



**Uponor**

PEX PLUMBING SYSTEMS  
DOMESTIC HOT WATER

**INSTRUCTION SHEET**

## Domestic Hot Water Instruction Sheet

Uponor AquaPEX® crosslinked polyethylene (PEX) piping is tested and listed to PEX 5106 NSF-pw (CL5). Per ASTM F876, the CL5 chlorine resistance rating is intended for an end-use condition of 100% at 140°F/60°C, which is the highest chlorine-resistance rating available through ASTM.

When a product is marked with a PEX 5106 NSF-pw (CL5) designation, it indicates the product is approved for use in continuous, domestic, hot-water circulation systems with up to 140°F/60°C water temperatures.

### Recirculated Hot-water System

To maintain satisfactory temperatures, hot-water systems are often recirculated. Several recirculating methods are available, including:

- 1. Manual control** — Should be used only when hot water is needed 24 hours a day. If that is not the case, manual control is not cost effective.
- 2. Thermostatic aquastat** — Used to shut off the pump during peak demands of hot water when circulation is not needed.
- 3. Timed** — Used during specific hours of operation when hot-water fixtures are most likely to be in use.

### 4. Combination aquastat/timed

— Combines the capabilities of the aquastat system with the timed control, reducing energy consumption.

### Velocity in Recirculated Hot-water Systems

Uponor requires that the velocity of the recirculation piping shall not exceed 2 ft./sec. and that the hot-water piping system (which includes the recirculation lines) meets the following requirements stated in the ASPE Plumbing Engineering Design Handbook, Volume 2, *Plumbing Systems*.

1. Calculate the heat-loss rates of the hot-water supply piping.
2. Calculate the heat-loss rates of the hot-water recirculation piping.
3. Calculate the circulation rates for all parts of the circulating piping and the total circulation rate required.
4. Determine the allowable uniform friction head loss and the total

head required to overcome friction losses in the piping when the water is flowing at the required circulation rate.

5. Calculate the rates of flow for various piping sizes that will give the uniform pressure drop established in **Step 4**, and tabulate the results.
6. Size the system based upon the tabulation set up in **Step 5**.
7. With the sizes established in **Step 6**, repeat **Steps 2 through 6** as a check on the assumptions made.

While Uponor recommends the more accurate process above, the following streamlined method is also available.

1. Allow a ½ gpm for each small hot-water riser (¾" to 1"); allow 1 gpm for each medium-sized hot-water riser (1¼" to 1½"); and allow 2 gpm for each large-sized hot-water riser (2" and larger).
2. Add 1 gpm for each group of 20 hot-water-supplied fixtures.

Uponor AquaPEX Velocities and Flow Rates at 2 ft./sec.			
Nominal Pipe Size (in)	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.**

## Balancing of Recirculated Hot-water Systems

Circulated hot-water systems require balancing to maintain satisfactory system temperatures. If systems are not properly balanced, circulated water has the tendency to short circuit through the shortest loop in the system, thus creating high velocities in that loop and resulting in hot water delays to remote loops. Hot water recirculated lines should be insulated, and they typically require little flow to maintain satisfactory system temperatures. Uponor limits the maximum velocity to **2 ft./sec.** in hot-water return piping that uses Uponor AquaPEX.

## Thermal Conductivity

Uponor PEX pipe has a very low coefficient of thermal conductivity: 0.219 Btu/(h·ft·°F). In comparison, copper has a coefficient of thermal conductivity between 173 and 231 Btu/(h·ft·°F), depending on wall thickness.

Uponor PEX has superior insulating qualities when compared to copper in the same application. Even though the difference in R-value is relatively small, the higher R-value of Uponor PEX piping will always result in less heat loss than with the same nominal-size copper pipe.

## Heat Trace

The use of approved heat trace cables is allowed with Uponor PEX products, provided the heat trace cable has automatic thermostatic control capability and the temperature does not exceed the maximum rating listed on the Uponor PEX piping (200°F/93.3°C). Heat tape should be wrapped around the piping and secured with zip or cable ties, not tape; then insulated with either closed-cell or fiberglass pipe insulation.

Delta T (°F)		60				80				100				
		0"	½"	1"	1½"	0"	½"	1"	1½"	0"	½"	1"	1½"	
Nominal Pipe Size	½"	Uponor PEX-a	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	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-a	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	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-a	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	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-a	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	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-a	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	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-a	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	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-a	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	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-a	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	86.37	21.93	13.76	10.51	115.16	29.24	18.35	14.01	143.95	36.55	22.93	17.51	

**Table 2: PEX-a vs. Copper Heat Loss Comparison (Btu/(hr·ft))**

### Notes

1. All calculations based on cylindrical thermal resistance methodology (ASPE/ASHRAE).
2. Based on fluid velocity of 8 ft./sec. at 160°F/71.1°C (maximizing heat transfer from 100% water).
3. Pipe convection set to be 1.761 Btu/hr·ft²·°F (based on standard value for free convection of air).
4. 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.

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