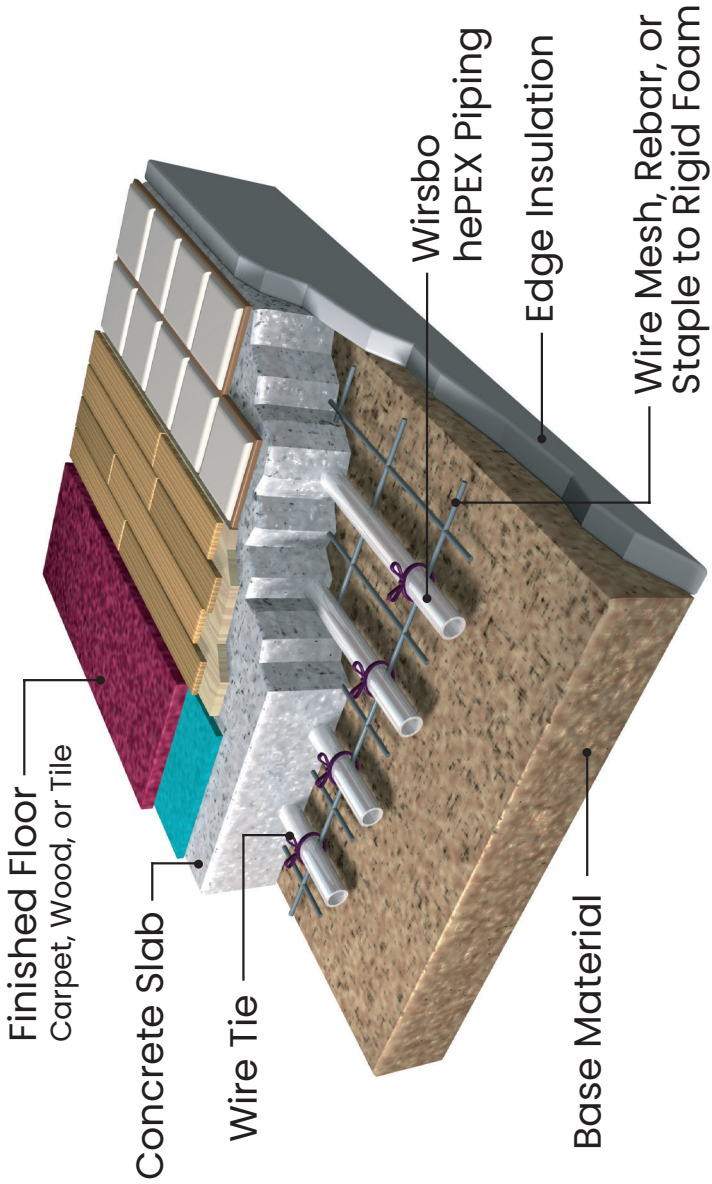


Figure 7-5: Slab on or below grade with edge insulation only

How – Place wire mesh or rebar over the compacted base material. Using Uponor Fixing Wire, secure the piping to the wire mesh or rebar. Space the wire ties a minimum of every 3 feet along straight runs. At the 180-degree turns, tie the piping at the top of the arc and once on each side, 12" from the top of the arc. This prevents the piping from dislodging and/or floating up into the pour.

Connect the piping to the manifold, and pressure test to a minimum of 60 psi at least overnight to ensure system integrity. Keep the piping under pressure until after the concrete is poured.

Where – This application is used primarily in commercial and light commercial construction, where room setpoint temperatures and space activities remain fairly constant. This method has several advantages including lower material costs and greater thermal storage ability. Some of the drawbacks include greater initial heat demand, longer ramp-up periods and slower response times to room setpoint changes.

What to look for – Under-slab heat loss may be critical to the performance of this radiant slab design. Complete under-slab insulation is required when:

- High water table or moist soil conditions are present
- Bedrock or ledge is present
- The upper envelope heat load is greater than 25 Btu/h
- Floor covering R-value is greater than 2.0
- The linear feet of perimeter is high in comparison to the gross floor area, as in most residential applications

Method A-2
Slab On or Below Grade Over a Compacted Soil/Sandbed

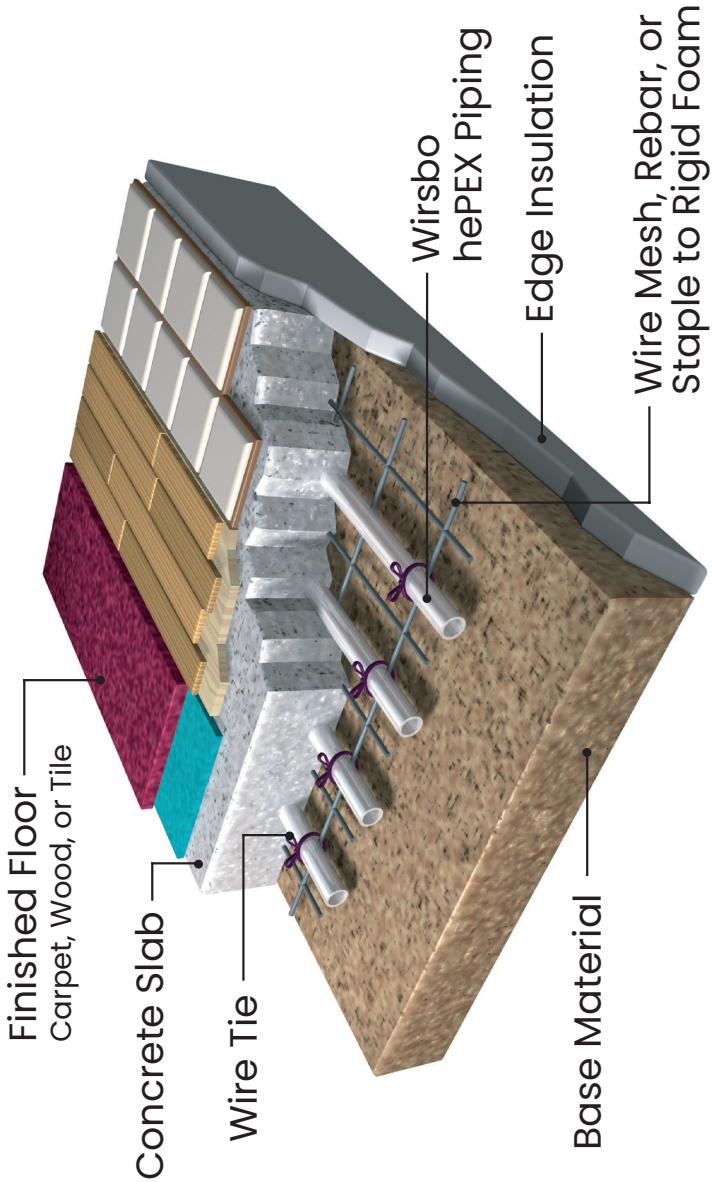


Figure 7-6: Slab on or below grade over a compacted soil/sandbed

How – Place the wire mesh or rebar over the compacted base material. Using Uponor Fixing Wire, secure the piping to the wire mesh or rebar. Place the wire ties a minimum of every 3 feet along straight runs. At the 180-degree turns, tie the piping at the top of the arc and once on each side, 12" from the top of the arc. This prevents the piping from dislodging and/or floating up into the pour.

Connect the piping to the manifold, and pressure test to a minimum of 60 psi at least overnight to ensure system integrity. Keep the piping under pressure until after the concrete is poured.

Lay and level a 2" layer of medium-grade, compacted soil/sand fill over the piping. Ensure the fill over the piping does not contain sharp aggregate. Pour concrete over the soil/sandbed.

Where – This method is used primarily in commercial and industrial applications. The purpose of the soil/sandbed is to protect the piping in case the structural slab is drilled. The advantage of this method is that the piping is unlikely to be damaged due to drilling for anchoring equipment or machinery. The disadvantages include greater material and labor costs. The slower response time due to the greater mass will have little effect within the commercial or industrial workspace.

What to look for – Under-slab heat loss may be critical to the performance of this radiant slab design. Complete under-slab insulation is recommended and essential when:

- High water table or moist soil conditions are present
- Bedrock or ledge is present
- The upper envelope heat load is high
- High R-value floor coverings are used
- The linear feet of perimeter is high in relationship to the gross floor area, as in most residential applications

Method A-3
Slab On or Below Grade with Under-Slab and Edge Insulation

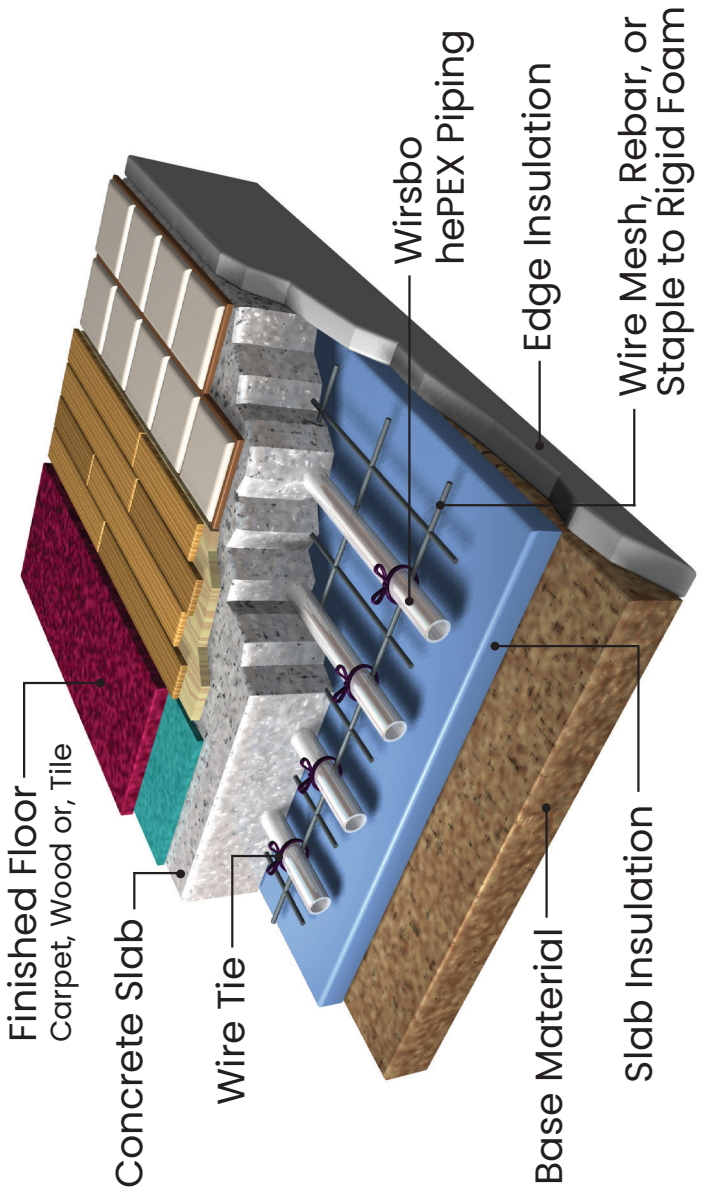


Figure 7-7: Slab on or below grade with under-slab and edge insulation

How – Place suitable, high-density rigid foam insulation over the compacted base material. Using Uponor Foam Staples with the Uponor Manual Stapler, secure the piping to the high-density insulation. Place the staples a minimum of every 3 feet along the straight runs. At the 180-degree turns, staple the piping at the top of the arc and once on each side, 12" from the top of the arc. This prevents the piping from dislodging and/or floating up into the pour.

Connect the piping to the manifold, and pressure test to a minimum of 60 psi at least overnight to ensure system integrity. Keep the piping under pressure until after the concrete is poured.

Note: The wire mesh or rebar is used only as a grid system to secure the piping. Mesh or rebar has no reinforcing value when installed at the bottom of the concrete slab.

Where – This method is primarily used in residential slab on or below grade installations or where downward losses are great. Some of the advantages of this method include quicker response time, lower initial heat load and lower operational costs through the life of the system. The primary drawback is higher costs up front for the initial materials due to the high-density insulation.

What to look for – Under-slab heat loss may be critical to the performance of this radiant slab design. A minimum of 1" of insulation is used. When one or more of the items listed below are involved with the application, a minimum of 2" of insulation is required.

- High water table or moist soil conditions are present
- Bedrock or ledge is present
- The upper envelope heat load is high
- High R-value floor coverings are used
- The linear feet of perimeter is high in relationship to the gross floor area, as in most residential applications

Method A-4
Slab On or Below Grade – Single Pour Over Piping in a Sandbed

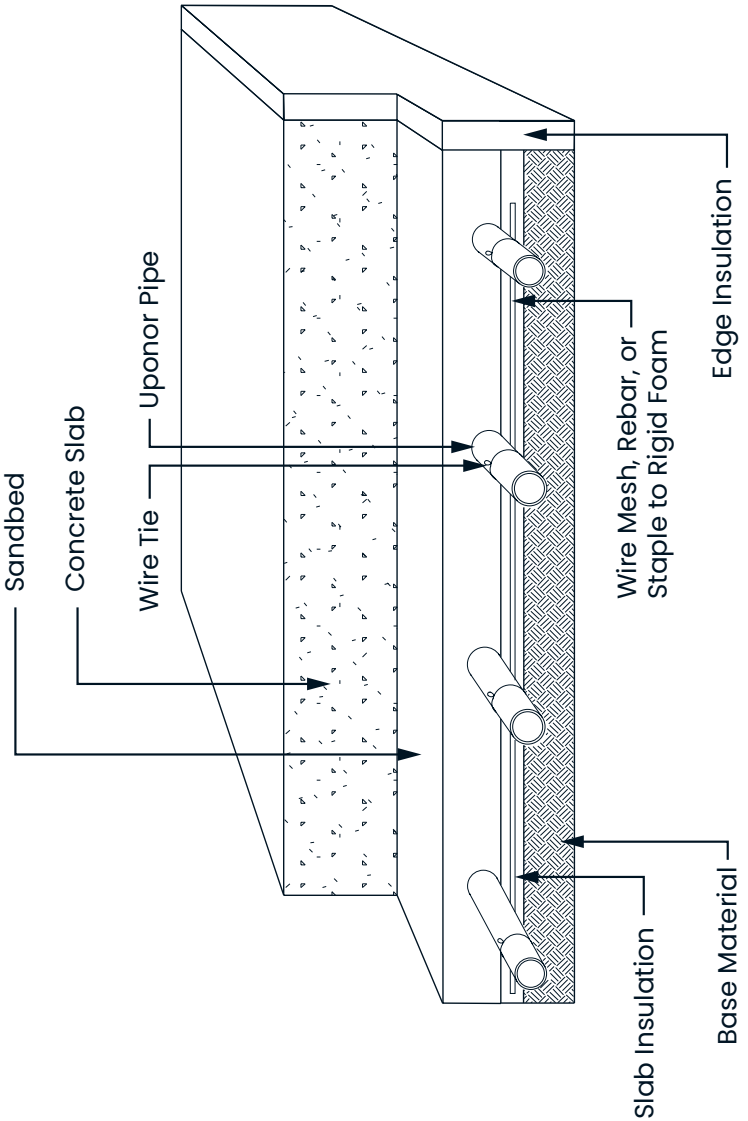


Figure 7-8: Slab on or below grade – single pour over piping in a sandbed

1. Lay out the wire mesh or rebar over the base material.
2. Connect one end of the loop to the supply manifold (see **Chapter 4** for connection methods).
3. Secure the piping to the wire mesh or rebar.
4. Tie the piping to the wire mesh or rebar using Uponor wire ties and wire twister. Secure the piping to the wire mesh or rebar every four feet along straight runs. At the 180° turns, tie the piping at the top of the arc and once on each side, 12" from the top of the arc (see figure below), to prevent it from dislodging or floating into the pour.
5. Once the complete loop has been laid out, connect the end of the loop to the return manifold. Complete the piping installation.
6. Pressure test the system (see **Chapter 8**) in accordance with local building codes.
7. Apply a suitable concrete mixture over the piping.
8. Apply a suitable concrete mixture over the sand.

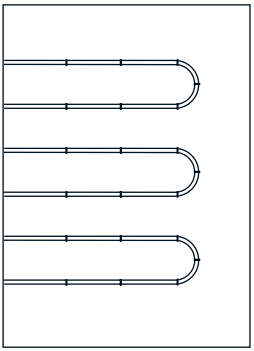


Figure 7-9: Slab on or below grade – single pour over piping in a sandbed

Method A-5
Poured Underlayment On a Suspended Wood Subfloor

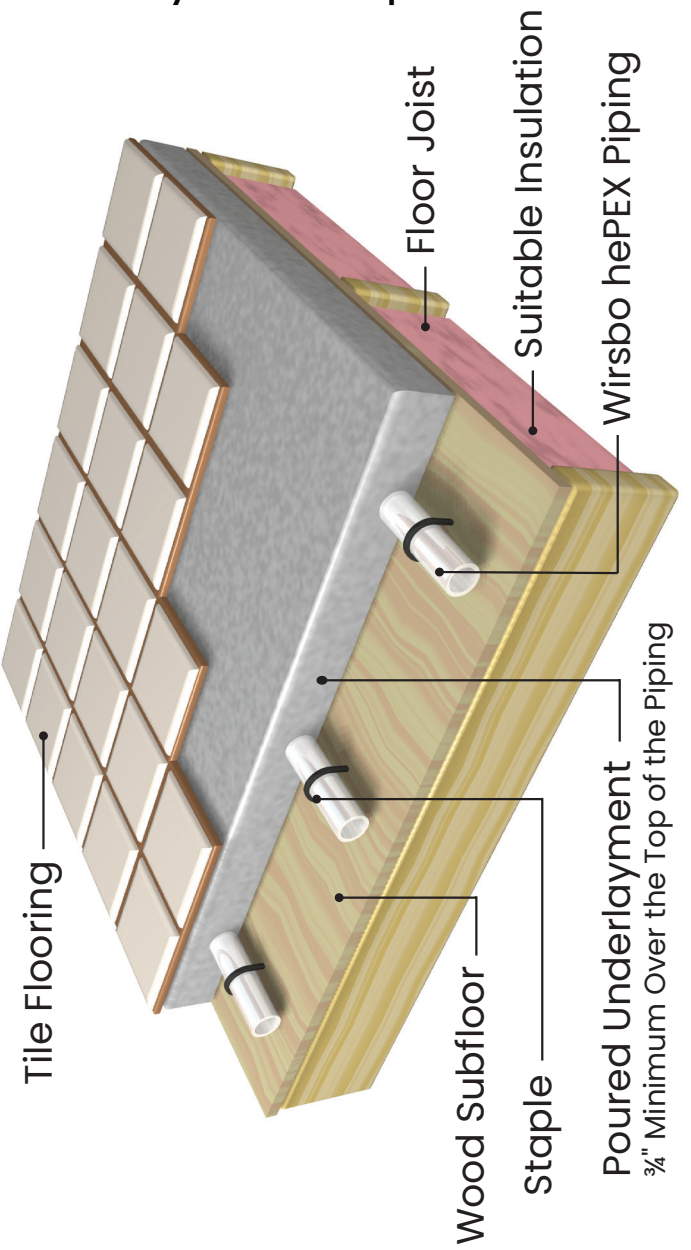


Figure 7-10: Poured underlayment on a suspended wood subfloor

How – Staple Uponor PEX directly to the subfloor. Staple the piping every 2 to 3 feet on the straight runs to prevent it from floating during the pour. At the 180-degree turns, secure one staple at the top of the arc and one staple on each side, 12" below the top of the arc.

Connect the piping to the manifold, and pressure test to a minimum of 60 psi at least overnight to ensure system integrity. Keep the piping under pressure until after the underlayment is poured.

Install suitable batt insulation tightly against the subfloor between the floor joists.

Where – This common residential and light commercial installation method is used when the piping is installed in a poured-floor underlayment. Pours are typically 1½" thick and are used as an underlayment for a hardwood, tile or carpeted finished floor.

What to look for – The minimum depth for a concrete pour in this application should be at least ¾" over the top of the piping. Consult the underlayment applicator for recommended pour depths.

If a lightweight, non-gypsum based concrete is used instead of the underlayment, take care to install proper expansion joints around the perimeter of the room and on all framed walls. Additionally, use suitable wire or plastic mesh in the lightweight concrete to add structural strength to the pour. Consult the lightweight concrete installer for installation recommendations.

Refer to **Chapter 16** in the **Uponor Complete Design Assistance Manual (CDAM)** for complete details on installing wood floors over a radiant system.

Method A-6
Poured Underlayment with Sleepers Over a Suspended Wood Subfloor

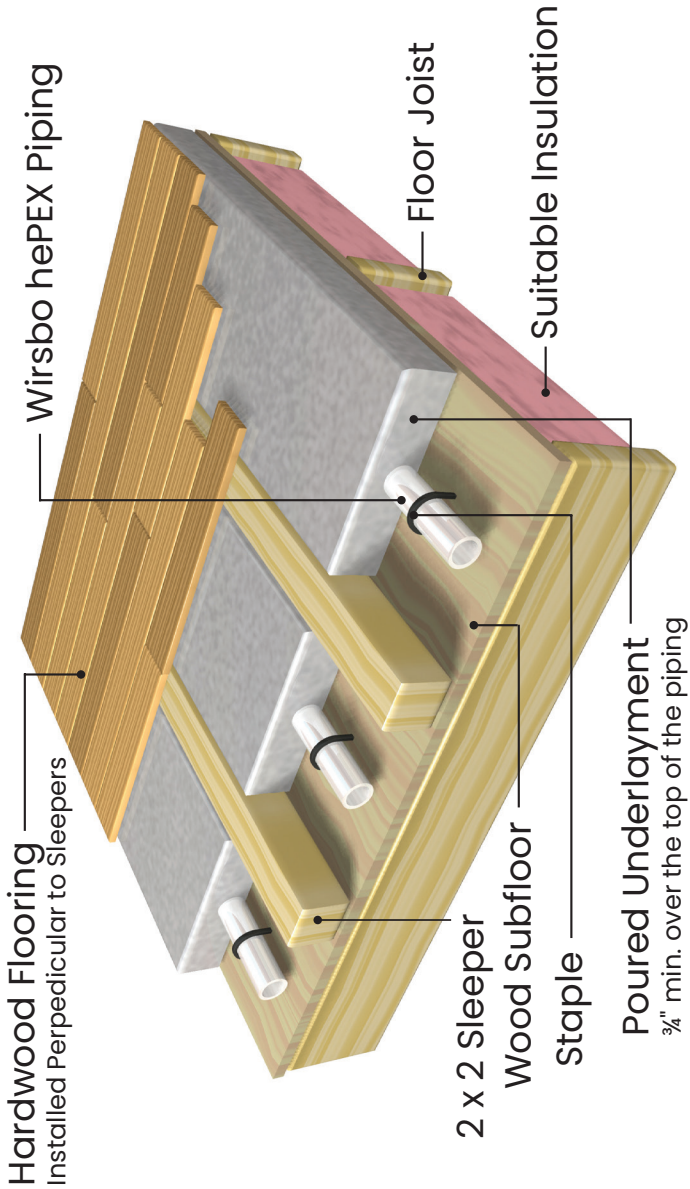


Figure 7-11: Poured underlayment with sleepers over a suspended wood subfloor

How – Staple Uponor PEX piping directly to the subfloor. Staple the piping every 2 to 3 feet on the straight runs to prevent it from floating during the pour. At the 180-degree turns, secure one staple at the top of the arc and one staple on each side, 12" below the top of the arc.

Install 2x2 (actual dimensions are 1½" by 1½") wood sleepers between the runs of piping, 9" to 12" on center. These sleepers serve as a nailing surface for hardwood floors or carpet tack strips. Install additional sleepers around the perimeter of the room.

Connect the piping to the manifold, and pressure test to a minimum of 60 psi at least overnight to ensure system integrity. Keep the piping under pressure until after the underlayment is poured.

The poured underlayment floats to the top of the sleepers resulting in a smooth, finished pour. Install suitable batt insulation tightly against the subfloor between the floor joists.

Where – This common residential and light commercial installation method is used when the piping is installed in a poured-floor underlayment. Pours are typically 1½" thick and are used as an underlayment for a hardwood, tile or carpeted finished floor.

Note: Uponor recommends floor surface temperatures not exceed 80°F (26.7°C) unless the wood flooring manufacturer provides a higher temperature rating.

What to look for – The minimum depth for a concrete pour in this application should be at least ¾" over the top of the piping. Consult the underlayment applicator for recommended pour depths.

If a lightweight, non-gypsum based concrete is used instead of the underlayment, take care to install proper expansion joints around the perimeter of the room and on all framed walls. Additionally, use suitable wire or plastic mesh in the lightweight concrete to add structural strength to the pour. Consult the lightweight concrete installer for installation recommendations.

Refer to **Chapter 16** in the **Uponor Complete Design Assistance Manual (CDAM)** for complete details on installing wood floors over a radiant system.

Method A-7
Fast Trak 0.5

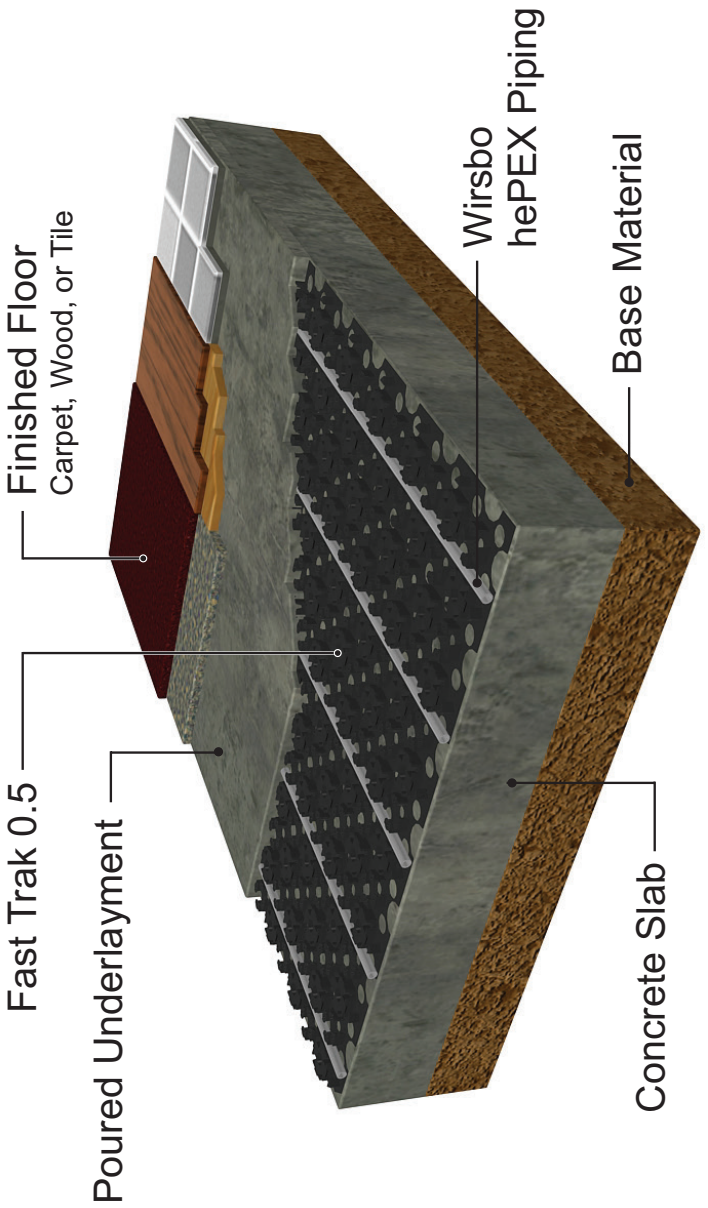


Figure 7-12: Fast Trak 0.5

How – Make sure that the subsurface is free from dust and debris before laying out the panels. Attach Fast Trak Edge Strips to the wall; be sure to cover all walls that will be exposed to the overpour. Remove the plastic foil to expose the adhesive backing before placing the panels on the floor.

Keep a 2" spacing to the wall when laying down the panels. Install the piping by walking or stepping the piping into the knobs on the panel. Piping spacing can be as little as 2", but the turns must have a minimum radius of 3".

Connect the piping to the manifold and pressure test to a minimum of 60 psi at least overnight to ensure system integrity. Keep the piping under pressure until after the overpour is poured. The overpour may be as thin as ¼" above the piping and still promote lateral heat transfer; however, local code may require thicker pours due to structural requirements and to avoid cracking.

Where – Uponor Fast Trak is the ideal overpour installation method for remodel and retrofit applications. The preformed, knobbed panels make it easy to install 5/16" Wirsbo hePEX piping for radiant floor heating systems. The Fast Trak 0.5 system requires a structural subsurface of some kind.

What to look for – A structural subsurface is required for this system, and the added weight of the overpour must be considered when determining if the finished installation can be supported by the structure.

Always check the local code for overpours to verify the pour thickness required.

Method A-8
Fast Trak 1.3i

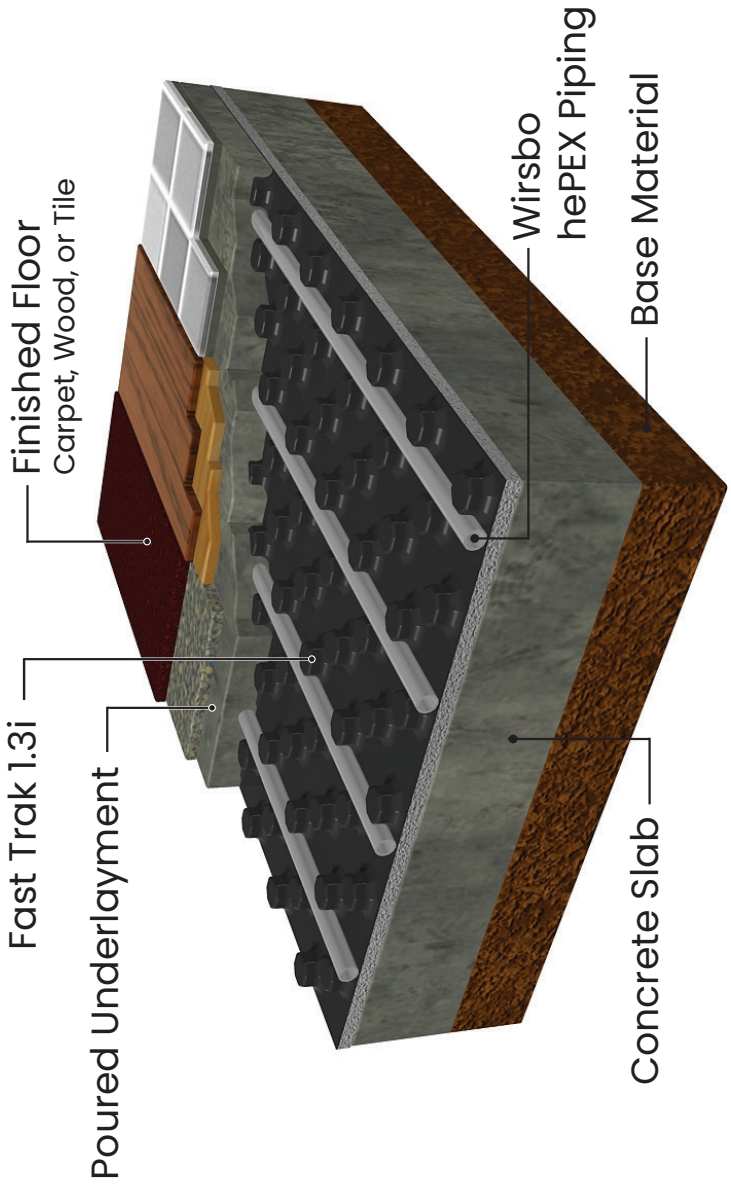


Figure 7-13: Fast Trak 1.3i

How – Make sure that the subsurface is level (see installation manual for details). If necessary, the subsurface can be leveled by using a self-leveling primer.

Ensure that the subsurface is free from dust and debris. Attach Fast Trak Edge Strips to the wall; be sure to cover all walls that will be exposed to the overpour.

Place the panels on the floor. The panels have an interlocking feature that ensures the overpour will not seep under the panels. After panels are laid out, apply the polyethylene self-adhesive strip of the Edge Strip to the Fast Trak panels to ensure the overpour cannot seep under the edges of the panel surface.

Install the piping by walking or stepping the piping into the knobs on the panel. Piping spacing can be as little as 2". Turns must have a minimum radius of 3" for ⅜" piping and 3½" for ½" piping.

Connect the piping to the manifold and pressure test to a minimum of 60 psi at least overnight to ensure system integrity. Keep the piping under pressure until after the overpour is poured.

Where – Uponor Fast Trak is the ideal overpour installation method for remodel and retrofit applications. The preformed, knobbed panels make it easy to install ⅜" or ½" Wirsbo hePEX piping for radiant floor heating systems.

What to look for – In this type of application, the pour must be at least 1½". The depth of the pour over the top of the piping must be at least ¾". This will prevent cracking and promote good lateral and vertical heat transfer. Consult applicator for further details.

Method A-9
Xpress Trak

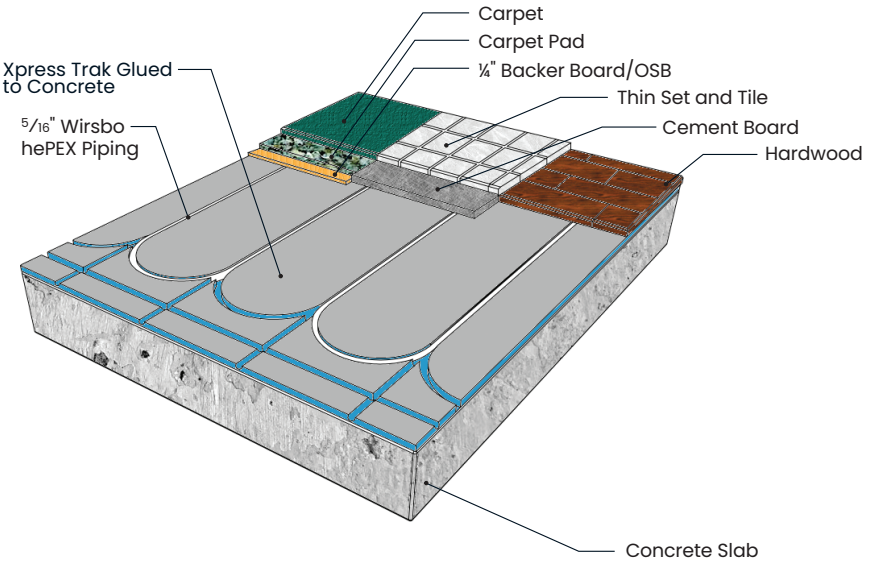


Figure 7-14: Xpress Trak over a concrete floor

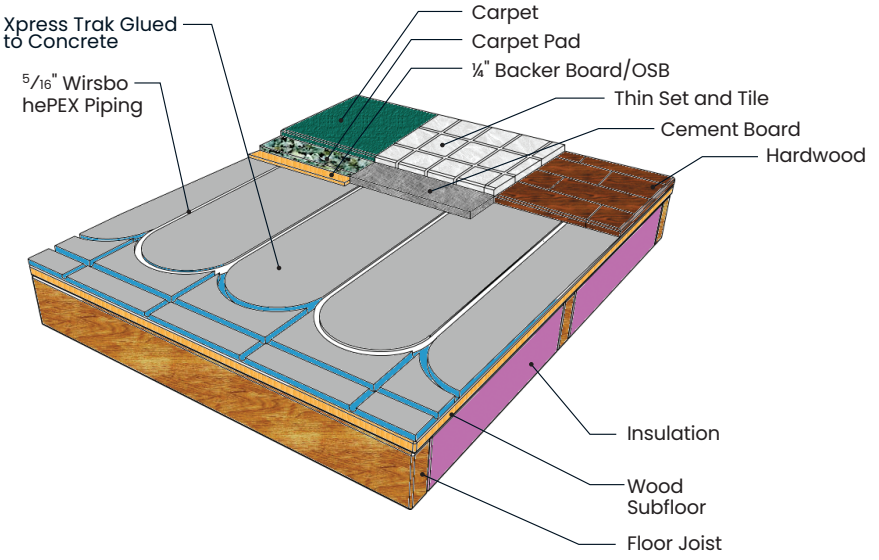


Figure 7-15: Xpress Trak over a suspended floor

How – Make sure that the subsurface is level (see installation manual for details). If necessary, the subsurface can be leveled by using a self-leveling primer. Ensure that the subsurface is free from dust and debris. Attach the Xpress Trak to the subsurface using construction adhesive. Apply adhesive to four (4) contact points on each panel to keep the panels from "floating" during the installation.

Take time to plan the radiant loop layout prior to installation. This will save time and ensure accurate ordering of Xpress Trak panels. Place the Xpress Trak panels in a configuration that supports your piping layout pattern. See the Xpress Trak installation manual for additional information.

Where – Uponor Xpress Trak is ideal for installation over existing slabs and suspended (wood frame) floors. The engineered grooves in the panels make it easy to install 5/16" Wirsbo hePEX piping.

What to look for – Outline all areas that will not have Xpress Trak panels (e.g., cabinets, built-ins) and fill in these areas with 5/8" high-density foam, plywood, or other material. Leave these areas open until after installing the Xpress Trak panels. (Either the carpentry contractor or the radiant installer can take care of this step.)

Method B – Installing Uponor PEX in Suspended Wood Floors

When installing piping below the subfloor between floor joists, it will become necessary to loop the piping from one joist cavity to the other. Loop the piping below the joist or drill a hole through the floor joist.

Note: Check local codes before drilling through floor joists.

Feeding Piping Through Floor Joists

1. Drill two 1½" holes in each joist as shown in **Figure 7-16**.
2. Feed piping off the uncoiler through holes farthest from the sill until the last joist bay to be done with that loop is reached.
3. Loop piping around and back through holes closest to the sill plate. Fasten loose end to the manifold (see **Chapter 4** for connection methods).
4. Starting with the joist bay farthest from the manifold, grab the loop and twist 180°. Then pull the loop the length of the joist bay. Fasten the end of the loop in place or let it hang. Continue to work back toward the manifold (see **Figure 7-17**).
5. Follow the specific instructions for the method of fastening used.

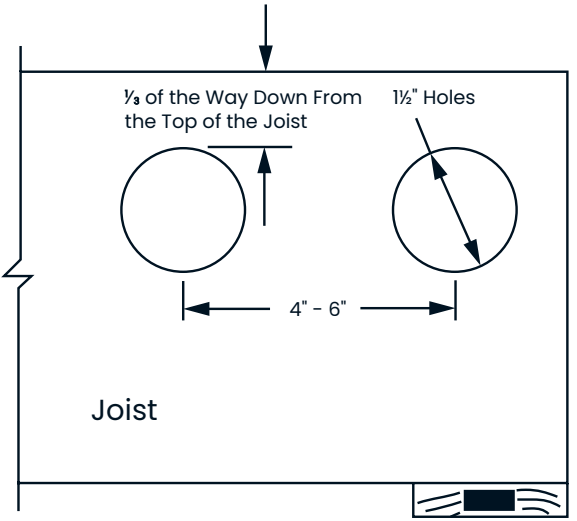


Figure 7-16: Side view of joist

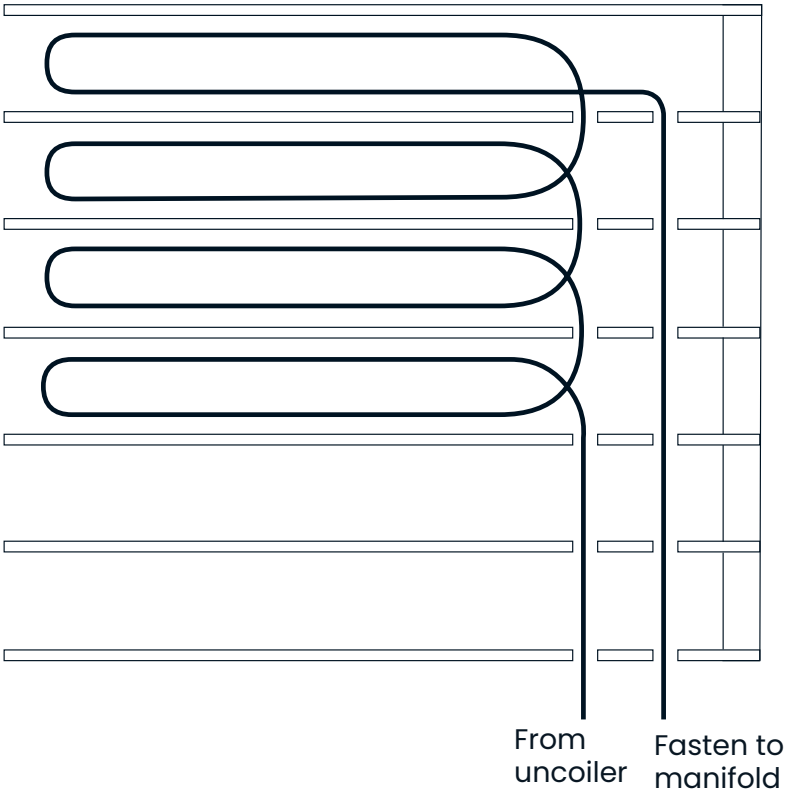


Figure 7-17: Top view of joist installation

The following pages illustrate installation methods with suspended wood floors.

Method B-1
Joist Heating Using Joist Trak Panels

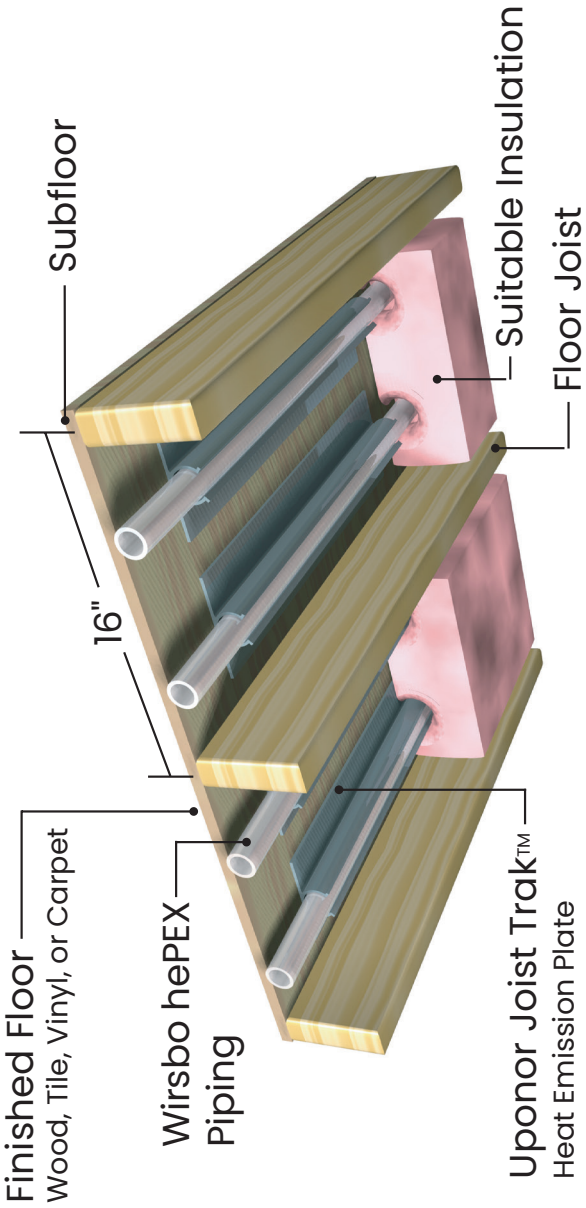


Figure 7-18: Joist heating using Joist Trak panel

How – Install the Joist Trak panels beneath the wood subfloor with ¾" drywall screws. In a 16", on-center joist bay, install the panels equal distance between the joists. Leave about a foot at the end of the joist bay without panels to allow piping turns. Leave about 1" between panel ends.

Drill two holes (1¼" minimum) side by side at the end of each joist cavity. Thread PEX piping in between the floor joists from below, looping from one joist cavity to the next as necessary. After piping is installed in the last joist bay, run the PEX straight back through the joist holes behind the first set of holes. Return this end of the PEX to the manifold and connect.

Install the loop farthest from the manifold by pulling the loop the length of that bay. Borrow slack from the loop hanging from the next joist bay. Next, snap the Uponor PEX piping into the grooves of the Joist Trak panels. Continue this process until all loops are neatly installed in the joist bays.

Install suitable installation in the joist bay, snug against the panels. Connect the piping to the manifold, and pressure test to a minimum of 60 psi at least overnight to ensure system integrity.

Where – This method is commonly used in both new and retrofit work where poured underlayment applications are impractical. Installing Joist Trak panels provides the same amount of heat load support using lower supply water temperatures than joist heating without panels.

Note: Check with local building codes before drilling through floor joists.

What to look for – Allow the bends of the piping at either end of the joist bay to straighten prior to installing in the panel. This ensures the piping enters t he panels in a straight line so that it does not cause noise by rubbing against the sides of the groove during operation.

A minimum R-11 fiberglass insulation is required even if the piping is installed over a heated space. A minimum R-19 is recommended when the piping is installed in a crawlspace. Standard unfaced insulation is adequate; foil-faced insulation is not necessary.

Install piping to align with the zone areas. Install insulation vertically to block the joist cavity beneath the zone wall.

Use either ⅜" or ½" PEX piping in joist heating applications. It is not recommended to exceed maximum individual loop lengths.

Method B-2
Joist Heating Using PEX Clips

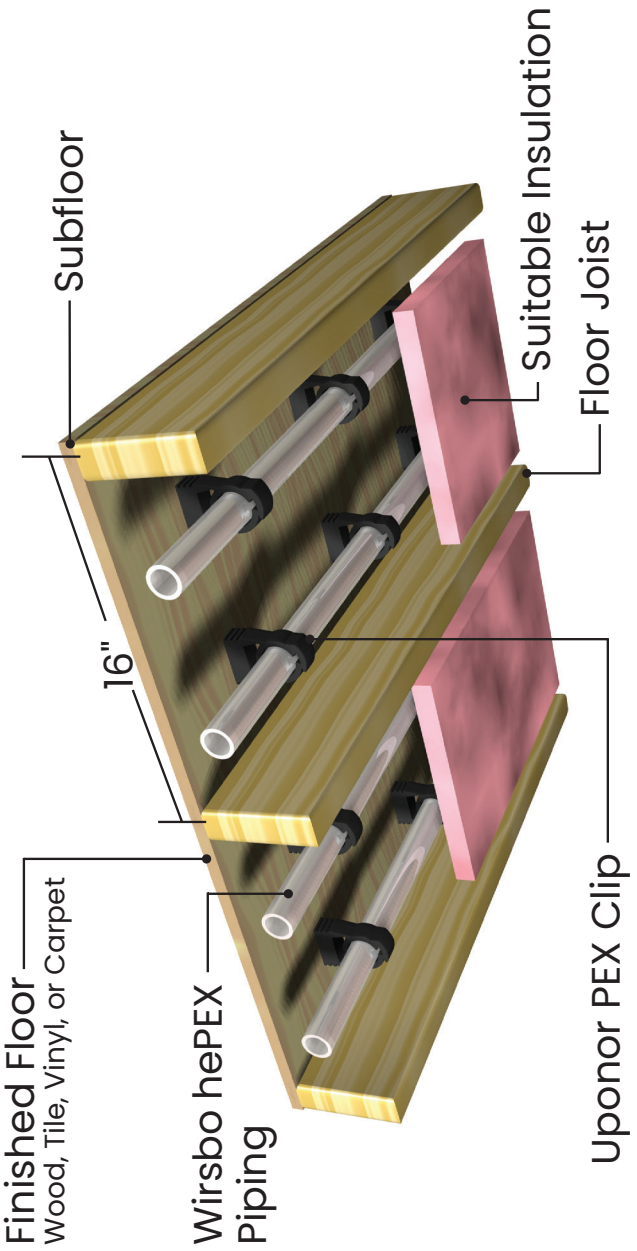


Figure 7-19: Joist heating using PEX clips

How – Drill two holes (1¼" minimum) side by side at the end of each joist cavity. Thread Uponor PEX piping in between the floor joists from below, looping from one joist cavity to the next as necessary. After installing piping in the last joist bay, run the PEX straight back through the joist holes behind the first set of holes. Return this end of the PEX to the manifold and connect.

Next, fasten Uponor PEX Clips to the bottom of the subfloor in each joist bay. The clips are 8" on center in 16" joist bays, 6" on center in 12" joist bays and 3 feet apart. Attach the PEX Clips with screws no larger than ¾".

Install the loop farthest from the manifold by pulling the loop the length of that bay. Borrow slack from the loop hanging from the next joist bay. Snap the piping into the PEX Clips, which suspends the piping about 1" below the subfloor. Continue the process until all loops are neatly installed in the joist bays.

Install suitable insulation in the bay, 1" below the piping, leaving about a 2" to 3" air gap under the subfloor. Connect the piping to the manifold, and pressure test to a minimum of 60 psi at least overnight to ensure system integrity.

Where – This method is commonly used in both new and retrofit work where poured underlayment applications are impractical. This installation is also used for floor conditioning — the warming of floors without providing heat into the space.

Note: This installation method is not recommended for open-web truss construction. Joist heating applications using only the PEX piping suspended in the plenum must have sufficient insulation R-value, and the insulation must be installed to limit air movement from the plenum. Joist heating applications with open-web truss construction should use the Joist Trak Panels as shown on **page 68** of this manual.

What to look for – A minimum R-11 fiberglass insulation is required even if the piping is installed over a heated space. A minimum R-19 is recommended when the piping is installed in a crawlspace. Standard unfaced insulation is adequate; foil-faced insulation is not necessary.

Install piping to align with the zone areas. Install insulation vertically to block the joist cavity beneath the zone wall.

Note: Check with local building codes before drilling through floor joists.

Use either ⅜" or ½" PEX piping in joist heating applications. It is not recommended to exceed maximum individual loop lengths.

Method B-3
Quik Trak Over a Wood Subfloor with Hardwood Floor Covering

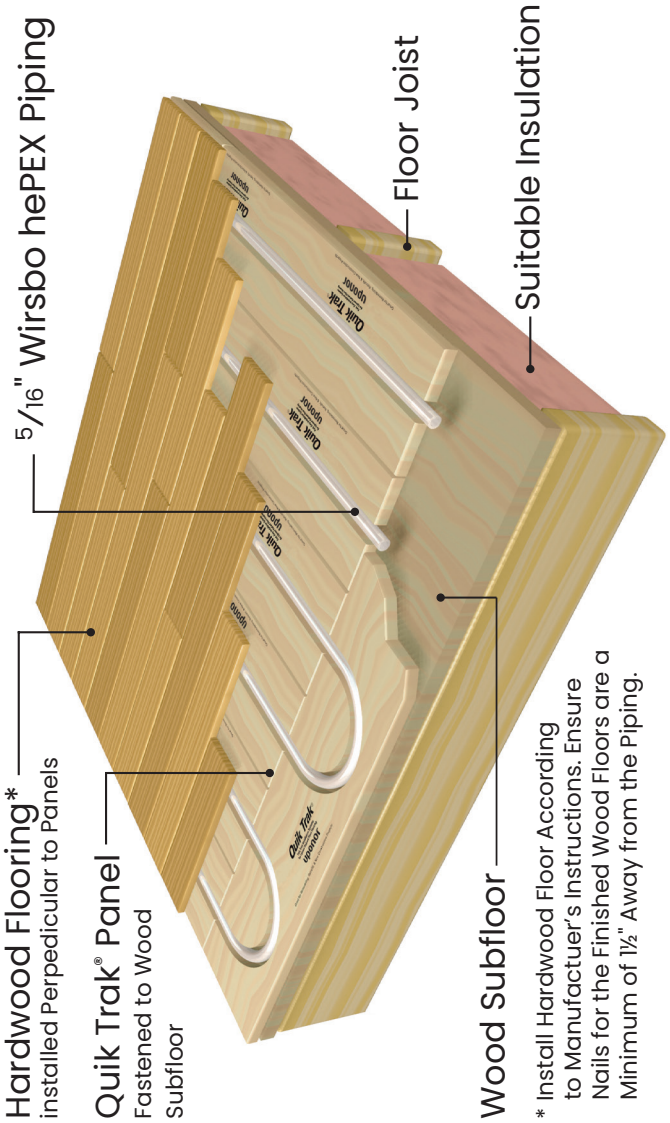


Figure 7-20: Quik Trak over a wood subfloor with hardwood floor covering

How – Lay Quik Trak panels over a plywood subfloor perpendicular to the finished wood floor. Make sure to stagger the seams of the Quik Trak.

After laying the panels, vacuum the debris from the panel grooves. Next, apply a thin (⅛") bead of Uponor Quik Trak Sealant throughout the entire length of the groove. The sealant is 100% silicone. It acts as an adhesive agent and promotes good heat transfer from the piping to the panel.

Install the piping by walking or stepping the piping into the panel grooves. If you're not wearing hard-sole shoes, you may need to use a rubber hammer to snap the piping into the groove.

Secure panels to the subfloor with 1¼" Quik Trak Screws or 1" staples. To start, secure the middle of the panel with a screw or staple. Work from the middle to the ends, alternating from side to side.

Where – This application is used in residential construction as an alternative to joist heating and poured-floor underlayment installations. Quik Trak is also beneficial when the finished floor material is hardwood. Installers can actually see the piping when installing the hardwood floor. This method offers several advantages, including minimal increase in floor height, no moisture from concrete and increased Btu/h/ft^2 output potential over joist heating.

What to look for – Always install hardwood floors in accordance with the flooring manufacturer's instructions. Ensure nails for the finished wood floor are a minimum of 1½" away from the piping.

Note: Uponor recommends floor surface temperatures not exceed 80°F (26.7°C) unless the wood flooring manufacturer provides a higher temperature rating.

Proper insulation is critical to the performance of Quik Trak. A minimum of R-19 is recommended in between the floor joists beneath the floor.

In all Quik Trak applications, the maximum loop length for ⅝" Wirsbo hePEX piping is 250 feet, including leader lengths. Flow rates for all Quik Trak installations are calculated to a 20°F (10°C) temperature differential.

Refer to **Chapter 16** in the **Uponor Complete Design Assistance Manual (CDAM)** for complete details on installing wood floors over a radiant system.

Method B-4
Quik Trak Over a Wood Subfloor with Tile/Linoleum Floor Covering

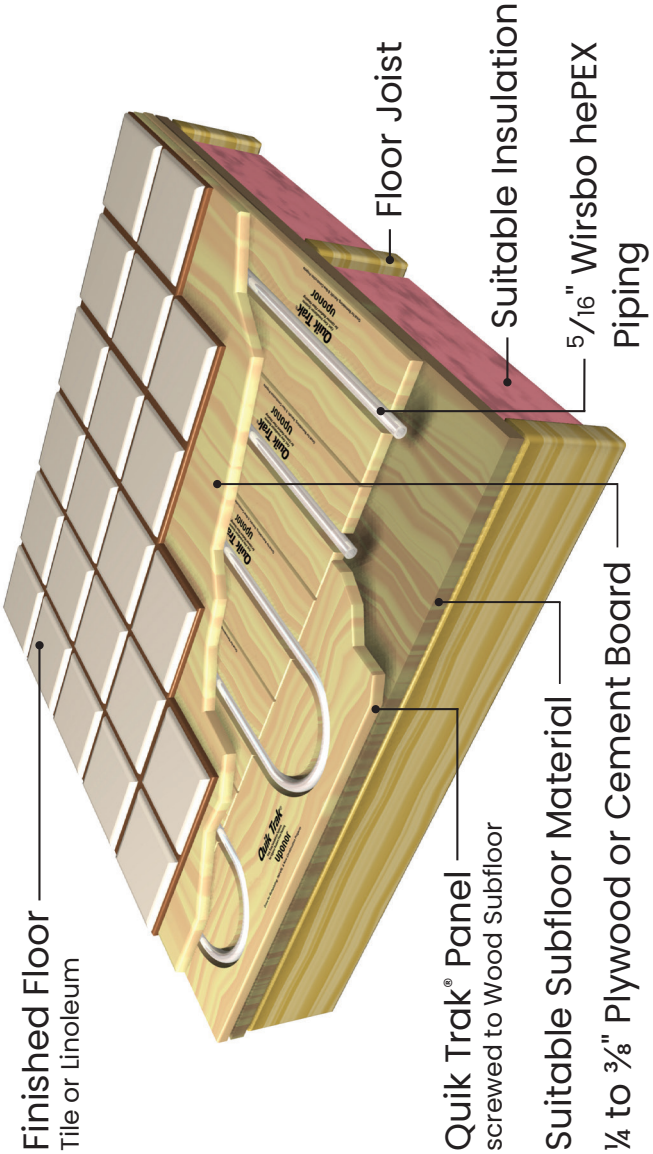


Figure 7-21: Quik Trak over a wood subfloor with tile/linoleum floor covering

How – Lay Quik Trak panels over a plywood subfloor perpendicular to the floor joists. Make sure to stagger the seams of the Quik Trak.

After laying the panels, vacuum the debris from the panel grooves. Next, apply a thin (⅛") bead of Uponor Quik Trak Sealant throughout the entire length of the groove. The sealant is 100% silicone. It acts as an adhesive agent and promotes good heat transfer from the piping to the panel.

Install the piping by walking or stepping the piping into the panel grooves. If you're not wearing hard-sole shoes, you may need to use a rubber hammer to snap the piping into the groove.

Secure panels to the subfloor with 1¼" Quik Trak Screws or 1" staples. To start, secure the middle of the panel with a screw or staple. Work from the middle to the ends, alternating from side to side.

Where – This application is used in residential construction as an alternative to joist heating and poured-floor underlayment installations. Quik Trak is also beneficial when the finished floor material is hardwood. Installers can actually see the piping when installing the hardwood floor. This method offers several advantages, including minimal increase in floor height, no moisture from concrete and increased Btu/h/ft^2 output potential over joist heating.

What to look for – Proper insulation is critical to the performance of Quik Trak. A minimum of R-19 is recommended in between the floor joists beneath the floor.

Note: Do not exceed 87.5°F (30.8°C) for tile and linoleum floor surface temperatures.

In all Quik Trak applications, the maximum loop length for ⅝" Wirsbo hePEX piping is 250 feet, including leader lengths. Flow rates for all Quik Trak installations are calculated to a 20°F (10°C) temperature differential.

Method B-5
Quik Trak Over a Wood Subfloor with Carpet Floor Covering

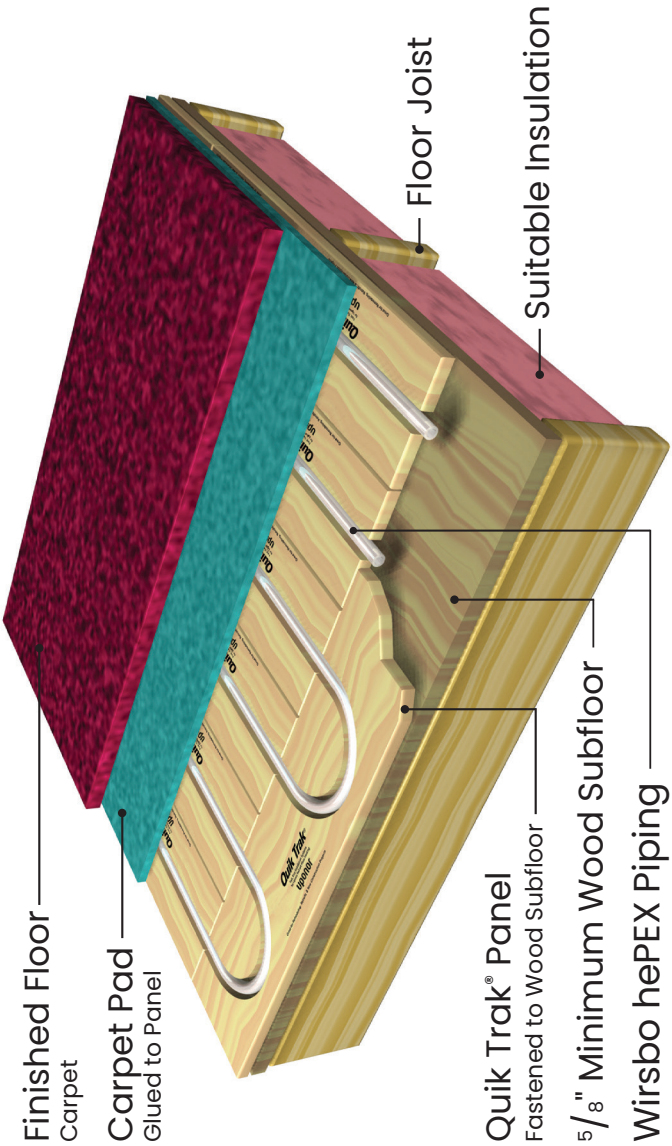


Figure 7-22: Quik Trak over a wood subfloor with carpet floor covering

How – Lay Quik Trak panels over a plywood subfloor perpendicular to the floor joists. Make sure to stagger the seams of the Quik Trak.

After laying the panels, vacuum the debris from the panel grooves. Next, apply a thin (⅛") bead of Uponor Quik Trak Sealant throughout the entire length of the groove. The sealant is 100% silicone. It acts as an adhesive agent and promotes good heat transfer from the piping to the panel.

Install the piping by walking or stepping the piping into the panel grooves. If you're not wearing hard-sole shoes, you may need to use a rubber hammer to snap the piping into the groove.

Secure panels to the subfloor with 1¼" Quik Trak Screws or 1" staples. To start, secure the middle of the panel with a screw or staple. Work from the middle to the ends, alternating from side to side.

Where – This application is used in residential construction as an alternative to joist heating and poured-floor underlayment installations. Quik Trak is also beneficial when the finished floor material is hardwood. Installers can actually see the piping when installing the hardwood floor. This method offers several advantages, including minimal increase in floor height, no moisture from concrete and increased Btu/h/ft^2 output potential over joist heating.

What to look for – Proper insulation is critical to the performance of Quik Trak. A minimum of R-19 is recommended in between the floor joists beneath the floor.

Note: Do not exceed 87.5°F (30.8°C) for carpeted floor surface temperatures.

In all Quik Trak applications, the maximum loop length for ⅝" Wirsbo hePEX piping is 250 feet, including leader lengths. Flow rates for all Quik Trak installations are calculated to a 20°F (10°C) temperature differential.

Method B-6
Quik Trak Over an Existing Concrete Slab

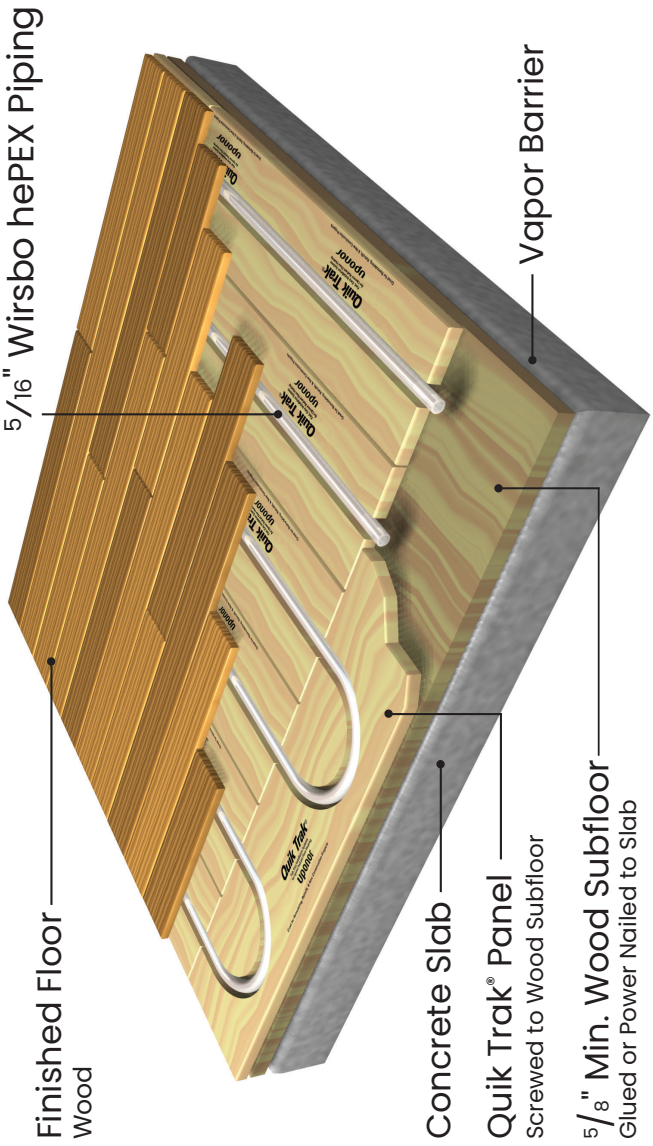


Figure 7-23: Quik Trak over an existing concrete slab

How – First, install a layer of ⅝" or ¾" plywood subfloor over the concrete slab. Glue or power-nail the plywood directly to the concrete if a vapor barrier is not required. If a vapor barrier is required, then you must power-nail the plywood to the concrete slab.

Lay Quik Trak panels over a plywood subfloor perpendicular to the floor joists. Make sure to stagger the seams of the Quik Trak.

After laying the panels, vacuum the debris from the panel grooves. Next, apply a thin (⅛") bead of Uponor Quik Trak Sealant throughout the entire length of the groove. The sealant is 100% silicone. It acts as an adhesive agent and promotes good heat transfer from the piping to the panel.

Install the piping by walking or stepping the piping into the panel grooves. If you're not wearing hard-sole shoes, you may need to use a rubber hammer to snap the piping into the groove.

Secure the panels to the subfloor with 1" screws or 1" staples. To start, secure the middle of the panel with a screw or staple. Work from the middle to the ends, alternating from side to side.

Where – This application is used in residential construction over existing concrete slabs. The plywood base together with the Quik Trak panel only adds 1⅛" to 1¼" in floor height. It is the ideal solution when retrofitting or remodeling a basement.

What to look for – A high water table will adversely affect the performance of this application. If there is moisture present that cannot be eliminated from the area, do not use this application.

Note: In a basement or walkout application, it is very important to install perimeter and edge insulation for proper design performance.

In all Quik Trak applications, the maximum loop length for 5/16" Wirsbo hePEX piping is 250 feet, including leader lengths. Flow rates for all Quik Trak installations are calculated to a 20°F (10°C) temperature differential.

Method B-7
Quik Trak Radiant Wall Installation

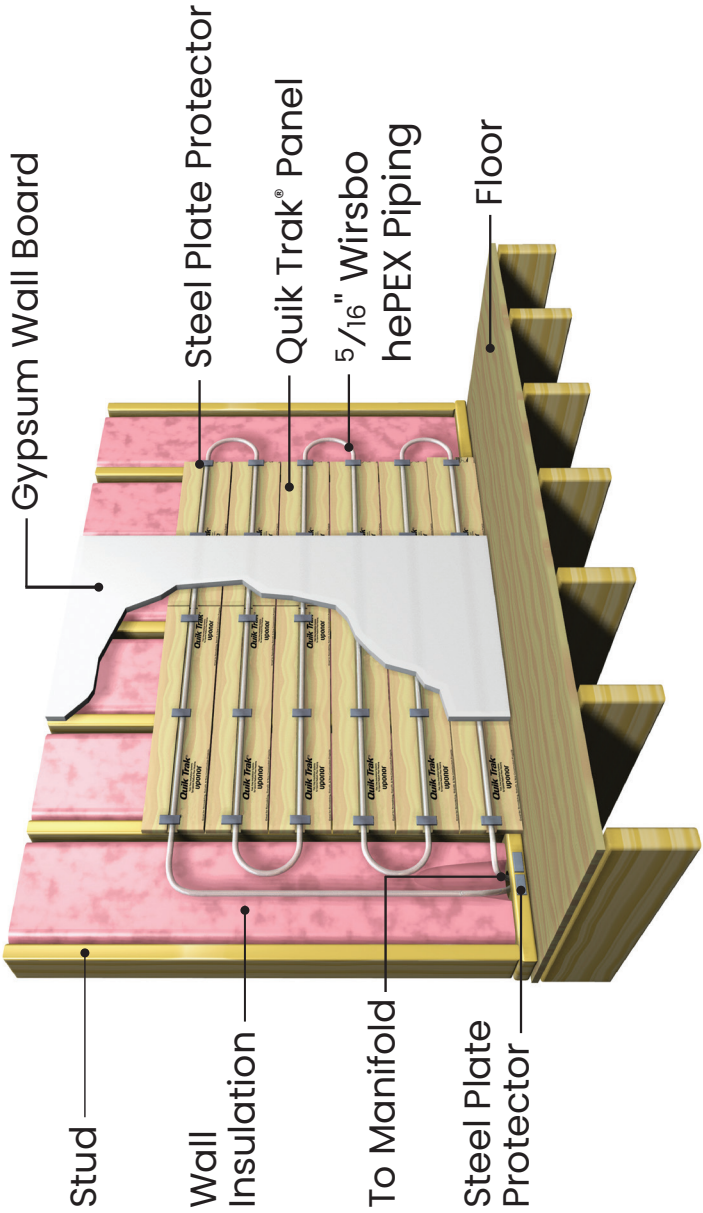


Figure 7-24: Quik Trak radiant wall installation

How – Starting at the floor level on the outside wall, install Quik Trak panels parallel to the floor at a maximum of six rows high (42") to avoid interference with window and picture placement. Screw panels to the studs on both sides of the groove with 1" drywall screws. After the panels are installed, attach ½" furring strips to the remainder of the stud wall, to provide an even base for the sheetrock.

To install the piping, drill two ⅝" holes in the footer plate opposite the Quik Trak Return Panel. Feed the supply through the ⅝" hole and attach to the supply manifold. Vacuum the grooves. Apply a thin (⅛") bead of Quik Trak Sealant in to the grooves. Firmly press piping into the groove. Feed return to the second ⅝" hole and attach to the return manifold. Lastly, attach protector plates (strike plates) where the piping crosses the studs to protect the piping from puncture.

Where – Radiant wall installations are a low-cost alternative to radiant floor heating and are often installed when radiant floor is not viable. This method is routinely used in retrofit applications. In addition, radiant wall installations are most often used in supplemental heat situations when the radiant floor cannot satisfy the heat loss of a room under design conditions.

What to look for – Do not install piping in an area where pictures may be hung.

Ensure the supply loop feeds from the top of the panel and works its way to the bottom. This will help eliminate the possibility of air lock in the loop.

Install a minimum of R-19 insulation in the exterior wall behind the Quik Trak panels.

In all Quik Trak applications, the maximum loop length for ⅝" Wirsbo hePEX piping is 250 feet, including leader lengths. Flow rates for all Quik Trak installations are calculated to a 20°F (10°C) temperature differential.

Method B-8
Radiant Ceiling Using Joist Trak Panels

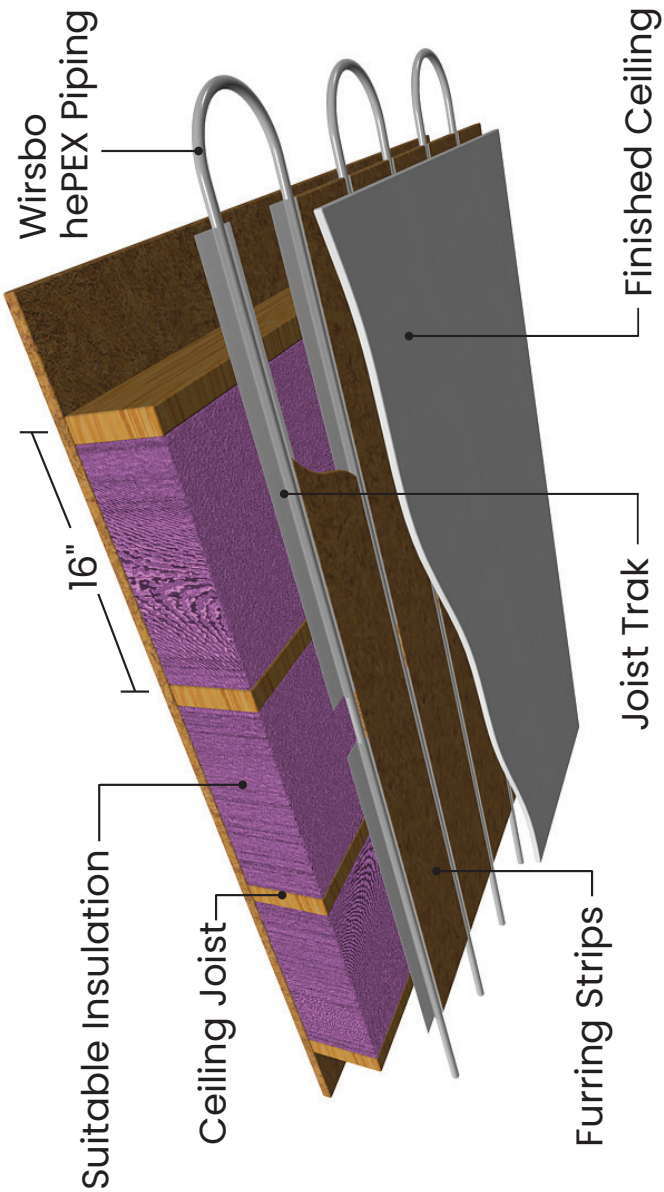


Figure 7-25: Radiant ceiling using Joist Trak panel

How – Starting at the outside wall (area of highest heat loss), secure a row of 1x6 furring strips to the bottom of the ceiling joists, perpendicular to the joists. Next, using an aluminum plate as a guide, install more rows of furring strips parallel to the first row. Staple the plates to the furring strips on one side only, allowing the plates to expand during operation. Leave about a 1" gap between each plate in a row. Be sure to leave space where the wall and ceiling meet to allow for 180-degree turns in the piping. Next, following the layout pattern, snap the piping into the Joist Trak groove to complete the room.

Connect the piping to a manifold, and pressure test to a minimum of 60 psi at least overnight.

Where – Radiant ceiling is a low-cost alternative to radiant floor, and it is often installed when radiant floor is not practical or viable (e.g., common retrofit applications). Radiant ceiling is often used in bedrooms where its relative low cost and quick response time are valued. In addition, radiant ceiling is a common method of providing auxiliary or extra heat in rare situations when a radiant floor cannot satisfy the heat loss of a room under design conditions.

What to look for – While radiant ceiling can be a powerful and versatile option, it is not as comfortable as a radiant floor.

Do not exceed 120°F water temperatures with radiant ceiling. Otherwise, flash from the ceiling, streaking and hot-head/cold-feet syndrome may develop. Because of its powerful output, it is not always necessary to install radiant ceiling over the entire ceiling area.

The amount of radiant panel area installed should equal the heat load of the room. Concentrate this panel area on the outside wall where the heat loss is the greatest.

Be sure there is adequate insulation installed above the piping and plates. Insulation required by code is generally adequate, but additional insulation is required in ceilings that aren't usually insulated.

Avoid puncturing the piping while installing the sheetrock. Mark safe areas for nailing or screwing on the walls and adjacent sheetrock panels prior to installing the sheetrock.

Do not use the system to accelerate the drying time of joint compound or sprayed ceilings.

Avoiding Noise in Aluminum Heat Emission Plate Installations

When using Joist Trak ⅜" Heat Transfer Panel (A5080375) or Joist Trak ½" Heat Transfer Panel (A5080500) in radiant floor/ceiling heating systems, conditions can exist that cause a ticking sound during operation. The sound is a result of the thermal expansion of PEX piping and the stresses placed on the aluminum plates from thermal expansion.

Uponor PEX piping products expand at a rate of 1.1" per 100' of piping per 10°F (5°C) temperature rise. Aluminum plate radiant floor systems often operate around 160°F (71.1°C); the total temperature rise from the time of installation is around 100°F (50°C). Expansion occurs because of the significant temperature rise. If the expansion is not accommodated, some noise in the system is possible. This noise is caused when the piping expands at the 90° bends and expansion continues until the piping meets the far side of the hole drilled in the joist. Once the piping has hit the far end of the hole, the added stress transmits back into the plate.

There are several easy ways to reduce or eliminate noise.

1. Drill the holes through the joists large enough so the piping does not hit the back side of the hole when it expands. Check local building codes for information on drilling through floor joists.
2. Use open truss span joists so that drilling holes in the joists is unnecessary.

Note: Uponor does not recommend installing radiant floor/ceiling heat in composite joists that have an unconditioned space on one side. Under certain conditions this may cause excessive movement of the floor/ceiling.

3. Install shorter runs so more loops are available to accommodate expansion.
4. The higher the water temperature the more the piping expands, so always use the lowest water temperature required to provide adequate heat.
5. Install expansion loops for longer runs.

Single-Plate Expansion Loop

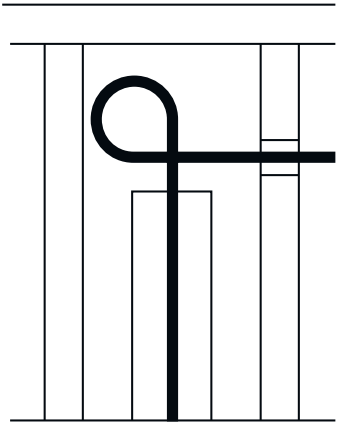


Figure 7-26: Single-plate expansion loop

Double-Plate Expansion Loop

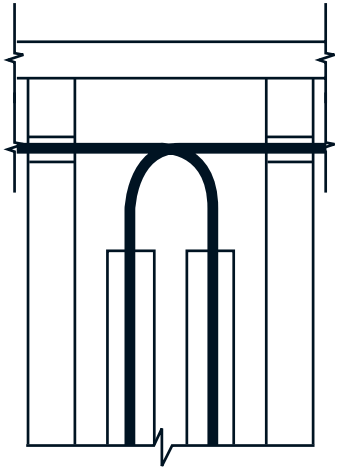


Figure 7-27: Double-plate expansion loop

Notes

Chapter 8: System Startup

Pressure Testing the System

Before the piping is covered, the system must be pressure tested. Air or water may be used as a test medium. Each manifold may be tested separately or, depending upon the construction schedule, the entire system may be tested at one time. The following is a recommended procedure for pressure testing.

1. Be sure all connections are properly sealed using the supplied gaskets.
2. On end cap with vent, remove air vent and drain cock and replace with proper sized plugs.
3. Install the Uponor Pressure Test Kit (E6122000) or suitable pressure test kit onto the system.
4. Pressurize the system with water or air to 60 psi. The system should maintain the 60 psi for a minimum of 24 hours.
5. Depending on the circumstances of the installation, the PEX piping may expand under pressure and require a one time addition of water or air to offset the piping expansion.

Maintain pressure on the system during the slab pour or when finished flooring is being installed. This simplifies leak detection if the piping is damaged during the pour or installation.

Note: The manifold internal valving is made up of flow valves that are not designed to hold high pressure. Pressure testing against these valves may result in some leakage and may compromise the test. Use appropriate end caps or plugs to further seal the system, as necessary.

The testing procedure detailed above is a recommendation from Uponor. Check local building codes for compliance or additional test requirements.

Filling the System with Water

Once the entire system has been properly pressure tested, use the following procedure to fill it with water:

1. Connect the system (at a fill point) to a water source.
2. Open all valves in the system. Be sure that all manual valves on the return manifolds are fully open by turning them counter-clockwise.
3. Open the in-line fill valve to begin filling the system with water. As the system fills and pressure builds, open the vent at the highest point available.

Purging Air From the System

In order for the system to operate properly, all the air must be purged from the system. There are several methods to purge air from the system. One manifold at a time simplifies the process.

1. Close all the isolation valves for each supply and return manifold.
2. One manifold at a time, attach one end of a service hose (female garden hose connector) directly to the boiler drain on the end cap and place the other end into a pail of water. Make sure the boiler drain is completely open and the hose is completely submerged in the bucket.
3. Close each manifold balancing valve (turn clockwise).
4. Start the circulator that services that manifold.

Note: Domestic water pressure or other means may be necessary to purge trapped air from the system.

5. Open the isolation valve to the supply manifold.
6. Open one manifold balancing valve. Allow water to circulate until no air is discharged into the bucket. Close all balancing valves.
7. Repeat this procedure for each balancing valve (each loop).
8. When all the loops on the manifold are completely purged, close the isolation valve to the supply manifold.
9. Repeat the process for each manifold.

Initial Balancing of Manifold Loops

When it is not possible to design your system using equal loop lengths (loop lengths within three percent of each other), then the system must be balanced in order to ensure adequate flow to each loop on a manifold. Uponor recommends using the visual flow indicators included with the manifold to properly balance the individual loops. Refer to design documents for the required flow for individual loops. If this information is not available, it may be necessary to add zoning (thermostat and actuators) to help control the flow.

Balancing the Manifold

Balancing the manifold helps to ensure proper system performance.

1. Ensure the system is operating and water is flowing through the manifold.
2. Remove the flow meter locking cover.
3. Turn the balancing valve to obtain the desired flow.

Note: Visually check the flow meter window to ensure proper flow.

4. Replace the flow meter cover to set the valve position and push it down into the locked position.

Notes

Chapter 9: Electrical Controls

Uponor offers a variety of thermostats and radiant controls to effectively and efficiently operate your radiant heating and/or cooling system.

While the focus of this installation manual will be on our traditional wired heat-only radiant controls, it's important to note that Uponor offers a more advanced radiant control system to suit all of your heating and cooling needs.

Smatrix Pulse is a wireless zoning control system that offers precise wireless control for radiant floor heating as well as their forced-air heating and cooling systems all with one solution that connects to a smart home assistant and can also be controlled remotely via an app.

The Smatrix Pulse system provides a wide variety of functionality and options to enhance the comfort and operation for residential radiant heating and cooling systems. To learn more, visit uponor.com/smatrixpulsecontrol.

Mounting the Thermostats

Each zone is controlled by a thermostat. The thermostat should be located:

1. In an area that experiences an average ambient temperature of the zone. Never locate a thermostat on an exterior wall or in close proximity to an exterior door or window. Avoid locations that are exposed to direct sunlight, abnormal drafts, or other factors that could result in erroneous temperature readings.
2. The thermostat should be mounted 60" above the finished floor.

The Uponor Zone Control Module

The Uponor Zone Control Module (A3031003 or A3031004) is a printed circuit control and diagnostic device that is designed to be used with Uponor thermostats and four-wire actuators or zone valves. The module provides connection to the power supply transformer, the interconnections between the individual thermostats and their respective actuators or zone valves, and the buss connection between all end switches. The control module is available in both three and four zone configurations and may be wired together with other modules to provide connections for up to 10 zones at any one location. The modules are internally fused for protection from overcurrent or direct shorts at the actuators and thermostats.

The end switch circuit is not protected from overcurrent or direct shorts and should have a 2 amp (maximum) fuse installed.

Diagnostic Features

Uponor Zone Control Modules feature light emitting diodes (LEDs) to indicate various functions of control. A green LED indicates that power is supplied to the module. Yellow LEDs indicate which zone(s) are calling for heat. Red LEDs indicate which end switches are closed and signaling the boiler or circulator pump to engage.

Compatible Components

Uponor Zone Control Modules are designed to be used with Heat-only Thermostat with Touchscreen (A3100101), SetPoint 521, Programmable Thermostat with floor sensor (A3040521), Thermal Actuator, four-wire (A3023522), ¾" and 1" Thermal Zone Valve (A3011075), Two-wire Thermal Actuator for EP Heating Manifolds (A3030522), Two-wire Thermal Actuator for TruFLOW™ Classic and Jr. Valved Manifolds (A3030523), Two-wire Thermal Actuator for Stainless-Steel Manifolds (A3030524), Single-zone Pump Relay (A3010100), and Three-zone Multi-pump Relay (A3080301).

Mounting Instructions

For best results, mount the control module in a convenient location above the actuators using either the double-sided tape (provided) or the mounting holes and suitable hardware. Ensure that the module will not be exposed to moisture or physical damage.

Connecting Modules Together

Use the provided module jumper to connect the modules together. This jumper must be fastened securely within the input and output blocks of the corresponding modules (see **Figure 9-1**).

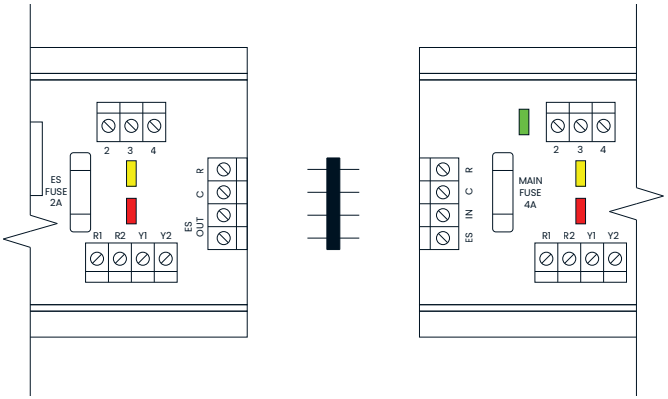


Figure 9-1: Input and output blocks

Wiring Instructions

Strip wire of insulation to a length of not more than ¼". Ensure that the wire is fully seated in the terminal and that it does not short to adjacent wires. Twist loose stranded wire tightly and ensure that no loose strands are present. Tighten the terminal nut securely. Each terminal is equipped with a jamb plate for accommodating stranded wire. If the terminal must be reconnected, it may be necessary to push the jamb plate back into place with a suitable round punch prior to reinserting the wires.

Combining Multiple Actuators or Zone Valves

Connect multiple actuators or zone valves together in the same block for control by one thermostat. If the wiring becomes too bulky, junction the wires prior to connecting them to the block.

Fuse Replacement

Replace the fuse as necessary with one of the following:

- 2 amp fuse for 50VA transformer
- 3 amp fuse for 75VA transformer
- 4 amp fuse for 100VA transformer (maximum)

Wiring Schematics

The following schematics provide detailed wiring instructions for common control strategies. Refer to the Complete Design Assistance Manual (CDAM) for complete wiring schematics details.

Schematic 1
Heat Only and Pump Relay

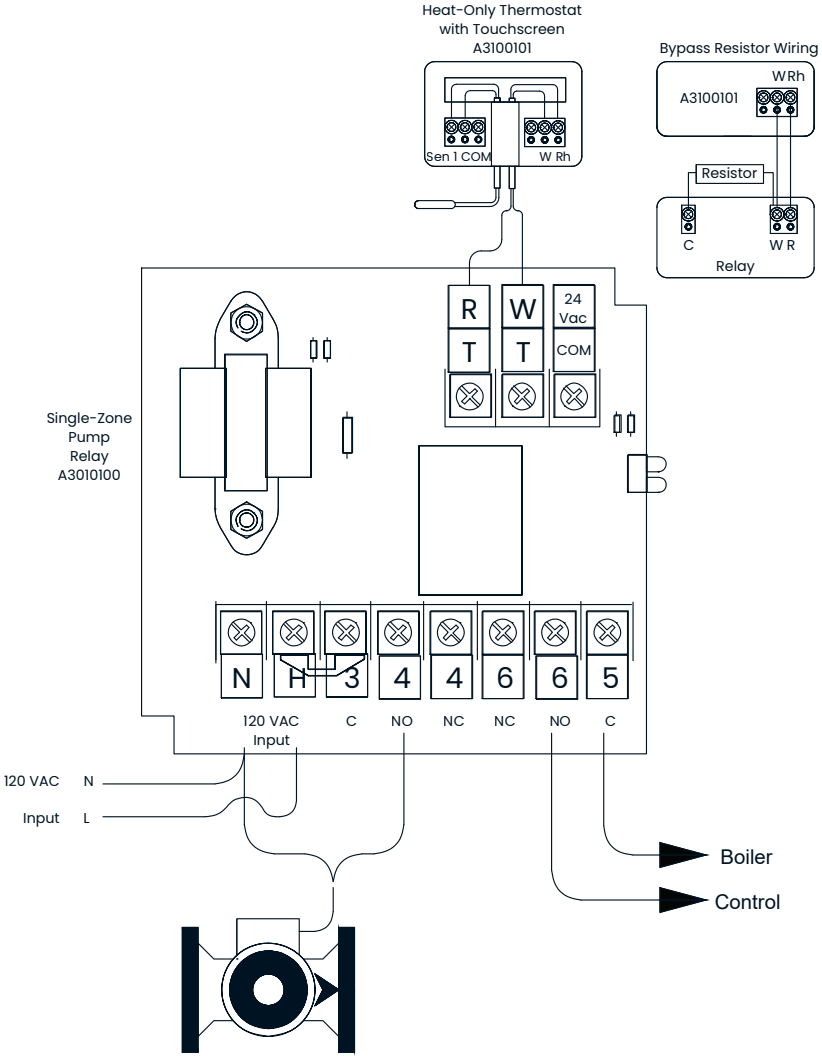


Figure 9-2: Heat only and pump relay

Schematic 2
Heat Only with Actuator and Pump Relay

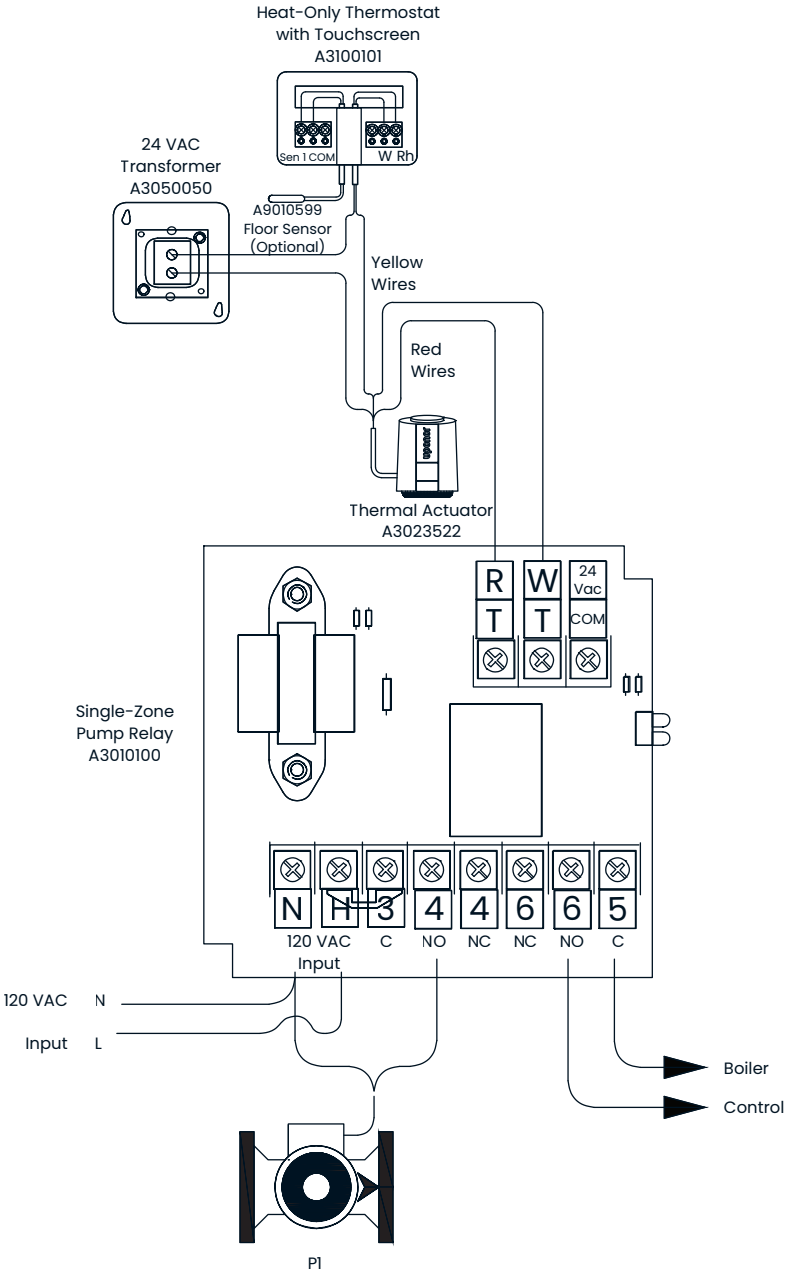


Figure 9-3: Heat only with actuator and pump relay

Schematic 3
SetPoint 521 and Pump Relay

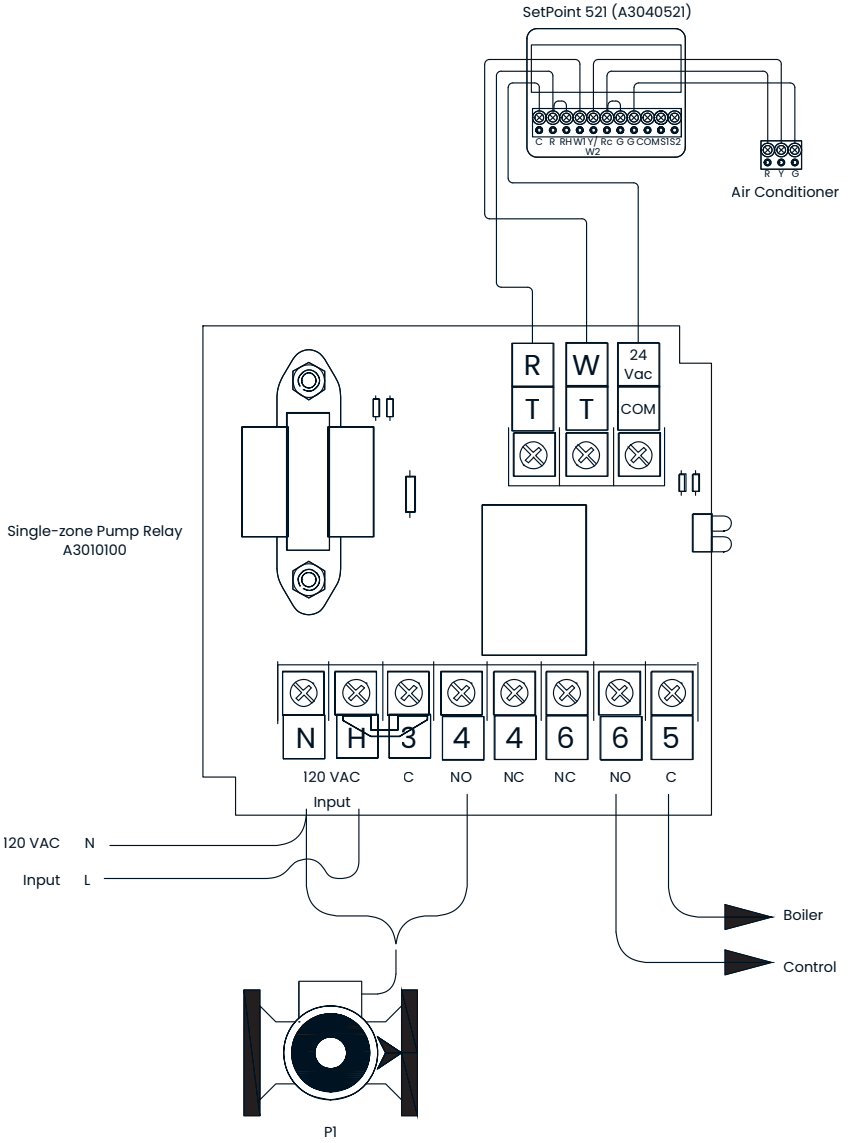


Figure 9-4: SetPoint 521 and pump relay

Schematic 4
Zone Control Module and Pump Relay

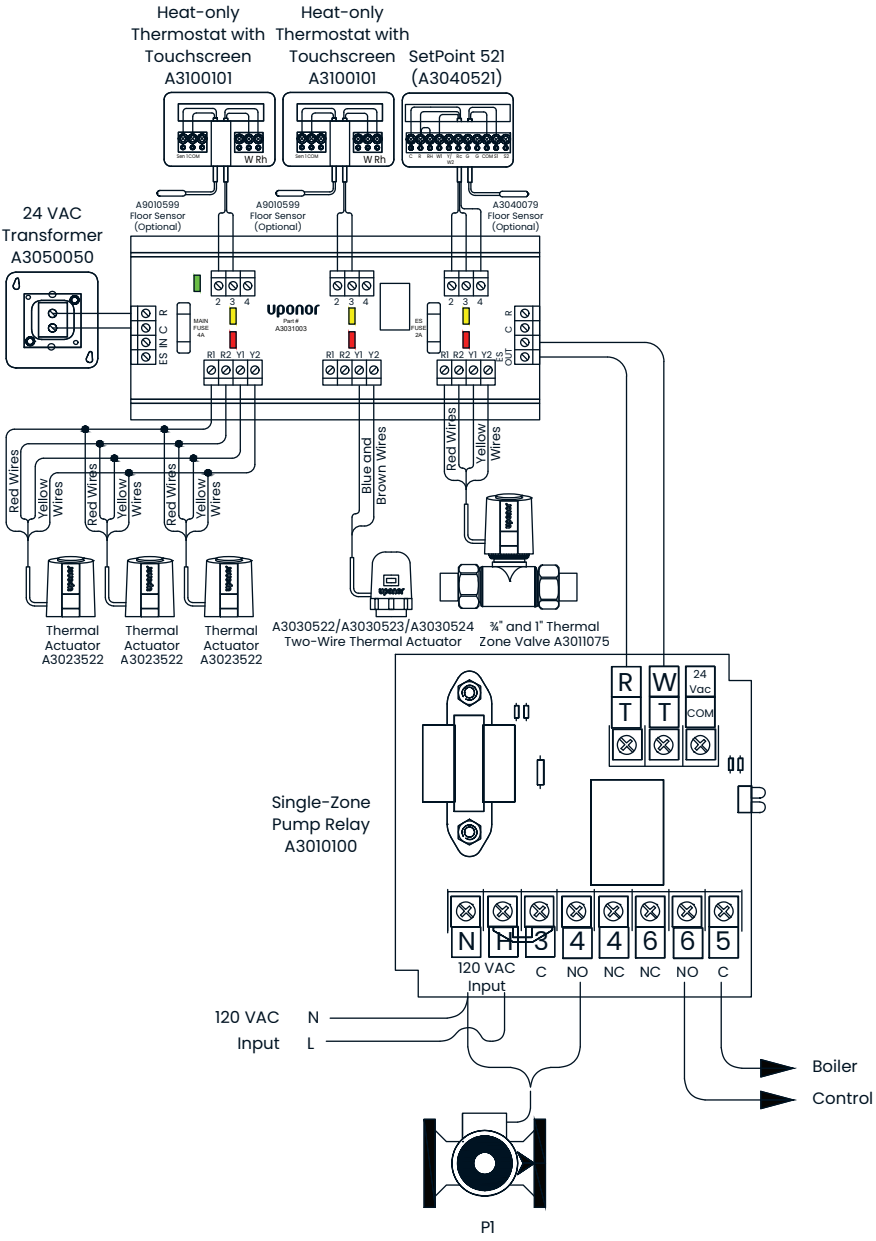


Figure 9-5: Zone Control Module and pump relay

Typical Data for Different Project Types (not for System Design)

Project Types	Commercial	Snow and Ice Melt	Permafrost	Industrial	Residential Heating	Residential Cooling
Pipe Size	½", ⁵/₈", ¾"	⁵/₈", ¾", 1"	⁵/₈", ¾", 1"	⁵/₈", ¾", 1"	⁵/₁₆", ½"	⁵/₈", ¾"
Loop Length, Ft.	300–500	200–500	500	300–500	200–330	200–400
Temperature Drop, °F	15–20	25–30	10–15	20	10–20	5–8
Heat Output Btu/h*Sq. Ft.	10–30	100–200	5–10	10–30	10–30	N/A
Cooling Output	N/A	N/A	N/A	N/A	N/A	6–14
Control	BMS, BAS, DDC provided by others	Automatic, Semi-Automatic, Manual	BMS, BAS, DDC provided by others	BMS, BAS, DDC provided by others	Uponor	BMS, BAS, DDC provided by others
On-Center Distance, In.	9–12	6–9	18–36	12–24	6–12	6–9
Room Temp., °F	65–72	N/A	N/A	50–65	68–72	75–78
Supply Water Temp., °F	85–130	90–150	50–60	85–130	80–165	55–65
Surface Temp., °F	70–85	36–42	N/A	65–85	72–84	68–70
Flow/Loop, gpm	0.5–1.5	1.0–2.5	0.5–1.5	0.5–1.5	0.3–1.2	0.5–1.5
Feet of Head/ Pressure	10–30	10–40	10–30	10–40	5–20	10–30

Table 9-1: Typical data for different kinds of projects

Supply and Return Piping

Use Uponor PEX to supply hot water to fin-type baseboards, hydronic unit heaters, cast-iron and panel-style radiators, and fan-coil units. Flexible PEX is faster and easier to install and more cost effective compared to copper.

Working with Wirsbo hePEX

Refer to **Chapter 3: Working with PEX** for guidelines when installing Wirsbo hePEX.

Joints and Connections

Uponor PEX installed in these applications can use both ProPEX or QS-style connections based individual preference. Refer to **Chapter 4** for instructions on how to properly install Uponor QS-style compression fittings and Uponor ProPEX expansion fittings.

Sizing for Baseboard Systems

Maximum Length of Wirsbo hePEX Using Typical Small Residential Circulation (1/25 HP Circulator)			
180°F (82°C) Supply Water 20°F (10°C) Differential Temperature		Maximum Length of Wirsbo hePEX Piping (Ft.)	
Btu/h	Feet of Baseboard Installed	Use No More Than Feet ½"	Use No More Than Feet ⅝"
10,000	17	391	659
20,000	33	101	271
30,000	50	39	106
40,000	67	16	42
50,000	83	N/A	12

Table 9-2: Sizing for baseboard systems

Maximum Length of Wirsbo hePEX Using Typical Small Residential Circulation (1/12 HP Circulator)			
180°F (82°C) Supply Water 20°F (10°C) Differential Temperature		Maximum Length of Wirsbo hePEX Piping (Ft.)	
Btu/h	With Feet of Baseboard Installed	Use No More Than Feet ½"	Use No More Than Feet ⅝"
10,000	17	714	1,203
20,000	33	199	534
30,000	50	90	242
40,000	67	47	127
50,000	83	25	67
60,000	100	12	35

Table 9-3: Sizing for baseboard systems

Note: Assumptions are: 600 Btu/h per linear foot at 180°F (82°C) with 10% friction loss for additional components included in chart calculations.

Connecting Uponor PEX to Baseboard Systems

Use Uponor ProPEX baseboard elbows for connecting ½", ⅝", and ¾" Uponor PEX to baseboard.

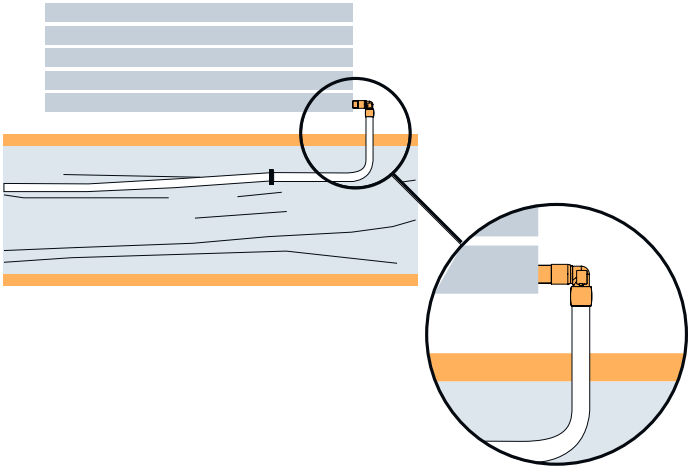


Figure 9-6: Connecting Uponor PEX with ProPEX baseboard elbows

Connecting Uponor PEX to Copper

Uponor ProPEX brass transition fittings offer a trusted, reliable, and code-listed solution for transitioning to hydronic piping systems. These transition fittings provide an efficient solution for converting ProPEX connections to male thread, female thread, copper tubing sweat, copper fitting sweat, and copper fitting press.

Figure 9-7: Uponor ProPEX brass transition fittings

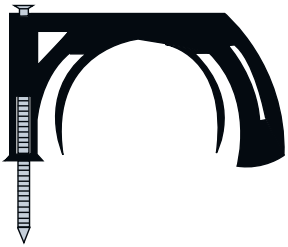
Use Uponor ProPEX copper press adapters to connect Wirsbo hePEX to copper pipe.

Use Uponor ProPEX copper press fitting adapters to connect Wirsbo hePEX to copper fittings.

Figure 9-8: Uponor ProPEX Copper Press Adapter and Uponor ProPEX Copper Press Fitting Adapter

Piping Supports

1. Uponor recommends the use of plastic pipe supports. However, it is acceptable to use metal supports designed for use with plastic piping.



2. Do not use supports that will damage the pipe. Inspect metal supports for sharp edges.
3. The linear expansion rate for Wirsbo hePEX is approximately 1.1" per 10˚F temperature change for each 100' of piping.

Figure 9-9: Pipe support

4. When installing runs of piping, allow 1/8" to 3/16" of slack per foot of run to accommodate thermal expansion. Piping should be allowed to dip slightly between supports. Do not pull piping tight during installation.
5. Do not rigidly anchor Wirsbo hePEX piping with pipe supports. Allow freedom of movement to expand and contract.
6. Allow adequate clearance between Wirsbo hePEX piping and the structure (bored holes or sleeves) to allow freedom of movement due to thermal expansion and contraction.

Piping Support Spacing

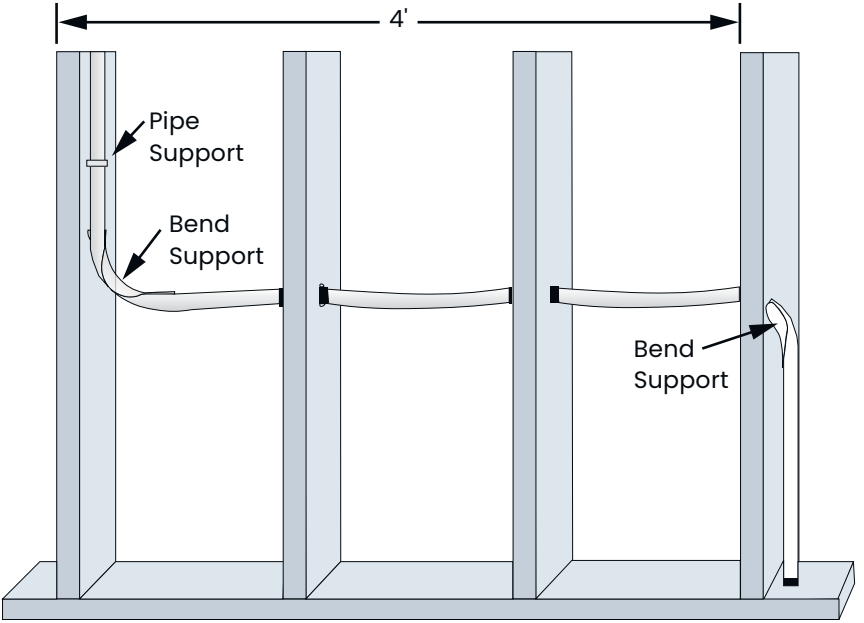


Figure 9-10: Allow ⅛" to 3/16" of slack per foot of Wirsbo hePEX pipe (4' x 3/16" = ¾" of slack)

Anchor Wirsbo hePEX securely enough to support the piping, yet loose enough to allow the pipe some play back and forth as it expands and contracts.

1. Along horizontal runs, install supports every 32". If horizontal runs are continuously supported, pipe supports may be placed at 6' intervals.
2. Along vertical runs, install supports every 4' to 5' on each floor along with a mid-story guide.

Do not install Wirsbo hePEX within 6" of any gas appliance vents or within 12" of any recessed light fixture.

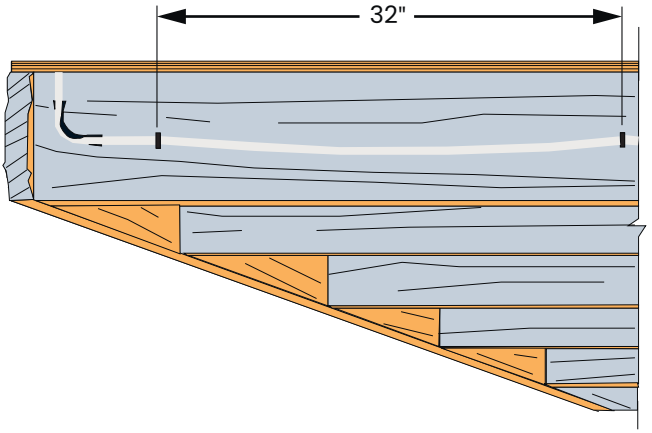


Figure 9-11: Horizontal pipe support spacing

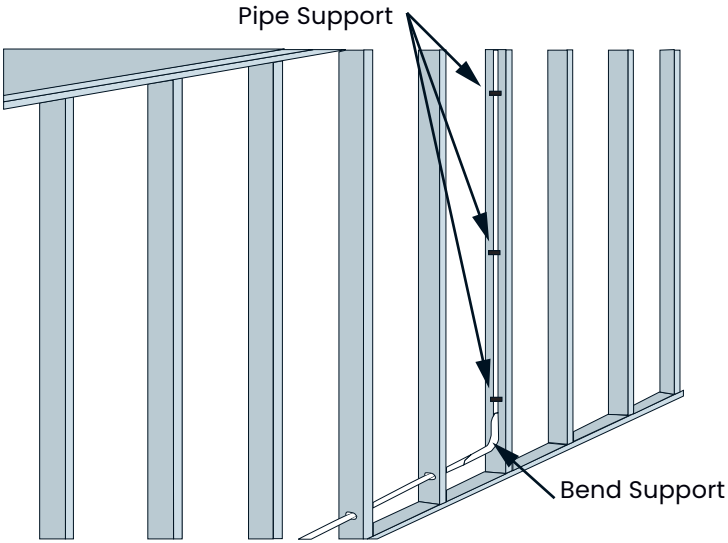


Figure 9-12: Vertical pipe support spacing

For more detailed information about radiant floor heating systems including installation methods, wiring diagrams, control strategies, and product information, consult the Uponor Complete Design Assistance Manual (CDAM).

Moving
> Water

uponor

Uponor Inc.
5925 148th Street West
Apple Valley, MN 55124
USA

T 800.321.4739
F 952.891.2008

Uponor Ltd.
6510 Kennedy Road
Mississauga, ON L5T 2X4
CANADA

T 888.994.7726
F 800.638.9517

uponor.com