



Commercial piping systems engineer reference guide

Uponor PEX pipe and ProPEX® fittings offer value, durability and performance to your commercial plumbing and hydronic piping projects. With more than 40 years of service in installations around the world, Uponor products and systems, which are proudly made in the U.S.A., are the proven solution that professionals require to meet the demands of the commercial building industry.

This reference guide is designed for architects, building officials, engineers and mechanical contractors interested in Uponor Commercial Piping Systems. It describes general installation recommendations that use Uponor PEX pipe and ProPEX fitting products. Uponor is not liable for installation practices that deviate from this guide or are not acceptable practices within the mechanical trades, codes or standards of practice. Always refer to local codes for additional requirements.

For further assistance, refer to the Uponor Plumbing Design Assistance Manual (PDAM), Uponor Hydronic Piping Design Assistance Manual (HPDAM) or contact Uponor Technical Services at 888.594.7726 or technical.services@uponor.com.

Uponor PEX—The most tested, trusted and third-party listed PEX in the industry

Hydrostatic temperature and pressure ratings

Uponor maintains standard-grade ratings for Uponor PEX pipe as tested in accordance with PPI TR-3. Uponor PEX products have the following temperature and pressure ratings:

- 200°F at 80 psi
- 180°F at 100 psi
- 73.4°F at 160 psi

Excessive short-term temperature/pressure capacity:

- 210°F at 150 psi tested up to 720 hours
- In accordance with Section 6.6 of ASTM F876, the minimum hydrostatic burst pressure for ½" pipe is 480 psi at 73.4°F. For ¾" pipe and larger, the minimum burst pressure is 475 psi at 73.4°F.

Uponor's quality lab performs daily burst pressure testing on all pipe sizes above and beyond the ASTM F876 standard. All samples are tested at 73.4°F and burst at an elevated pressure of 800 psi (+/- 20 psi) which is nearly twice the pressure requirement of ASTM F876.



Uponor PEX vs. copper, CPVC, black iron pipe (BIP) and polypropylene random (PP-R)

| Pipe comparisons | PEX | Copper | CPVC | BIP | PP-R |
|--|-----|--------|------|-----|------|
| Flexible, fewer required connections, reduces potential leak liability | Yes | No | No | No | No |
| Expands up to 3X its diameter to help resist freeze damage | Yes | No | No | No | No |
| Manufactured fitting connection, cannot be dry fit | Yes | No | No | No | Yes |
| One simple tool for connections | Yes | No | No | No | No |
| Resists corrosion, pitting and scaling | Yes | No | Yes | No | Yes |
| Dampens rushing water noise, reduces water hammer | Yes | No | No | No | Yes |
| Retains more heat in hot water lines | Yes | No | Yes | No | Yes |
| Less susceptible to condensation on cold-water lines | Yes | No | Yes | No | Yes |
| Stable material costs; eliminates jobsite theft concerns | Yes | No | Yes | Yes | Yes |
| Pipe and fittings warranty | Yes | No | Yes | No | Yes |



Uponor PEX



Copper



CPVC



Black iron pipe (BIP)



Polypropylene random (PP-R)

Not all PEX is created equal



Uponor PEX

- Most tested and third-party listed of all PEX
- Highest degree of crosslinking (>80%)
- “Hot” crosslinking above the crystal melting temperature
- Most flexible of all PEX and allows kink reparability
- Shape memory ideal for cold-expansion ProPEX fittings
- Increased resistance to corrosion

PEX-b

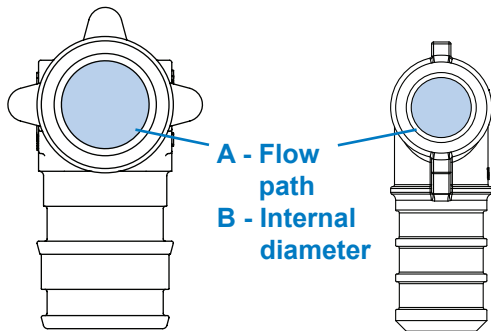
- Lowest degree of crosslinking (65-70%)
- Crosslinking performed in a secondary, post-extrusion process
- Stiffer product
- No kink reparability
- Not intended for cold-expansion fittings
- Standard insert fittings have less flow

PEX-c

- Lesser degree of crosslinking (70-75%)
- “Cold” crosslinking below the crystal melting temperature
- Less uniform, less consistent
- Stiffer product
- No kink reparability
- Not intended for cold-expansion fittings
- Standard insert fittings have less flow

ProPEX fittings vs. standard insert fittings

| | | Uponor ProPEX cold-expansion fitting | | Standard insert (crimp) fitting | |
|--------------------------------------|-----|---|--|---|--|
| | | ASTM F1960 brass | ASTM F1960 engineered polymer (EP) | ASTM F1807 brass | ASTM F2159 plastic |
| A Flow path | ½" | 0.112 sq. inches 2.8 gpm @ 8 ft./sec. 4.2 gpm @ 12 ft./sec. | 0.116 sq. inches 2.9 gpm @ 8 ft./sec. 4.4 gpm @ 12 ft./sec. | 0.096 sq. inches 2.4 gpm @ 8 ft./sec. 3.6 gpm @ 12 ft./sec. | 0.078 sq. inches 1.9 gpm @ 8 ft./sec. 2.9 gpm @ 12 ft./sec. |
| | ¾" | 0.278 sq. inches 6.9 gpm @ 8 ft./sec. 10.4 gpm @ 12 ft./sec. | 0.273 sq. inches 6.8 gpm @ 8 ft./sec. 10.2 gpm @ 12 ft./sec. | 0.221 sq. inches 5.5 gpm @ 8 ft./sec. 8.3 gpm @ 12 ft./sec. | 0.166 sq. inches 4.1 gpm @ 8 ft./sec. 6.2 gpm @ 12 ft./sec. |
| | 1" | 0.496 sq. inches 12.4 gpm @ 8 ft./sec. 18.6 gpm @ 12 ft./sec. | 0.488 sq. inches 12.2 gpm @ 8 ft./sec. 18.2 gpm @ 12 ft./sec. | 0.396 sq. inches 9.9 gpm @ 8 ft./sec. 14.8 gpm @ 12 ft./sec. | 0.292 sq. inches 7.3 gpm @ 8 ft./sec. 10.9 gpm @ 12 ft./sec. |
| | 1¼" | 0.724 sq. inches 21.8 gpm @ 8 ft./sec. 32.6 gpm @ 12 ft./sec. | 0.739 sq. inches 18.4 gpm @ 8 ft./sec. 27.6 gpm @ 12 ft./sec. | 0.595 sq. inches 14.8 gpm @ 8 ft./sec. 22.2 gpm @ 12 ft./sec. | Not available |
| | 1½" | 0.923 sq. inches 23.0 gpm @ 8 ft./sec. 34.5 gpm @ 12 ft./sec. | 0.923 sq. inches 23.0 gpm @ 8 ft./sec. 34.5 gpm @ 12 ft./sec. | 0.817 sq. inches 20.4 gpm @ 8 ft./sec. 30.6 gpm @ 12 ft./sec. | Not available |
| | 2" | 1.877 sq. inches 47.1 gpm @ 8 ft./sec. 70.6 gpm @ 12 ft./sec. | 1.730 sq. inches 43.1 gpm @ 8 ft./sec. 64.7 gpm @ 12 ft./sec. | 1.463 sq. inches 36.5 gpm @ 8 ft./sec. 54.7 gpm @ 12 ft./sec. | Not available |
| | 2½" | 3.110 sq. inches 77.6 gpm @ 8 ft./sec. 116.3 gpm @ 12 ft./sec. | 2.688 sq. inches 67.0 gpm @ 8 ft./sec. 100.6 gpm @ 12 ft./sec. | Not available | Not available |
| | 3" | 4.562 sq. inches 113.8 gpm @ 8 ft./sec. 170.6 gpm @ 12 ft./sec. | 3.871 sq. inches 96.5 gpm @ 8 ft./sec. 144.8 gpm @ 12 ft./sec. | Not available | Not available |
| B Minimum internal diameter | ½" | 0.378" | 0.385" | 0.350" | 0.315" |
| | ¾" | 0.595" | 0.590" | 0.530" | 0.460" |
| | 1" | 0.795" | 0.788" | 0.710" | 0.610" |
| | 1¼" | 0.960" | 0.970" | 0.870" | Not available |
| | 1½" | 1.084" | 1.084" | 1.020" | Not available |
| | 2" | 1.550" | 1.484" | 1.365" | Not available |
| | 2½" | 1.990" | 1.850" | Not available | Not available |
| | 3" | 2.410" | 2.220" | Not available | Not available |



**ProPEX ASTM F1960
and CAN/CSA B137.5
expansion fitting**

**ASTM F1807/F2159
insert fitting**

**29% LARGER I.D.
70% GREATER flow¹**

¹ When comparing 1" F1960 EP with F2159 plastic fittings.

Uponor PEX codes and standards

Codes: IMC, IPC, IRC, NSPC, UMC, UPC, NPCC, IBC

Listings: AWWA, HUD, IAPMO, ICC, Intertek, ITS, NSF, NSF-pw, NSF-rcw, NSF-rfh, PPI, QAI, UL

Standards: ASTM E84, ASTM E814, ASTM E119, ASTM F876, ASTM F877, ASTM F2023, ASTM F1960, ASTM F2657, ANSI/NSF 14 and 61

Fire-rated assemblies: Tested in accordance with ASTM E119/UL 263; G573, K913, L557, U372, V444

ASTM E84 (plenums)

Uponor PEX pipe products are approved for installation in return-air plenums as described below. All Uponor PEX pipe, Uponor ProPEX rings and Uponor ProPEX fittings (EP, brass and lead-free brass) were tested and approved.

½" to ¾" Uponor PEX (uninsulated)

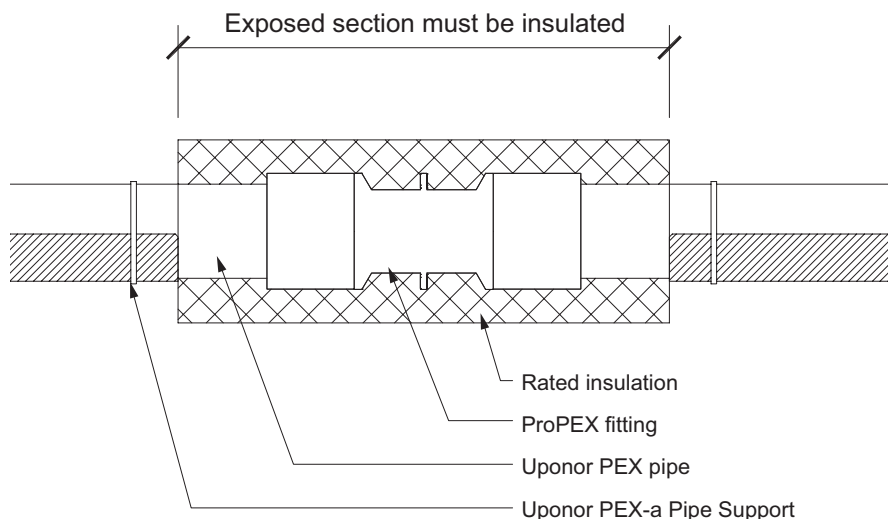
Adjacent runs of uninsulated ½" to ¾" Uponor PEX pipe in a return-air plenum must be separated by 18".

Up to and including 3" Uponor PEX-a supported with Uponor PEX-a Pipe Support

Uponor PEX-a piping manufactured with a maximum nominal outside diameter (OD) of 3" and supported with Uponor PEX-a Pipe Support. Pipe or fitting sections without PEX-a Pipe Support must be covered with a rated insulation. There is no minimum length of PEX-a Pipe Support segments. There are also no spacing limitations between adjacent runs of this pipe.

| Classified as to surface burning characteristics | | | |
|---|--------------|-----------------|---|
| ASTM E84 | Flame spread | Smoke developed | Limitations |
| Nominal ½" to ¾" size | 25 or less | 50 or less | Adjacent pipe runs shall be located at least 18" apart. |
| 3" maximum nominal size Uponor PEX-a supported with Uponor PEX-a Pipe Support | 25 or less | 50 or less | Pipe or fitting sections without PEX-a Pipe Support must be covered with a rated insulation. There is no minimum length of PEX-a Pipe Support segments. |
| 3" maximum nominal size Uponor PEX-a with ½" insulation | 25 or less | 50 or less | ½" minimum thickness insulation |

Uponor AquaPEX® ASTM E84 requirements



Up to 3" Uponor PEX (insulated)

Uponor PEX manufactured with a maximum OD of 3" nominal pipe size (NPS) and encased in an approved ½" fiberglass insulation shall have no limitation on spacing. This applies to piping runs with or without Uponor EP fittings. Refer to Chapter 3 of the Uponor Plumbing Design Assistance Manual (PDAM) for approved insulations.

Per UL fire-resistance classifications and follow-up service inspections, ongoing verification of product compliance is achieved through quarterly inspection audits at manufacturing location(s) during which a review of the product's process, suppliers and in-house quality control procedure is conducted. This audit ensures the product has not changed since the ASTM E84 testing was conducted and will still meet the requisite standards.

Expansion and contraction

Uponor PEX pipe expands and contracts at variable rates depending upon the installation method. For overhead installations, Uponor recommends the use of Uponor PEX-a Pipe Support, paired with fixed anchor points, to control expansion and contraction in piping systems.

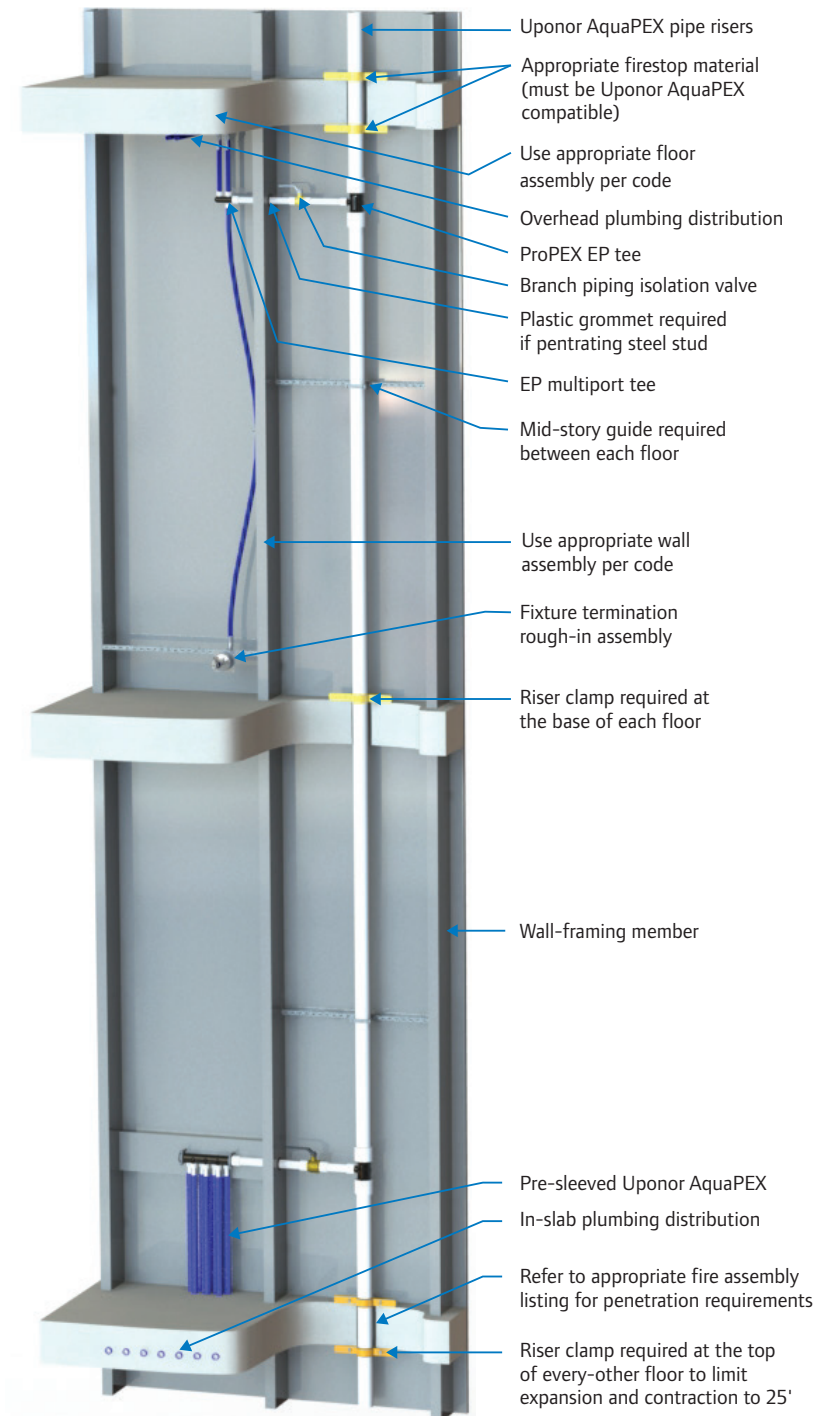
For vertical pipe, CTS riser clamps shall be used as the fixed anchor points.

For below-grade applications, Uponor recommends that PEX piping be installed in a snaking pattern to accommodate expansion and contraction forces.

Risers

Risers typically feature Uponor PEX pipe in sizes from 1¼" to 3" with CTS riser clamps at the base of each floor.

Plumbing riser detail

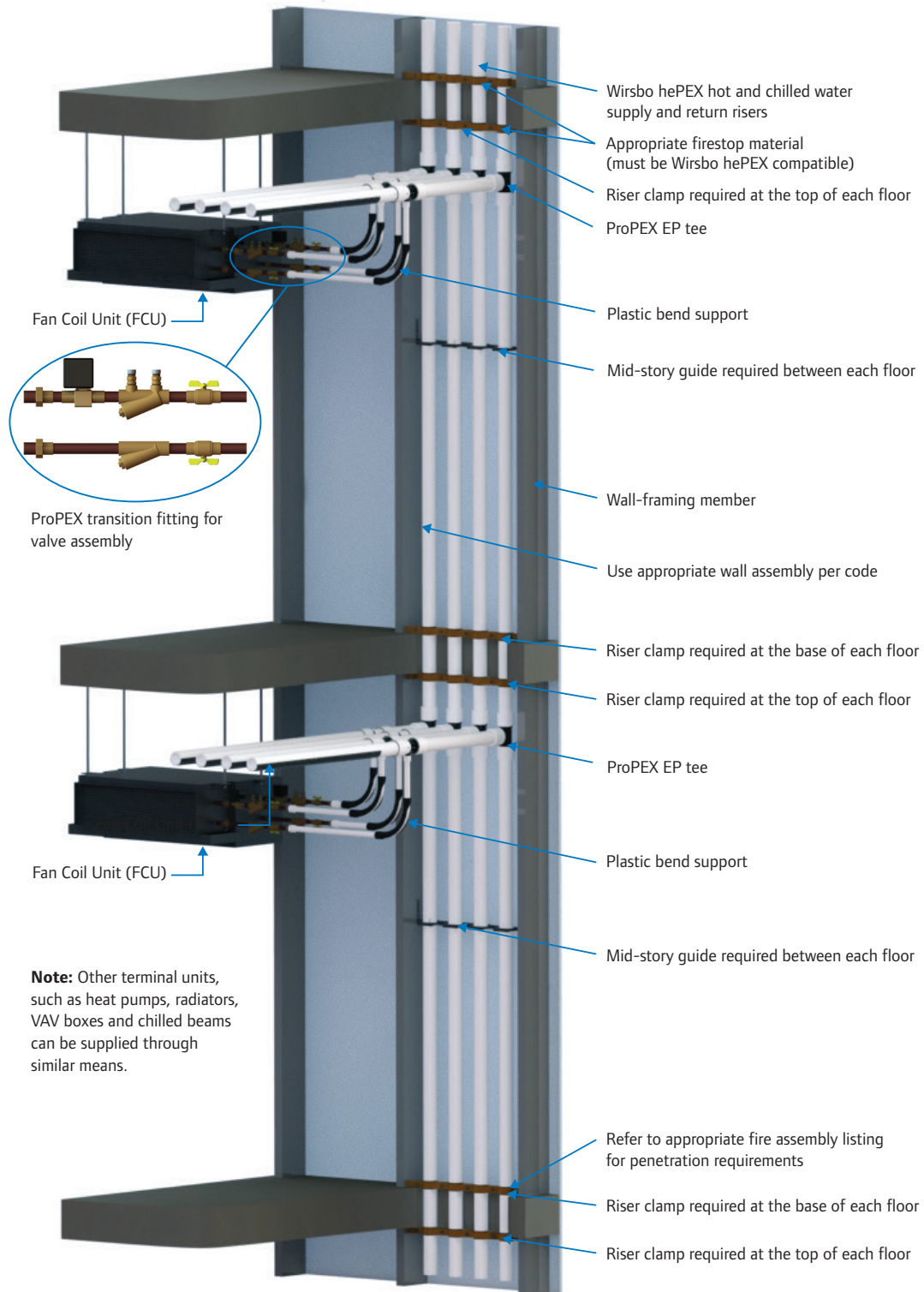


| Horizontal fixed anchor point requirements | |
|--|----------------------------|
| System type | Fixed anchor point spacing |
| Domestic hot water | 65 ft. (19.8m) |
| Domestic cold water | 150 ft. (45.7m) |
| Heating hot water | 65 ft. (19.8m) |
| Chilled water | 65 ft. (19.8m) |

| Riser support requirements | |
|----------------------------|--|
| System type | Riser support |
| Domestic hot water | Base of each floor; top of every other floor; provide a mid-story guide |
| Domestic cold water | Base of each floor; top of every fourth floor; provide a mid-story guide |
| Heating hot water | Base of each floor; top of every floor; provide a mid-story guide ¹ |
| Chilled water | Base of each floor; top of every floor; provide a mid-story guide ¹ |

¹Maximum spacing of mid-story guides is 5 ft. (1.5m). Floors greater than 10 ft. in height will require multiple mid-story guides.

Hydronic piping riser detail



Suspended piping installations

For suspended runs of piping, Uponor PEX can be supported by the same conventional means as metallic pipe using copper tube size (CTS) pipe hangers or supports.

Uponor recommends using hangers and supports designed for use with plastic pipe. Use PEX pipe support or pipe support channel that continuously supports the pipe to achieve nearly the same support spacing as copper pipe.

Suspended piping should be supported at intervals not to exceed 6' for 1/2" and 3/4" pipe; 8' for 1" to 3 1/2" pipe.

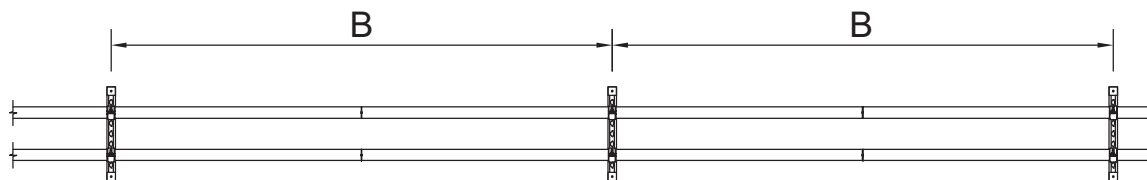
Maximum distance from clamp/hanger to end of PEX Pipe Support is 18".

For more information regarding support solutions, contact Uponor Technical Services at 888.594.7726 or technical.services@uponor.com.

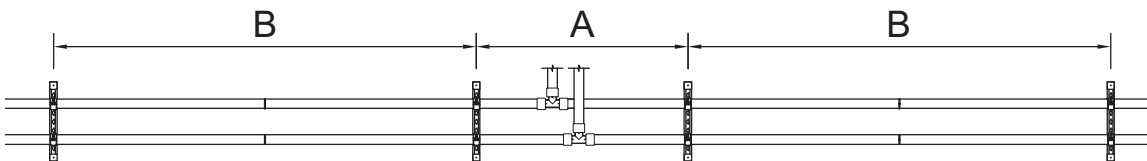


Maximum allowable support spacing for PEX pipe

| Nominal pipe size | Spacing for bare PEX (dimension A) | | | Spacing with PEX-a Pipe Support (dimension B) | | |
|-------------------|------------------------------------|-----------------------------|---|---|-----------------------------|---|
| | International Plumbing Code (IPC) | Uniform Plumbing Code (UPC) | National Plumbing Code of Canada (NPCC) | International Plumbing Code (IPC) | Uniform Plumbing Code (UPC) | National Plumbing Code of Canada (NPCC) |
| 1/2" | 32" | 32" | 32" | 6'-0" | 6'-0" | 6'-0" |
| 3/4" | 32" | 32" | 32" | 6'-0" | 6'-0" | 6'-0" |
| 1" | 32" | 32" | 32" | 8'-0" | 8'-0" | 8'-0" |
| 1 1/4" | 32" | 48" | 32" | 8'-0" | 8'-0" | 8'-0" |
| 1 1/2" | 32" | 48" | 32" | 8'-0" | 8'-0" | 8'-0" |
| 2" | 32" | 48" | 32" | 8'-0" | 8'-0" | 8'-0" |
| 2 1/2" | 32" | 48" | 32" | 8'-0" | 8'-0" | 8'-0" |
| 3" | 32" | 48" | 32" | 8'-0" | 8'-0" | 8'-0" |



PEX-a Pipe Support without fittings



PEX-a Pipe Support with fittings

Surge pressure and sound intensity

The main sources of sound in a water piping system are cavitation, surface roughness and water hammer caused by surge pressure. Cavitation is generally a design issue, so the question is which material will absorb more of the sound if it occurs? Typical polymers will absorb sound in the range of 10 dB/cm, whereas metals are on the order of 0.1 to 1.0 dB/cm. For a given change in velocity, the intensity of sound from a copper pipe will be at least 8 times higher than that of PEX pipe and peak pressures caused by a quick-acting valve could be reduced by 18% to 40% by utilizing PEX in lieu of copper pipe.

PEX offers
up to **40%** reduction
in surge pressure

Surge pressure generated in response to a quick-acting valve (PPI Report #3285)

| Pipe material | Maximum measured pressure, psi | | | | |
|------------------|--------------------------------|-----|-----|-----|-----|
| | 2 | 2.5 | 3 | 4 | 6 |
| Flow rate, gpm | | | | | |
| ½" Uponor PEX | 136 | 150 | 169 | 193 | 244 |
| ½" PEX-b | 143 | 168 | 177 | 212 | 274 |
| ½" CPVC | 155 | 173 | 201 | 222 | 296 |
| ½" Type L copper | 194 | 239 | 266 | 318 | 422 |

Pressure response measurements include 60 psi static pressure. Closing speed of quick-acting valve estimated at 25 milliseconds. Test performed at 54°F cold water temperature.

Commercial flush bank detail

Water hammer arrestor where required by code
(exact locations vary by manufacturer)

Bend support
(½" to ¾" typical)

Uponor AquaPEX pipe
supply (size varies)

Stud wall assembly

Uponor AquaPEX pipe
header (size varies)

Uponor ProPEX EP tee
Support

Vent
pipe

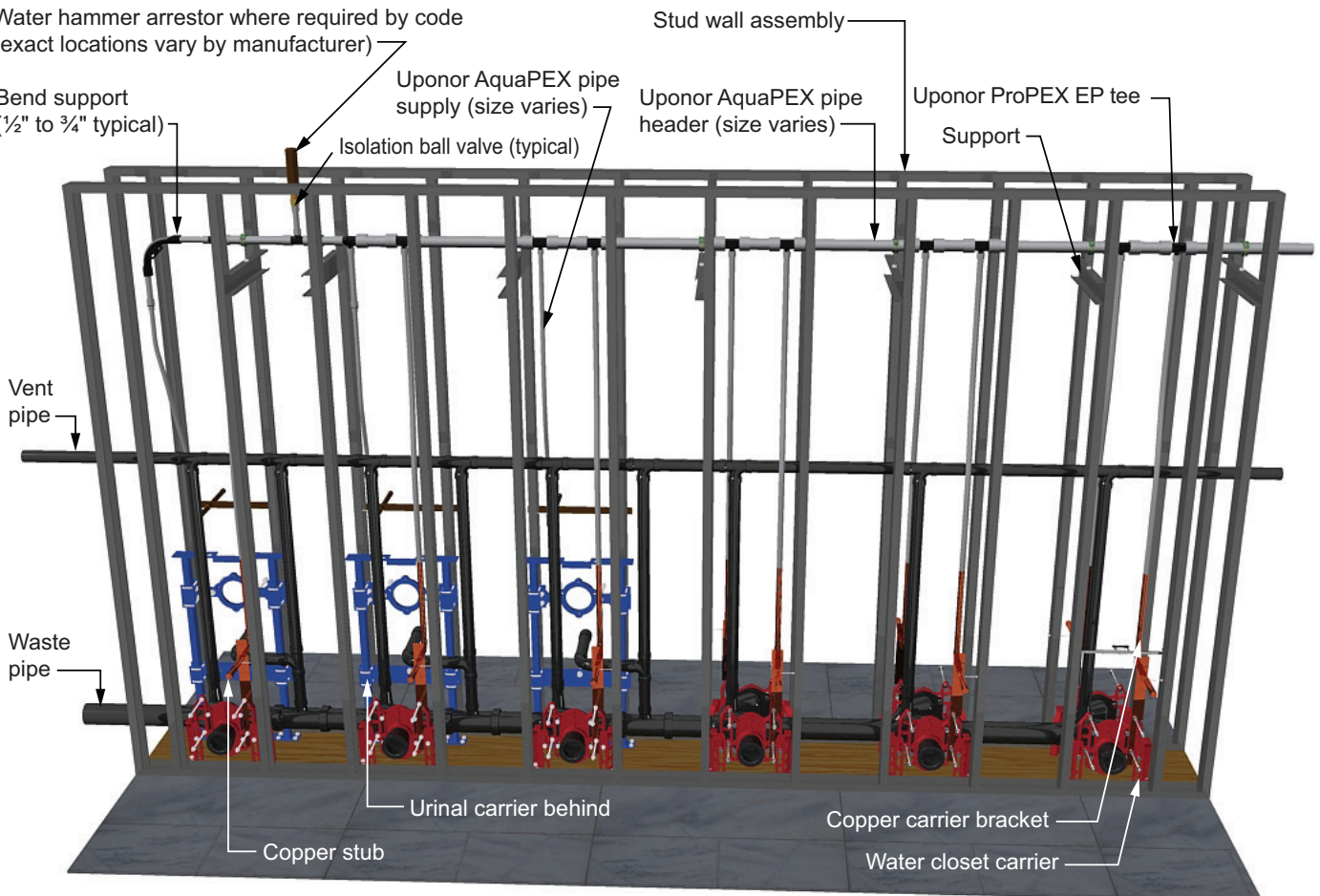
Waste
pipe

Urinal carrier behind

Copper carrier bracket

Copper stub

Water closet carrier

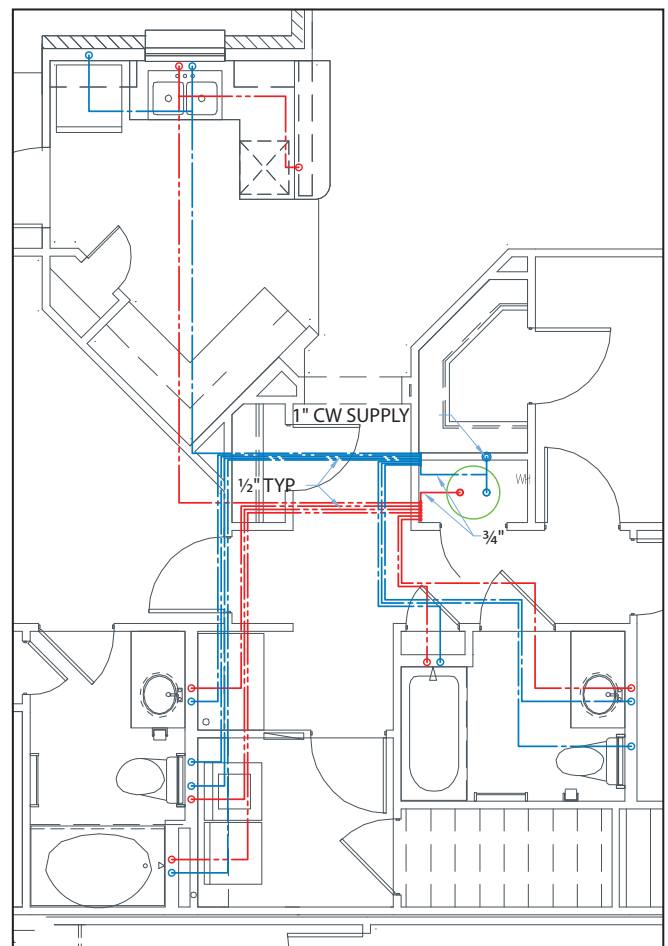
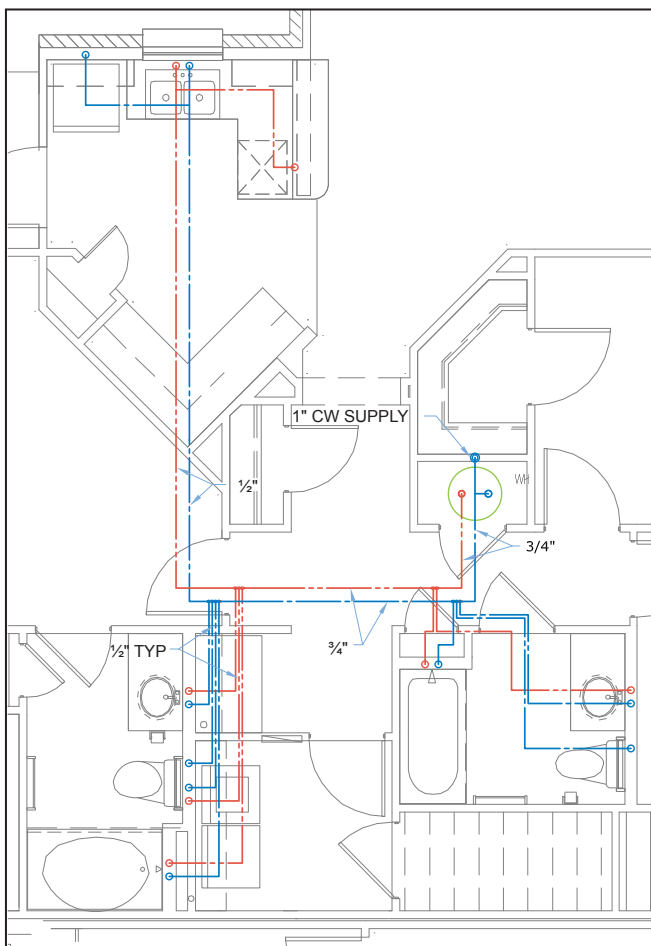


Uponor Logic plumbing

Uponor Logic is the smart way to plumb, using flexible PEX pipe and multiport tees to minimize connections and maximize system performance. With an Uponor Logic layout, plumbing systems typically require fewer fittings than a trunk and branch design and less pipe than a home run layout.

| Uponor Logic | |
|-----------------------|-------------|
| Number of fittings | 9 |
| Number of connections | 33 |
| Nominal pipe size | Length (ft) |
| 1/2" | 261 |
| 3/4" | 38 |
| 1" | 5 |
| Total | 304 |

| Home run | |
|-----------------------|-------------|
| Number of fittings | 7 |
| Number of connections | 27 |
| Nominal pipe size | Length (ft) |
| 1/2" | 475 |
| 3/4" | 30 |
| 1" | 5 |
| Total | 510 |

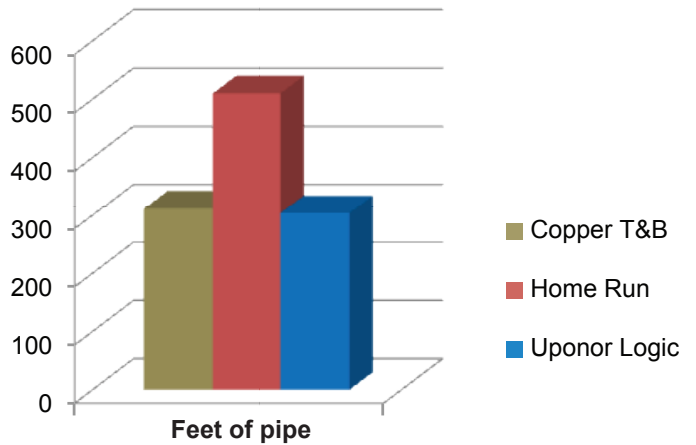
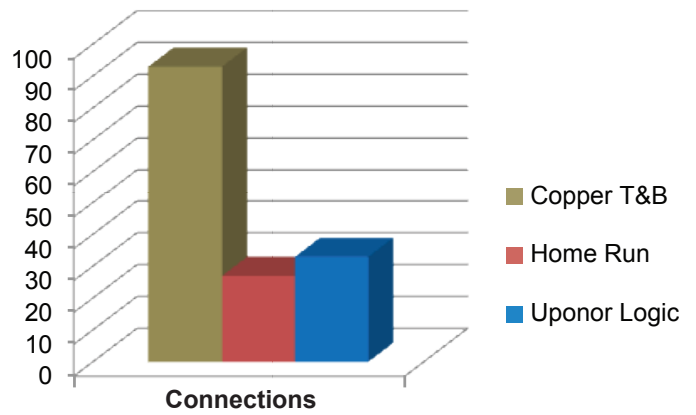
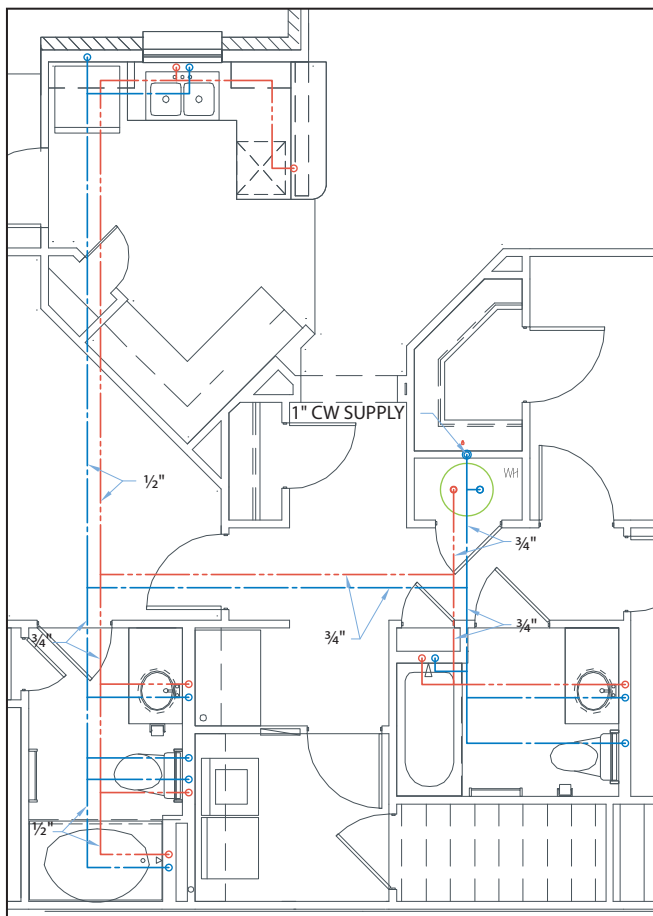
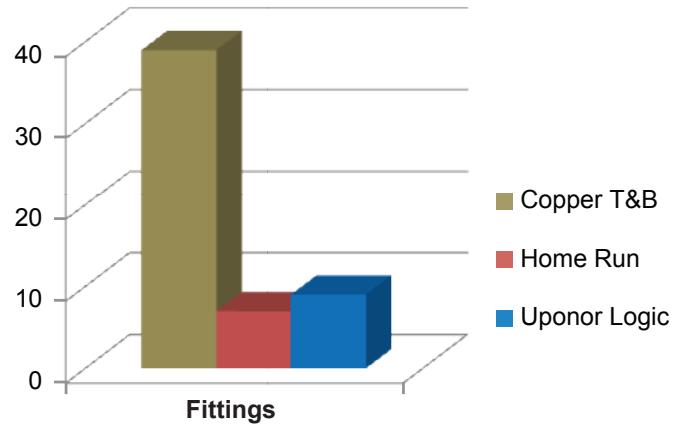


Critical path = HWS - W.H. to Tub **UPC tub** = 4 wsfu = 4 gpm
CWS = 60°F **HWS** = 120°F **Mixed** = 110°F **Hot-water multiplier** = 0.83 = 3.32 gpm

| System type | I.D. (in.) | | Distance (ft.) | | Volume (gal.) | | | Velocity (ft./sec.) | | Pressure loss (psi) | | | HW time-to-fixture Critical Path - Tub Only |
|--------------|------------|-------|----------------|------|---------------|-------|-------|---------------------|------|---------------------|-------|-------|--|
| | 1/2" | 3/4" | 1/2" | 3/4" | 1/2" | 3/4" | Total | 1/2" | 3/4" | 1/2" | 3/4" | Total | |
| Copper T & B | 0.527 | 0.745 | 13 | 33 | 0.147 | 0.746 | 0.893 | 4.8 | 2.43 | 1.22 | 0.561 | 1.781 | 16.1 sec. |
| Home Run | 0.475 | 0.671 | 32 | 9 | 0.294 | 0.165 | 0.459 | 5.8 | 3 | 4.16 | 0.252 | 4.412 | 8.3 sec. |
| Uponor Logic | 0.475 | 0.671 | 19 | 17 | 0.174 | 0.312 | 0.486 | 5.8 | 3 | 2.47 | 0.476 | 2.946 | 8.7 sec. |

Uponor Logic—The smarter way to plumb

| Copper trunk and branch | |
|-------------------------|--------------|
| Number of fittings | 39 |
| Number of connections | 93 |
| Nominal pipe size | Length (ft.) |
| 1/2" | 234 |
| 3/4" | 73 |
| 1" | 5 |
| Total | 312 |



Uponor Logic delivers

- Hot water to fixtures 45% faster than copper trunk and branch
- Hot water to fixtures with 33% less pressure loss compared to home run
- Over 65% fewer fittings and connections than trunk and branch
- 40% less pipe than home run

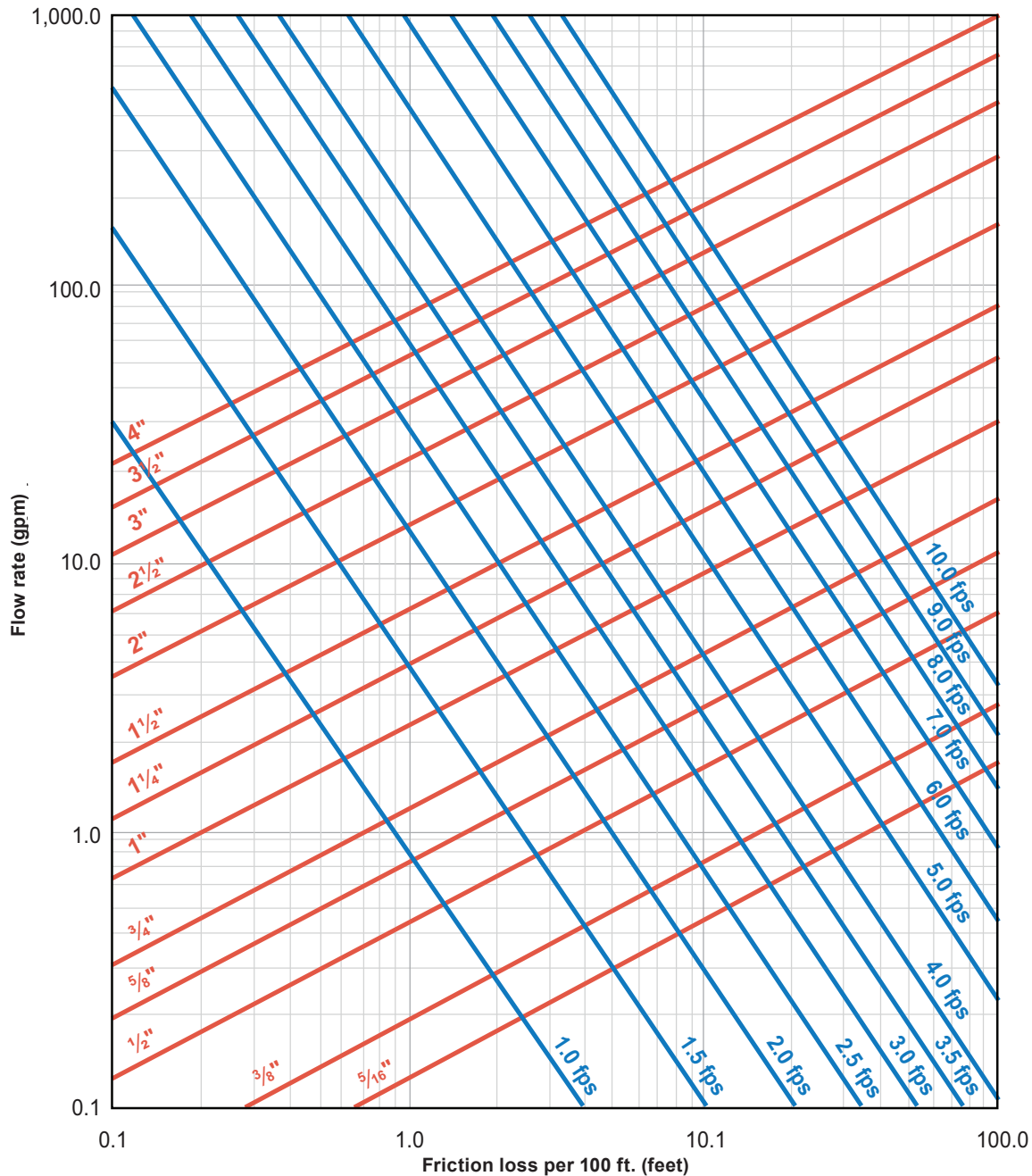
Pipe sizing an Uponor AquaPEX plumbing system

Uponor recommends using the uniform friction loss method of pipe sizing. After determining the system's friction loss (psi/100 ft.) by performing a building supply water calculation, develop a water size chart for each system's water temperature and pipe size. To do this, reference the Uponor AquaPEX flow charts on uponorpro.com and convert the gallons per minute (gpm) to fixture units for each nominal pipe size or use Uponor's Pipe Sizing Calculator at uponorpro.com/calculator. Per manufacturer's recommendations, Uponor allows the dedicated fixture supply pipe to be of the same nominal size as the fixture being supplied, provided the dedicated pipe is no longer than 25 linear feet from a uniform friction loss-sized pipe.

Note: Maximum velocity through Uponor AquaPEX systems shall be 12 ft./sec. Uponor recommends not exceeding 10 ft./sec. for cold domestic water systems, 8 ft./sec. for hot domestic water systems and 2 ft./sec. for domestic hot water recirculation. Contact Uponor Technical Services at 888.594.7726 or technical.services@uponor.com to determine the maximum velocities based on the use, geographical region and intended operating systems for your specific project.

www.uponorpro.com/calculator

Uponor PEX friction-loss chart (100% water)



Thermal conductivity

PEX pipe has a very low coefficient of thermal conductivity, 2.628 Btu•in/(hr•ft²•°F), whereas copper has a coefficient of thermal conductivity between 2080 and 2773 Btu•in/(hr•ft²•°F) depending on wall thickness (Type K, L or M). Therefore, PEX pipe does not sweat like copper does. PEX has superior insulative qualities when compared to copper in the same application. Even though the difference in R-Value is relatively small, the higher R-Value with a PEX pipe will always result in less heat loss when compared to the same nominal size copper pipe. Uponor recommends insulating all return piping as well as any hydronic piping (heating/chilled) to conserve energy and maintain desired fluid temperature. Uponor also recommends insulating any piping installed in an unconditioned space or poorly ventilated areas with excessive moisture content.



| Pre-insulated PEX with ½" insulation | | | |
|--------------------------------------|----------------------|---------|-----------------------|
| Tubing size | Insulation thickness | R-value | Heat loss at 70°F Δ T |
| ½" | 0.6 (15mm) | 3.9 | 7.4 Btu/(hr • ft) |
| ¾" | 0.6 (15mm) | 3.6 | 9.0 Btu/(hr • ft) |
| 1" | 0.6 (15mm) | 3.4 | 10.6 Btu/(hr • ft) |
| 1¼" | 0.6 (15mm) | 3.3 | 12.1 Btu/(hr • ft) |
| 1½" | 0.6 (15mm) | 3.2 | 13.6 Btu/(hr • ft) |
| 2" | 0.6 (15mm) | 3.1 | 16.5 Btu/(hr • ft) |

Pre-insulated Uponor AquaPEX consists of PEX-a pipe and closed cell, crosslinked polyethylene insulation with a thermal conductivity of 0.25 Btu•in/(hr•ft²•°F).

| Pre-insulated PEX with 1" insulation | | | |
|--------------------------------------|----------------------|---------|-----------------------|
| Tubing size | Insulation thickness | R-value | Heat loss at 70°F Δ T |
| ½" | 1.0 (25mm) | 7.5 | 6.3 Btu/(hr • ft) |
| ¾" | 1.1 (28mm) | 7.9 | 7.1 Btu/(hr • ft) |
| 1" | 1.0 (25mm) | 6.4 | 8.8 Btu/(hr • ft) |
| 1¼" | 1.0 (25mm) | 6.1 | 10.0 Btu/(hr • ft) |

| Pre-insulated PEX with 1½" insulation | | | |
|---------------------------------------|----------------------|---------|-----------------------|
| Tubing size | Insulation thickness | R-value | Heat loss at 70°F Δ T |
| 1½" | 1.7 (42mm) | 11.2 | 7.0 Btu/(hr • ft) |
| 2" | 1.6 (40mm) | 9.9 | 8.6 Btu/(hr • ft) |

Uponor PEX vs. copper heat loss comparison—Btu/(hr•ft)

| | | Delta T (°F) | 20 | | | | 40 | | | | 60 | | | | 80 | | | | 100 | | | |
|--------------------|-----|---------------|-------|------|------|------|-------|-------|------|------|-------|-------|-------|-------|--------|-------|-------|-------|--------|-------|-------|-------|
| | | | 0" | ½" | 1" | 1½" | 0" | ½" | 1" | 1½" | 0" | ½" | 1" | 1½" | 0" | ½" | 1" | 1½" | 0" | ½" | 1" | 1½" |
| Nominal pipe sizes | ½" | Uponor PEX | 5.44 | 2.22 | 1.63 | 1.37 | 10.89 | 4.44 | 3.25 | 2.74 | 16.33 | 6.65 | 4.88 | 4.10 | 21.78 | 8.87 | 6.51 | 5.47 | 27.22 | 11.09 | 8.13 | 6.84 |
| | | Type L Copper | 5.76 | 2.24 | 1.63 | 1.37 | 11.52 | 4.47 | 3.27 | 2.74 | 17.27 | 6.71 | 4.90 | 4.11 | 23.03 | 8.95 | 6.53 | 5.48 | 28.79 | 11.18 | 8.16 | 6.85 |
| | ¾" | Uponor PEX | 7.48 | 2.73 | 1.95 | 1.61 | 14.96 | 5.47 | 3.89 | 3.21 | 22.44 | 8.20 | 5.84 | 4.82 | 29.92 | 10.94 | 7.78 | 6.43 | 37.40 | 13.67 | 9.73 | 8.03 |
| | | Type L Copper | 8.06 | 2.77 | 1.96 | 1.61 | 16.12 | 5.54 | 3.91 | 3.22 | 24.18 | 8.31 | 5.87 | 4.84 | 32.25 | 11.07 | 7.83 | 6.45 | 40.31 | 13.84 | 9.78 | 8.06 |
| | 1" | Uponor PEX | 9.42 | 3.23 | 2.25 | 1.83 | 18.85 | 6.47 | 4.50 | 3.66 | 28.27 | 9.70 | 6.75 | 5.49 | 37.69 | 12.93 | 8.99 | 7.33 | 47.11 | 16.17 | 11.24 | 9.16 |
| | | Type L Copper | 10.36 | 3.29 | 2.27 | 1.84 | 20.73 | 6.58 | 4.53 | 3.68 | 31.09 | 9.86 | 6.80 | 5.52 | 41.46 | 13.15 | 9.06 | 7.36 | 51.82 | 16.44 | 11.33 | 9.20 |
| | 1¼" | Uponor PEX | 11.29 | 3.72 | 2.54 | 2.05 | 22.58 | 7.44 | 5.08 | 4.09 | 33.87 | 11.16 | 7.63 | 6.14 | 45.16 | 14.88 | 10.17 | 8.19 | 56.45 | 18.60 | 12.71 | 10.24 |
| | | Type L Copper | 12.67 | 3.80 | 2.57 | 2.06 | 25.34 | 7.60 | 5.14 | 4.12 | 38.00 | 11.40 | 7.70 | 6.18 | 50.67 | 15.20 | 10.27 | 8.24 | 63.34 | 19.00 | 12.84 | 10.30 |
| | 1½" | Uponor PEX | 13.08 | 4.20 | 2.83 | 2.26 | 26.15 | 8.40 | 5.66 | 4.51 | 39.23 | 12.60 | 8.49 | 6.77 | 52.30 | 16.79 | 11.31 | 9.03 | 65.38 | 20.99 | 14.14 | 11.28 |
| | | Type L Copper | 14.97 | 4.31 | 2.86 | 2.27 | 29.94 | 8.61 | 5.73 | 4.55 | 44.91 | 12.92 | 8.59 | 6.82 | 59.89 | 17.23 | 11.45 | 9.10 | 74.86 | 21.53 | 14.32 | 11.37 |
| | 2" | Uponor PEX | 16.46 | 5.13 | 3.39 | 2.66 | 32.93 | 10.27 | 6.77 | 5.33 | 49.39 | 15.40 | 10.16 | 7.99 | 65.85 | 20.54 | 13.55 | 10.65 | 82.31 | 25.67 | 16.94 | 13.32 |
| | | Type L Copper | 19.58 | 5.31 | 3.45 | 2.69 | 39.16 | 10.63 | 6.89 | 5.38 | 58.73 | 15.94 | 10.34 | 8.08 | 78.31 | 21.25 | 13.78 | 10.77 | 97.89 | 26.57 | 17.23 | 13.46 |
| | 2½" | Uponor PEX | 19.30 | 5.92 | 3.92 | 3.00 | 38.60 | 11.85 | 7.84 | 6.01 | 57.90 | 17.77 | 11.76 | 9.01 | 77.20 | 23.69 | 15.68 | 12.01 | 96.50 | 29.61 | 19.60 | 15.01 |
| | | Type L Copper | 24.20 | 6.32 | 4.09 | 3.10 | 48.41 | 12.63 | 8.18 | 6.20 | 72.61 | 18.95 | 12.26 | 9.30 | 96.82 | 25.26 | 16.35 | 12.40 | 121.02 | 31.58 | 20.44 | 15.50 |
| | 3" | Uponor PEX | 22.54 | 6.94 | 4.47 | 3.44 | 45.07 | 13.88 | 8.93 | 6.89 | 67.61 | 20.82 | 13.40 | 10.33 | 90.14 | 27.76 | 17.86 | 13.77 | 112.68 | 34.70 | 22.33 | 17.22 |
| | | Type L Copper | 28.79 | 7.31 | 4.59 | 3.50 | 57.58 | 14.62 | 9.17 | 7.01 | 86.37 | 21.93 | 13.76 | 10.51 | 115.16 | 29.24 | 18.35 | 14.01 | 143.95 | 36.55 | 22.93 | 17.51 |

- All calculations based on cylindrical thermal resistance methodology (ASPE/ASHRAE).
- Based on fluid velocity of 8 ft./sec. at 160°F/71.1°C (maximizing heat transfer from 100% water).
- Pipe convection set to be 1.761 Btu/hr•ft²•°F (based on standard value for free air convection).
- This heat loss comparison uses 0.24 Btu•in/(hr•ft²•°F) as the insulation thermal conductivity. This is a standard value for fiberglass pipe insulation at a 100°F/37.8°C mean temperature.

Sizing an Uponor PEX hydronic piping system

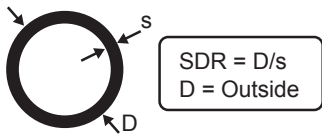
Wirsbo hePEX™ pipe is manufactured to have an outside diameter (OD) equal to copper tube size (CTS) dimensions and a wall thickness with a standard dimension ratio (SDR) of 9 (i.e., wall thickness is one-ninth the pipe OD).

Due to the thickness of PEX, which provides superior noise insulation and durability characteristics, the inside diameter (ID) of Wirsbo hePEX is slightly smaller than that of copper pipe. However, Wirsbo hePEX is three times smoother than new copper pipe. This smoothness means systems may be designed at higher velocities, thus reducing the difference in flow and friction loss characteristics between PEX-a and copper (resulting from PEX-a's smaller ID).

Standard dimension ratio (SDR)

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

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



| ASTM F876 temperature and pressure ratings for SDR9 PEX | | |
|---|---------------------------------|---------------------------------|
| Rated temperature (F°) | Hydrostatic design stress (psi) | Pressure rating for water (psi) |
| 73.4 | 630 | 160 |
| 180 | 400 | 100 |
| 200 | 315 | 80 |

Temperature and pressure ratings

The Plastics Pipe Institute (PPI) determines the temperature and pressure ratings for PEX piping as required by the ASTM F876 standard. The minimum burst pressure per ASTM F876 is 480 psi at 73.4°F (23°C) for ½" PEX and 475 psi at 73.4°F (23°C) for ¾" and larger PEX.

Note that Uponor PEX can withstand burst pressures up to 770 psi at 73°F (22.7°C), 290 psi at 180°F (82.2°C)

and 240 psi at 200°F (93.3°C) without failure, so designers can feel comfortable designing Uponor PEX up to its maximum temperature and pressure limits.

To start the evaluation, pipes of all sizes are empirically tested to ASTM D2837 to determine the hydrostatic design basis (HDB); this test method is used for all polyethylene-based piping. That data is then multiplied by 0.5 design factor to determine the hydrostatic design stress

(HDS). The HDS is then run through an ISO equation (ISO R-161-1690) to determine the temperature and pressure limits of the pipe.

While Wirsbo hePEX can handle velocities up to 10 feet per second (fps) (which is typical for Uponor AquaPEX pipe in Uponor plumbing systems), best practices for designing hydronic systems typically keep the velocities below 8 fps due to head-loss constraints from pumping requirements.

| Minimum and maximum design velocity | | |
|-------------------------------------|---------|---------|
| | Minimum | Maximum |
| Main | 1.5 fps | 8 fps |
| Riser | 1.5 fps | 8 fps |
| Long branch | 1.5 fps | 8 fps |
| Short branch (< 50 ft.) | 1.0 fps | 8 fps |

uponor Pipe Sizing Calculator

Plumbing **Hydronic** Radiant

For each calculator, provide the criteria and then click calculate. [Email Report](#)

Enter your distribution system parameters for each column to generate GPM flow ranges based on pipe size and input parameters:

| Water Temp 1 | Water Temp 2 | Water Temp 3 | Water Temp 4 | |
|--------------|--------------|--------------|--------------|---|
| 160 | 140 | 42 | 53 | Water Temperature (°F) |
| 1.5 | 1.5 | 1.5 | 1.5 | Min. Velocity (ft./sec.) |
| 8 | 8 | 8 | 8 | Max. Velocity (ft./sec.) |
| 4 | 4 | 4 | 4 | Maximum Head Loss Per 100 Ft. of Pipe (ft.) |
| 0% | 0% | 0% | 0% | Glycol Mixture (%) |

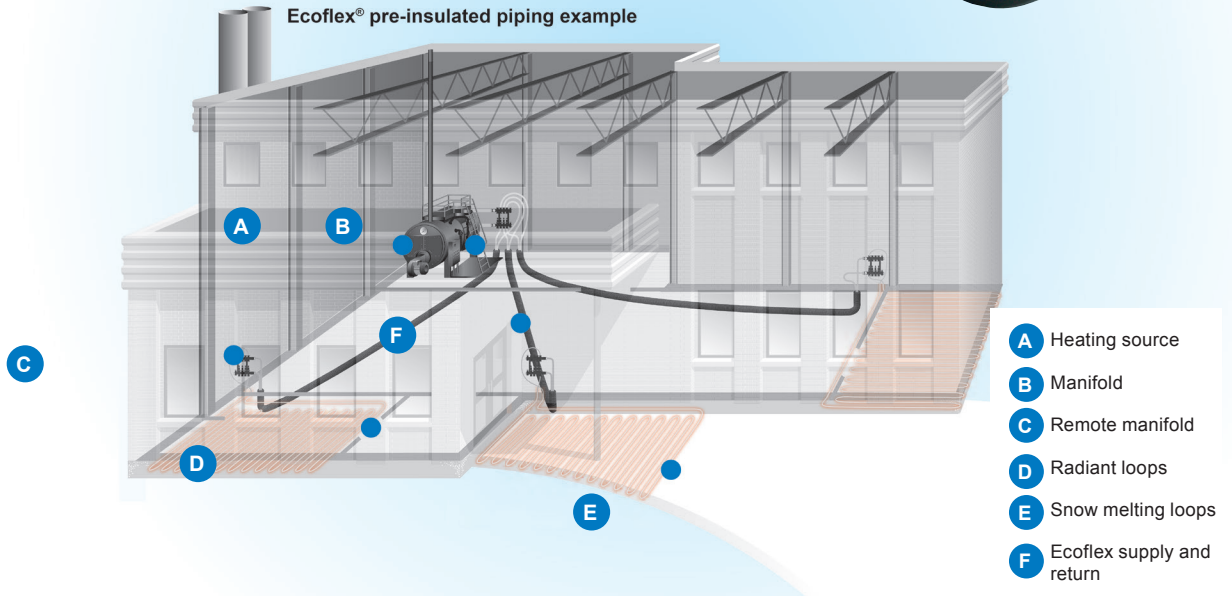
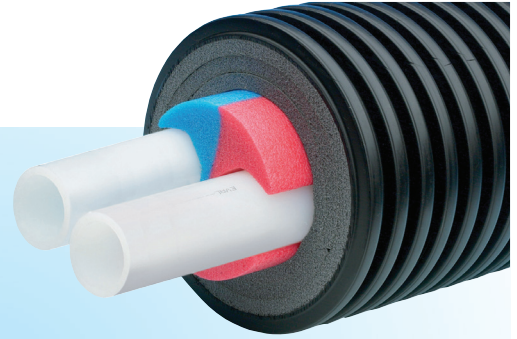
[Calculate](#)

Online pipe sizing calculator

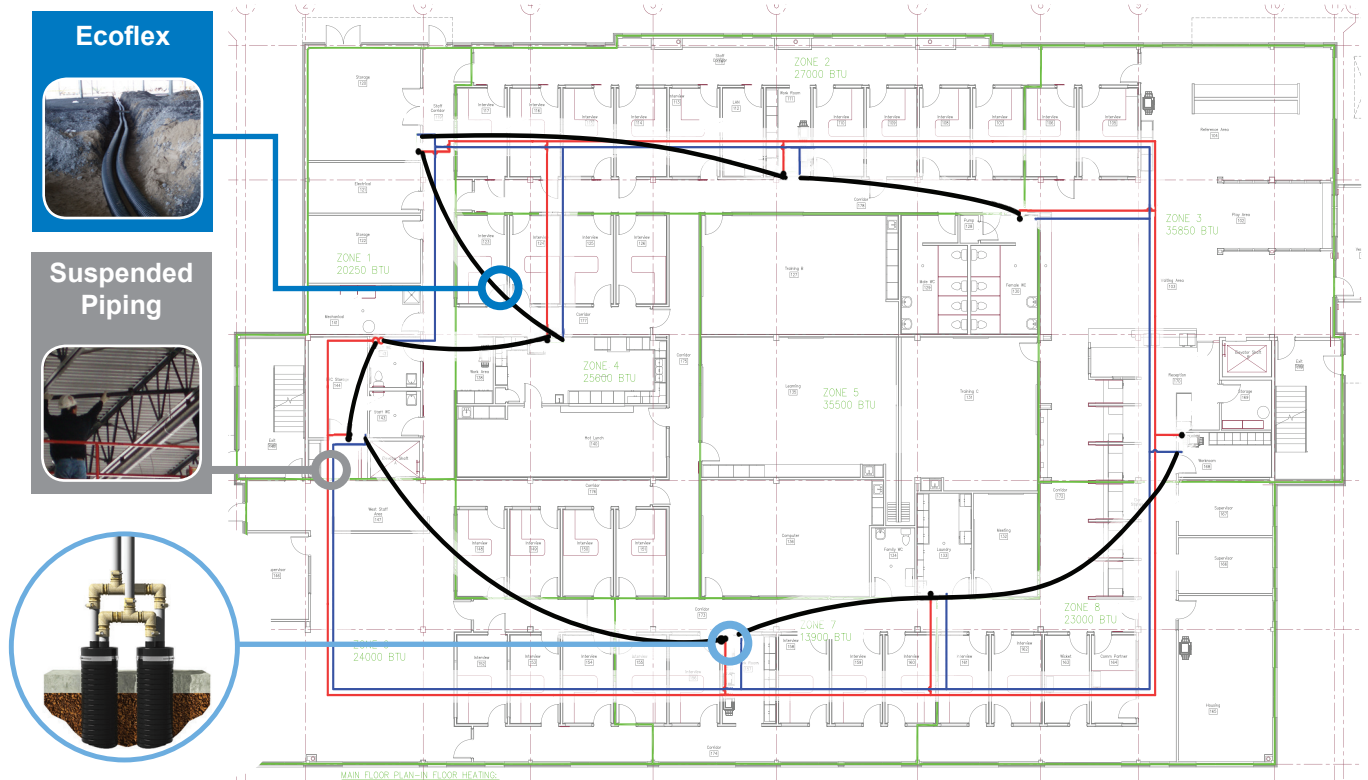
Uponor offers an online hydronic pipe sizing calculator that is capable of generating flow tables for hydronic piping systems based on user-specified inputs. Access the Uponor online pipe sizing calculator at uponorpro.com/calculator.

Ecoflex® for hydronic piping

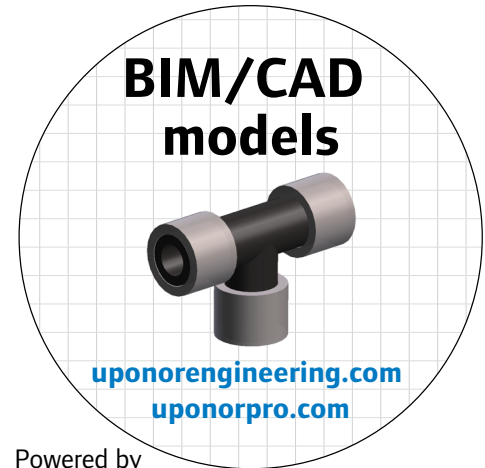
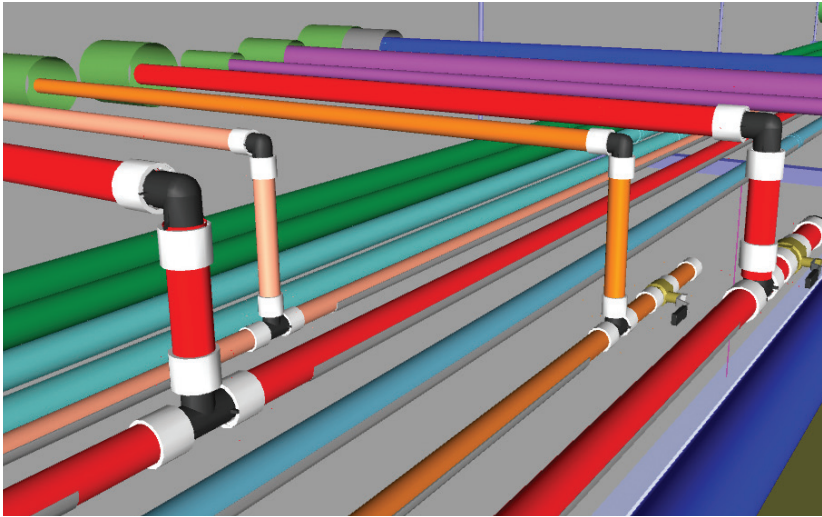
Uponor Ecoflex® pre-insulated pipe features single or twin PEX service pipes surrounded by multi-layer, PEX-foam insulation and covered by a corrugated, high-density polyethylene (HDPE) jacket.



Piping layout (Ecoflex vs. suspended piping)



Traditional suspended hydronic perimeter loop distribution system overlaid with an underground Ecoflex pre-insulated distribution system



Powered by
THOMAS  Enterprise Solutions™

Uponor Design Services

The PEX design experts

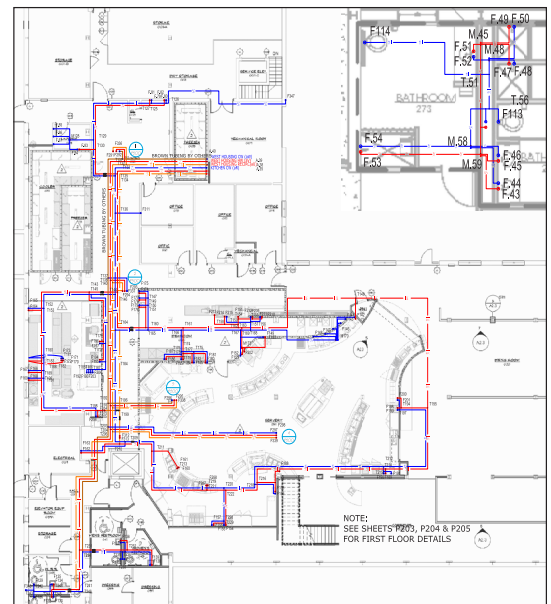
Providing the mechanical, electrical and plumbing (MEP) industry with PEX design support since 1994, Uponor Design Services is a dedicated team of experienced design professionals and project managers trained in PEX applications for domestic water plumbing, radiant heating/cooling, hydronic piping and fire sprinkler systems for residential and commercial structures.

Uponor design advantage

- Broad suite of services from concept to construction
- Experienced staff of design professionals; industry-affiliated and certified (ASHRAE, ASPE, RPA, NICET, NFPA, AFSA, NFSA)
- Personalized project consultants for tailored support based on project phase
- Specializing in PEX take-off and design
- Optimized pipe sizing using unique properties of Uponor PEX systems
- Efficient piping layouts using Uponor Logic design concepts
- Engineering calculation package for easy approval
- Estimates with labor data

BIM/CAD models

- BIM/CAD content managed and hosted by Uponor
- On-demand BIM/CAD model generation via Navigator on uponorpro.com and uponorengineering.com
- Providing the best digital experience for discovering and selecting BIM/CAD content



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