

Pipe Sizing an Uponor AquaPEX® Plumbing System

Uponor AquaPEX® crosslinked polyethylene (PEX-a) 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 insulation and durability characteristics, the inside diameter (ID) of Uponor AquaPEX pipe is slightly smaller than that of copper pipe. However, Uponor PEX-a is three times smoother than new copper pipe. This smoothness means it can be designed at higher velocities, thus reducing the difference in flow characteristics between PEX-a and copper (resulting from PEX-a's smaller ID).

To calculate pressure loss for an Uponor AquaPEX Plumbing system, refer to the [Plumbing Pressure Loss Tables](#) on www.uponorpro.com in [Technical Support/Manuals/Plumbing](#).

U.S. Pipe Sizing

For sizing an Uponor AquaPEX Plumbing System in residential and light commercial buildings in the U.S., use the fixture unit tables for determining pipe size as published in the model plumbing codes.

To support this pipe sizing practice, Uponor consulted with the International Code Council (ICC) and the International Association of Plumbing and Mechanical

Officials (IAPMO) by means of an evaluation report (ER) to substantiate their approvals.

The following ER numbers endorse the use of the 2012 UPC Table 610.4 (or 2009-prior UPC Table 6-6) and 2012-prior IPC Table E201.1 for pipe sizing an Uponor AquaPEX Plumbing System.

- IAPMO ER-0253
- ICC ES PMG 1006

Canada Pipe Sizing

For sizing an Uponor AquaPEX Plumbing System in residential and light commercial buildings in Canada, use Table A-2.6.3.1.(2)A of the 2010 National Plumbing Code of Canada (NPCC).

Uniform Friction Loss Method

For larger systems, the most common method of pipe sizing is the uniform friction loss method. This method utilizes the pipe material's specific flow characteristics in conjunction with velocity-sizing criteria.

The examples on the following page illustrate how to employ the uniform friction loss method.

To simplify the uniform friction loss method when sizing an Uponor AquaPEX Plumbing System, use Uponor's pipe sizing calculator at www.uponorpro.com/calculator.

Uniform Friction Loss Method

Step One

Perform a building water supply calculation to determine how much pressure is available for friction loss through the pipe and fittings. (See **Figure 1**.)

Designer must know the following:

- Pressure available at building (minimum static pressure available before water meter or after hydro-pneumatic tank/booster-pump system)
- Minimum fixture working pressure (minimum pressure required at farthest fixture outlet)
Note: Be sure to select the most demanding fixture in the farthest fixture group (i.e., bathtub). Refer to local code for minimum fixture working pressure.
- Static loss (height in ft. of the highest fixture outlet above the supply source)
- Additional component loss (total pressure loss in psi of the following system components — water meter, filters, softeners, backflow prevention devices and pressure regulators)

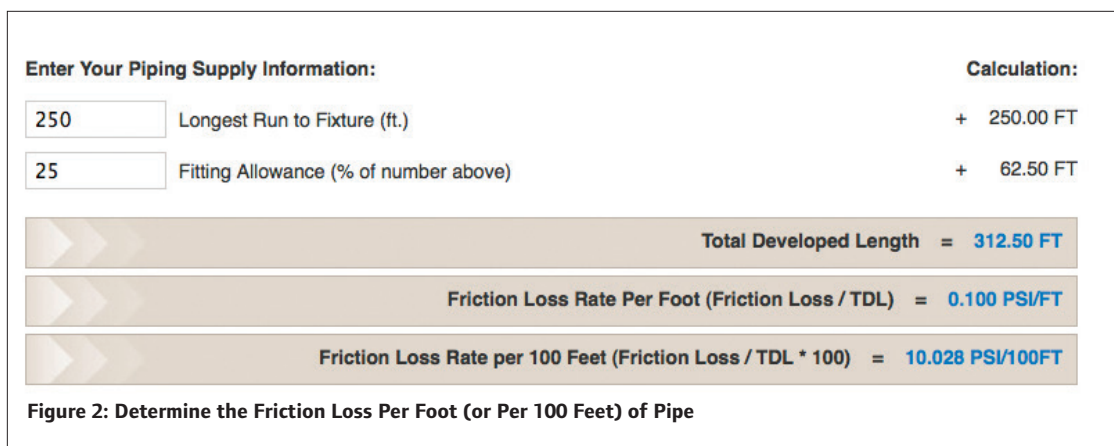
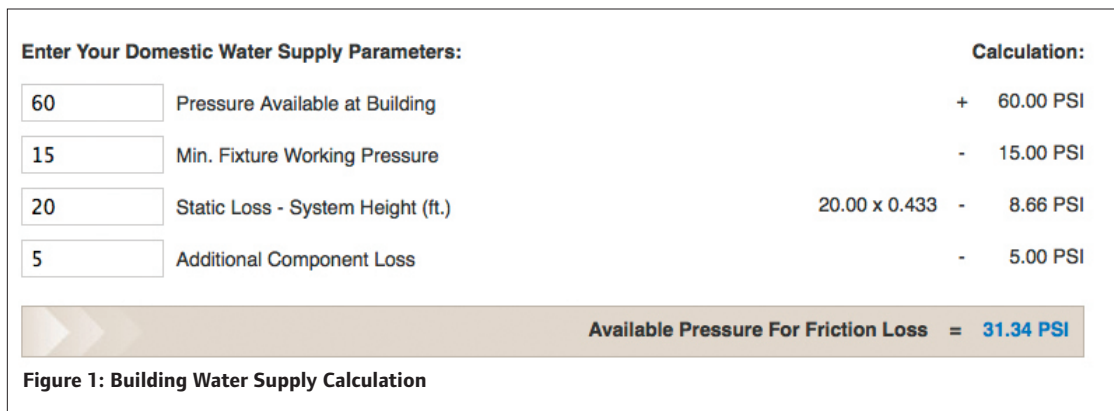
Step Two

Calculate the total developed length (TDL) of the system and divide the available pressure for friction loss (calculated in **Figure 1**) by the TDL to determine the friction loss per foot or per 100 feet of pipe. (See **Figure 2**.)

Designer must know the following:

- Longest run to fixture (total linear feet of piping from water meter or supply source to the most hydraulically demanding fixture)
- Fitting allowance (percentage of longest run piping that represents friction loss through fittings and valves along the critical path, typically between 20% and 30% for an Uponor AquaPEX system)

Note: Alternatively, the designer can add up equivalent-length losses of fittings and valves along the critical path and add to the longest run footage. Refer to the **Plumbing Pressure Loss Tables** for a complete equivalent-length set of data for Uponor ProPEX® expansion fittings.



Step Three

Develop water size charts for each pipe material and water temperature. (See **Figures 3 and 4.**)

Designer must know the following:

- Pipe materials being designed and range of sizes for each system
- Supply and return design water temperatures

Note: For commercial systems, size domestic hot-water return piping per the requirements stated in ASPE Plumbing Engineering Design Handbook, Volume 2, *Plumbing Systems*.

- Maximum velocity of each pipe material per water temperature
- Table approved by the local authority having jurisdiction (AHJ) or referenced plumbing code table for converting gallons per minute (GPM) to water supply fixture units (WSFU)
- If the domestic cold-water system demand is predominately flush valve or flush tank WSFU

Step Four

Apply the appropriate water size chart to the plumbing design. Calculate WSFU demand per pipe segment by adding all the WSFUs of the fixtures being supplied by that pipe segment. (See **Figure 5.**)

Enter Your System Parameters for Each Table:

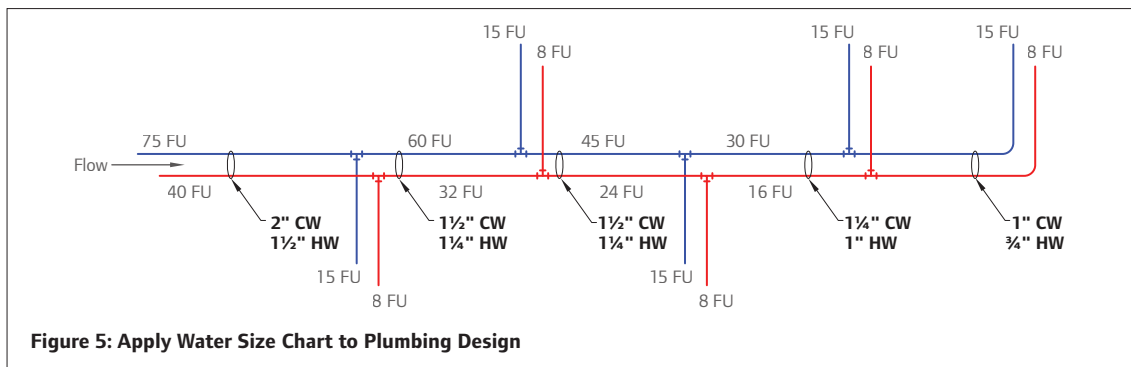
A	B	C	
<input type="text" value="60"/>	<input type="text" value="120"/>	<input type="text" value="110"/>	Water Size Table Temperature (°F)
<input type="text" value="10"/>	<input type="text" value="8"/>	<input type="text" value="2"/>	Max. Velocity Per Water Temp (ft./sec.)
<input type="text" value="UPC"/>			Applicable Plumbing Code
<input type="text" value="FT"/>	<input type="text" value="FT"/>	<input type="text" value="FT"/>	WSFU Predominant Fixture Curve

Figure 3: System Parameters

Water Size Chart for Uponor AquaPEX:

Uponor AquaPEX Water Size Table UPC Code - Flush Tank 100% Water @ 60°F 10.028 PSI/100ft. Max. Velocity = 10 ft./sec.				Uponor AquaPEX Water Size Table UPC Code - Flush Tank 100% Water @ 120°F 10.028 PSI/100ft. Max. Velocity = 8 ft./sec.				Uponor AquaPEX Water Size Table UPC Code - Flush Tank 100% Water @ 110°F 10.028 PSI/100ft. Max. Velocity = 2 ft./sec.			
Pipe Size	WSFU Range	Velocity (ft./sec.)	GPM	Pipe Size	WSFU Range	Velocity (ft./sec.)	GPM	Pipe Size	WSFU Range	Velocity (ft./sec.)	GPM
3/8"	0 -- 0	3.60	1.08	3/8"	0 -- 0	4.10	1.23	3/8"	0 -- 0	2.00	0.60
1/2"	1 -- 2	4.60	2.54	1/2"	1 -- 2	5.00	2.76	1/2"	0 -- 0	2.00	1.10
3/4"	3 -- 7	5.80	6.39	3/4"	3 -- 8	6.40	7.05	3/4"	1 -- 1	2.00	2.20
1"	8 -- 17	7.00	12.73	1"	9 -- 19	7.60	13.83	1"	2 -- 3	2.00	3.64
1 1/4"	18 -- 33	8.00	21.76	1 1/4"	20 -- 33	8.00	21.76	1 1/4"	4 -- 6	2.00	5.44
1 1/2"	34 -- 63	9.00	34.10	1 1/2"	34 -- 54	8.00	30.31	1 1/2"	7 -- 9	2.00	7.58
2"	64 -- 195	10.00	64.97	2"	55 -- 130	8.00	51.97	2"	10 -- 17	2.00	12.99
3"	196 -- 585	10.00	140.79	3"	131 -- 431	8.00	112.63	3"	18 -- 49	2.00	28.16

Figure 4: Water Size Chart





Uponor AquaPEX Design Parameters

Domestic Cold-water Piping

- Maximum velocity of 12 ft./sec. through pipe
- Recommended velocity of 10 ft./sec. through pipe

Domestic Hot-water Piping

- Maximum velocity of 12 ft./sec. through pipe
- Recommended velocity of 8 ft./sec. through pipe
- Maximum operating temperature of 200°F (93.3°C)

Domestic Hot-water Return Piping

- Maximum velocity of 2 ft./sec. through pipe
- Maximum operating temperature of 140°F (60°C)
- Sized per the requirements stated in ASPE Plumbing Engineering Design Handbook, Volume 2, *Plumbing Systems*

Note: 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: Uponor allows the use of ½" pipe for domestic hot-water return piping provided a flow-control device is in place to maintain velocities at or below 2 ft./sec. Refer to the table below for appropriate flow rates at 2 ft./sec.

To determine the maximum velocities based on the use, geographical region and intended operating conditions for your specific project, contact Uponor Design Services at:

U.S.: 888.594.7726 or design.services@uponor.com

Canada: 888.994.7726 or design.ca@uponor.com

Nominal Pipe Size	Velocity (ft./sec)	Gallons Per Minute (gpm)	Friction Loss per Foot at 120°F/48.9°C
½"	2	1.1	0.0195
¾"	2	2.2	0.0126
1"	2	3.6	0.0092
1¼"	2	5.4	0.0072
1½"	2	7.5	0.0059
2"	2	12.9	0.0042

Table 1: Uponor AquaPEX Velocities and Flow Rates at 2 ft./sec.

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 Apple Valley, MN 55124 USA
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 Fax: 952.891.2008

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