PP-RCT Piping Systems Installation Guide

Owner name _____

Installer number _____

Trainer name _____

Trainer email _____

Trainer phone _____

Uponor PP-RCT Piping Systems Installation Guide is published by

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

T 800.321.4739
F 952.891.2008

uponor.com

First publication May 2022
Third edition September 2024

Printed in the United States of America

Foreword

This installation guide is published for architects, building officials, engineers, and mechanical contractors interested in designing and/or installing Uponor PP-RCT pipe and fitting systems. It describes general installation recommendations that use Uponor PP-RCT pipe and fittings products.

Uponor has made reasonable efforts to collect, prepare and provide quality information and material in this installation guide. However, system enhancements may result in modification of features or specifications without notice. Always follow local codes for additional requirements.

Uponor is not liable for installation practices that deviate from this installation guide or are not acceptable practices within the mechanical trades, codes, or standards of practice.

Prior to installing Uponor PP-RCT systems, all installers must attend Uponor PP-RCT piping systems installation training performed by an Uponor trainer or manufacturer's representative. To schedule a training session at your business or job site, contact your local Uponor PP-RCT representative or call 800.321.4739.

Direct any questions regarding the suitability of an application or a specific design to Uponor Technical Services at 888.594.7726.

Table of contents

Uponor PP-RCT overview

General product information

Uponor PP-RCT piping systems are ideal for commercial projects, offering a solution that provides greater job-site safety with lighter weights and no open flame while also delivering a more sustainable system that resists corrosion for a longer service life.

PP-RCT is an acronym for polypropylene random copolymer with modified crystallinity and temperature resistance.

The piping system is approved for use in aboveground and direct-burial installations for the following applications:

- Hot and cold potable water
- Heating hot water
- Chilled water
- Industrial

For specific product application information, contact Uponor Technical Services at 888.594.7726 or support.UNA@uponor.com.

Listings and code approvals

Uponor products are listed to the following standards:

- ASTM F2389 Standard Specification for Pressure Rated Polypropylene (PP) Piping System
- NSF/ANSI 14 Plastic Piping Systems Components and Related Materials
- NSF/ANSI 61 Drinking Water System Components – Health Effects
- NSF/ANSI 51 Food Equipment Materials

- ICC-ES-PMG 1106 Polypropylene (PP-R) and (PP-RCT) Pipe and Fitting System
- CSA B137.11 Polypropylene (PP-R) Pipe and Fittings for Pressure Applications
- IAPMO K-12775 Research and Testing – Pressure Rated Polypropylene Piping Systems
- QAI P321-5 Water Pipe Systems – PP-RCT Pipe and Fittings ASTM E84

Note: Uponor PP-RCT is tested and listed by Hilti® to firestop systems approved to ASTM E814/UL 1479 and CAN/ULC S115. For details, visit the UL website to view Hilti listings that include Uponor PP-RCT.

Uponor PP-RCT is approved for use under the following codes:

- International Residential Code (IRC)
- International Mechanical Code (IMC)
- Uniform Mechanical Code (UMC)
- California Mechanical Code (CMC)
- International Plumbing Code (IPC)
- Uniform Plumbing Code (UPC)
- California Plumbing Code (CPC)
- National Plumbing Code of Canada

Uponor manufacturing plant is listed to the following standards:

- ISO 9001:2007 for Quality Management
- ISO 14001 for Environmental Management
- OHSA 18001:2007 for Occupational Health and Safety Management

Operating temperature and pressure for mechanical and cold potable piping

Table 1 shows the hydrostatic temperature and pressure ratings of the pipes using a design factor of 1.5 per ASTM F2389.

In the case of short-term increases in temperature and/or pressure, Uponor assumes no responsibility.

Note: These ratings are independent of application ratings. For domestic hot-water (**DHW**) and DHW recirculation (**DHW-R**) installations, operating conditions **should not exceed 140°F (60°C) at 80 psi (5.5 bar)**.

Temperature (°F)	SDR 7.4	SDR 9	SDR 11	SDR 17.6
	Pressure (psi)			
40	414	316	257	155
50	392	300	244	147
60	369	285	231	140
70	347	270	219	132
73	**340**	**265**	**215**	**130**
80	324	254	206	125
90	302	239	194	117
100	279	223	181	110
110	257	208	168	102
120	235	193	156	95
130	212	177	143	87
140	**190**	**150**	**120**	**70**
150	167	146	118	72
160	145	131	105	65
170	122	115	93	57
180[1]	**100**[2]	**100**	**80**[3]	**50**[3]

Table 1: Hydrostatic temperature and pressure ratings

[1] ASTM F2389 requires the pressure rating at 180°F to be calculated based on an application class 5 from ISO 15874-2, hence pressure derived for >158°F results in less than 50 years' service life.

[2] ASTM F2389 limits pressure to 100 psi at 180°F. Actual pressure rating is 130 psi.

[3] SDR 11 and 17.6 products are not typically used or rated at 180°F.

Note: For systems with operating temperatures outside the scope of this table, please contact Uponor Technical Services at 888.594.7726.

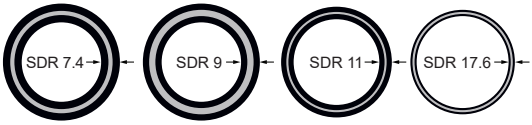


Figure 1: SDR = d/s, where d = pipe outside diameter, s = pipe wall thickness

Note: Table 1 shows hydrostatic ratings for water applications only. When transporting chemicals, it is important to consider the effects that pressure and temperature have on the pipe. For conveyance of chemicals or compressed air, contact Uponor Technical Services at 888.594.7726.

Operating temperature, pressure, and velocity for hot potable piping

Uponor PP-RCT Hot Potable pipe is approved for use in domestic hot-water (DHW) systems with a maximum temperature of 140°F (60°C) at 80 psi (5.5 bar) and a velocity of 8 fps [2.4 meters per second (m/s)].

For DHW recirculation (DHW-R) systems, Uponor PP-RCT Hot Potable pipe is approved for use at a maximum temperature of 140°F (60°C) at 80 psi (5.5 bar) and a velocity of 2 fps (0.6 m/s).

System velocity

Uponor recommends and promotes a complete polymer solution using PP-RCT and PEX-a products. When installing metallic materials in conjunction with Uponor PP-RCT, use proper velocity design limits for the respective material.

DHW-R systems

Uponor PP-RCT Hot Potable pipe is tested to and meets the requirements to achieve a "Class 3" chlorine rating per ASTM F2389, allowing use in DHW-R line applications for temperatures up to 140°F (60°C) for 50% of the time, or 12 hours per day.

Combined-use systems

Uponor does not recommend using PP-RCT in combined-use systems unless the return lines are sized for DHW-R limits of 2 fps. A combined-use system is defined as when the plumbing system is designed entirely for potable use (lead free, etc.) and is piped in combination with the heating system, where all heating components meet the requirements of a plumbing system.

Mixed PP-RCT and copper systems

When possible, replace all copper piping in a system with Uponor PP-RCT. If limited copper piping remains as part of the system, strictly follow the rules and guidelines of the Copper Development Association (CDA Publication A4015-14/16: Copper Tube Handbook) regarding flow rates and water conditions.

Also, ensure the operating conditions do not cause degradation, erosion, or corrosion of the copper. Test the level of copper in the water and ensure the copper levels do not exceed 0.1 ppm (mg/L). Higher levels indicate erosion/corrosion of the copper pipe due to system and/or water

conditions. Note that high levels of copper in a piping system with Uponor PP-RCT will void the warranty. However, small amounts of copper or brass in valves or other equipment will typically not cause an issue.

Velocity in mixed PP-RCT and copper systems

In DHW systems with both Uponor PP-RCT and copper, strictly follow the rules and guidelines of the Copper Development Association (CDA Publication A4015-14/16: Copper Tube Handbook). Do not exceed 5 fps (1.5 m/s). In DHW-R systems with both PP-RCT and copper piping, do not exceed 1.5 fps (0.5 m/s).

Copper concentrations with unknown velocity

For re-pipe applications where Uponor PP-RCT is replacing and connecting to copper lines and the design or actual system velocity is unknown, copper concentrations found in the water stream should not exceed 0.1 parts per million (ppm) during annual maintenance and water sampling.

Compressed-air systems

Uponor PP-RCT Mechanical and Hot Potable SDR 7.4 and SDR 9 piping products are approved for use in compressed-air systems up to 150 psi (10.3 bar) with temperatures up to 104°F (40°C). Be sure to always follow local code for acceptable compressed-air testing.

Thermal conductivity

The thermal conductivity of PP-RCT piping is 1.67 Btu·in/(hr·ft^{2}·°F). This low conductivity value, combined with the thickness of the pipe and fitting wall, act as a natural insulator. Traditional metal piping systems have much higher thermal conductivity values. Under normal operating conditions, non-insulated PP-RCT pipes have less heat loss or gain and greater resistance to condensation compared to metal and other types of plastic piping systems.

One of the objectives of energy and building codes is to improve operating efficiencies through piping insulation recommendations. Because Uponor PP-RCT piping systems have much lower heat losses and heat gains than traditional metal systems, they are capable of operating at an equal or, in most cases, more efficient levels than other metal systems under the same code. Using Uponor PP-RCT piping systems has the potential to save both space and materials. For piping insulation details, refer to the installation section.

Chemical resistance

PP-RCT is resistant to many chemical substances and therefore suitable for a wide variety of applications. **Table 2** on the following pages lists examples of PP-RCT chemical resistance behavior toward a small variety of chemicals. It is very important to select appropriate transition fittings (fittings with metal inserts). When designing the system with special requirements, or for questions relating to polypropylene (PP) chemical resistance, please consult Uponor Technical Services at 888.594.7726.

Note: Chemical resistance varies with applied stress, temperature, and chemical concentration. The data in **Table 2** represents general guidelines. Specific applications with applied mechanical stress may result in stress-crack growth in PP-RCT. Additionally, the data represents the impact of individual chemicals on PP-RCT. A combination of chemicals could result in a synergistic effect. This information does not address the potential impact of chemical combinations on PP-RCT.

Uponor PP-RCT chemical resistance (continued)				
Chemical or product	Concentration	Temperature		
		68°F (20°C)	140°F (60°C)	212°F (100°C)
Fernox F3, Fremont 9917 (central heating cleaner)	50%	S	S	L
Firecaulk (inorganic polymerized silicate)	–	S	S	S
Glutaraldehyde (biocide)	3%	NS	NS	NS
GP epoxy glue	–	S	S	S
Hydrochloric acid	37%	L	NS	NS
Hydrogen peroxide	30%	S	–	–
Hydraulic oil (petroleum distillate based)	–	NS	NS	NS
Isocyanate foam (polyurethane foam)	–	S	S	S
Izothiazole (biocide)	100 ppm	S	–	–
Leak detector (AGA LT4)	–	S	S	S
Liquid argon	–	S	S	S
Nitrous oxide	100%	S	S	S
Ozone in water	–	L	–	–
Paint (oil) alkyd (mineral spirit as solvent)	–	S	S	S
Paint (urethane modified-alkyd)	–	S	S	S

S = Satisfactory

L = Limited

NS = Non-satisfactory

– = No data available

Table 2: Uponor PP-RCT chemical resistance

Uponor PP-RCT chemical resistance (continued)				
Chemical or product	Concentration	Temperature		
		68°F (20°C)	140°F (60°C)	212°F (100°C)
Phosphoric acid	50%	S	S	S
Propylene glycol:water	50:50	S	S	S
Rust removal using HCl or HPO4	–	S	–	–
Rust removal using HCl or HPO4	–	S	–	–
SMP-polymer (silyl modified polymer/silane modified polymer)	–	S	S	S
Sodium cumenesulfonate basic solution (e.g., Fremont C103)	30% with 10% NaOH	S	S	S
Sodium hydroxide	50%	S	S	S
Sodium molybdate	500 ppm	S	S	S
Sodium nitrite	2,000 ppm	S	S	S
Sulfuric acid	50%	S	S	L
Triethanolamine	100 ppm	S	L	L

S = Satisfactory

L = Limited

NS = Non-satisfactory

– = No data available

Table 2: Uponor PP-RCT chemical resistance

Product shipping and storage

Shipping

It is the customer's responsibility to verify the product against the packing slip and visually inspect it for damage. Document and report any variations in the shipment or any damaged product.

Storage

PP-RCT pipe is shipped in 13-ft. and 19-ft. straight lengths packaged in plastic bags to protect from UV exposure and debris. Uponor recommends keeping the pipes in their protective packaging until ready for use.

Store pipe on a flat surface. If storing on racks, ensure a minimum of four evenly spaced supports. Uponor recommends placing plywood or a similar form of backing across the supports to prevent the pipe from deforming. Maximum stacking height for the pipe is 3 ft.

Uponor recommends storing PP-RCT pipe indoors. Avoid storage in areas where solvents, paints, glues, or similar products are kept.

If stored outside for an extended period, keep the pipes in their UV-resistant bags and place them in a shaded area. If storing outside with a cover, use a light-colored tarp as darker colors can cause heat damage. If pipes are exposed to UV radiation for more than 30 days, it will void the warranty.

Getting started

Important safety information

To reduce the risk of injury, read and understand this PP-RCT piping systems installation guide before beginning work. Also, read all product safety warnings and operator's manuals for the heat-fusion tools to ensure proper and safe operation. Always wear safety goggles or safety glasses with side shields when performing work.

WARNING: Cancer and Reproductive Harm
P65Warnings.ca.gov

Job-site material handling

Refer to the following guidelines to ensure proper pipe handling.

1. Protect the ends of the pipe. Dropping them on a hard surface or stepping on them can cause micro-fractures in the pipe wall.
2. If the pipe is dropped or crushed, check it for damage. Identify, mark and eliminate any damaged pipe. Damage may not be visible so better to discard potentially damaged pipe.
3. Cold weather makes the pipe less flexible and more susceptible to impact damage. Use caution when handling in cold temperatures. Uponor does not recommend handling PP-RCT products in temperatures below -5°F (-20.5°C).

4. Use caution when using a forklift to move the pipe. Do not drape the pipe over the fork. Instead, place the pipe on a pallet for support and then transport. Do not insert the forks into the end of the pipe.
5. When shipping, load on a flat or supported surface and only strap in supported areas to prevent pipe deformation.
6. Keep the fittings in their original bags for ease of identification.

Pipe and fitting information

Although all Uponor PP-RCT pipes are metric, Uponor has assigned imperial pipe-size equivalents for compatibility with the North American market. Refer to the table below for nominal and actual pipe sizes.

Nominal Size		Actual (Inch)		Actual (Metric)	
Inch	Metric	Min.	Max.	Min.	Max.
½	20	0.787	0.799	20	20.3
¾	25	0.984	0.996	25	25.3
1	32	1.26	1.272	32	32.3
1¼	40	1.575	1.591	40	40.4
1½	50	1.969	1.988	50	50.5
2	63	2.48	2.504	63	63.6
2½	75	2.953	2.98	75	75.7
3	90	3.543	3.579	90	90.9
4	125	4.921	4.969	125	126.2
6	160	6.299	6.358	160	161.5
8	200	7.874	7.945	200	201.8
10	250	9.842	9.941	250	252.5
12	315	12.401	12.5	315	317.5

Table 3: Nominal vs. actual pipe sizes

SDR	Color	Pipe sizes	Straight lengths
7.4	Green with gray stripes	½" – ¾"	13 ft.
9	Green with gray stripes	1" – 2"	13 ft.
		2½" – 6"	19 ft.
11	Solid green	1" – 2"	13 ft.
		2½" – 12"	19 ft.
17.6	Solid green	4" – 12"	19 ft.

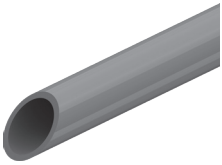


Table 4: Uponor PP-RCT Mechanical Pipe

SDR	Color	Pipe sizes	Straight lengths
7.4	Green with red stripes	½" – ¾"	13 ft.
9	Green with red stripes	1" – 2"	13 ft.
		2½" – 8"	19 ft.

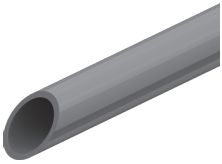


Table 5: Uponor PP-RCT Hot Potable Pipe

SDR	Color	Pipe sizes	Straight lengths
7.4	Green with blue stripes	½" – ¾"	13 ft.
11	Green with blue stripes	1" – 2"	13 ft.
		2½" – 8"	19 ft.

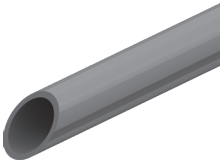
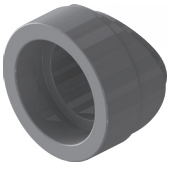
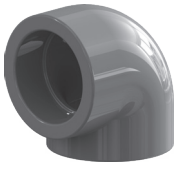


Table 6: Uponor PP-RCT Cold Potable Pipe

Fittings offering

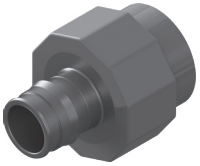
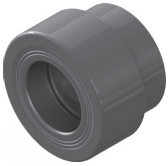
Uponor offers molded socket fusion fittings in tees, couplings, elbows and adapters for ½" (20 mm) to 4" (125 mm) pipe along with fabricated butt-fusion fittings for 6" (160 mm) to 12" (315 mm) SDR-specific pipe. In addition, Uponor offers various transition fittings for ProPEX expansion, threaded and flange adapters. Refer to the tables below for details.





Fitting type	Saddle outlet fusion	Socket fusion	Fabricated (butt fusion)
Sizes	½" to 4" (20 mm to 125 mm)	½" to 4" (20 mm to 125 mm)	6" to 12" (160 mm to 315 mm)
SDR pipe	9, 11, 17.6	7.4, 9, 11, 17.6	9, 11, 17.6
Material	PP-RCT (molded)	PP-RCT (molded)	PP-RCT pipe

Table 7: Uponor PP-RCT saddle outlet, socket, and fabricated fittings


Fitting type	Saddle outlet fusion	Socket fusion	Fabricated (butt fusion)
Sizes	½" to 1" (20 mm to 32 mm)	½" to 2" (20 mm to 63 mm)	1½" to 12" (50 mm to 315 mm)
SDR pipe	N/A	N/A	9, 11, 17.6

Table 8: Uponor PP-RCT transition fittings

Making connections

Qualified training

Uponor offers factory or field training through sales professionals or manufacturer's representatives. Installers must be properly trained and qualified for the system to be covered under warranty. The Uponor PP-RCT warranty is only valid when installers are properly trained and qualified and when the system is properly installed, pressure tested, documented and submitted.

Safety precautions

The heat-fusion connection method requires tool temperatures up to 518°F (270°C). It is extremely important to refer to the following safety guidelines to prevent potential injury.

- Only persons qualified in heat fusion shall perform heat fusion connections.

- Always post a warning sign before beginning the fusion process.
- Always wear personal protective equipment (PPE) which may include safety glasses, long sleeves, gloves, footwear and hard hat.
- Be aware of your environment and verify that it is a safe space to operate fusion equipment.
- Understand proper operation and safety procedures for the fusion equipment.
- Ensure all fusion tools are in good working order.
- Never leave heated fusion tools unattended.
- When unplugged, store fusion tools properly.
- When using electric fusion tools, follow recommended electrical safety practices.

Tool power supply

It is imperative that adequate power is available for the fusion equipment. Insufficient power can result in cold fusions that will fail. If using extension cords, ensure the cords are capable of delivering the required power and that you are within a reasonable distance from the power source. Refer to the tool manufacturer's operating manual for specific power requirements.

Fusion tool recommendations

The tables in this section represent Uponor's recommendations for fusion tools, by pipe size, for the three most common PP-RCT fusion tool manufacturers: McElroy, Ritmo, and Widos. Note that there may be additional tools produced by each tool manufacturer that are capable of fusing sizes not listed in these tables. Contact each specific tool manufacturer with additional questions on tool/pipe size fusion compatibility.

McElroy tool recommendations

Pipe size	Socket fusion*			Butt fusion*		Outlet fusion*	
	Socket kit	Socket assist	Socket fabrication	Butt fusion	Butt fusion / miters	Outlet (by outlet size)	Outlet assist (by outlet size)
½" - 20 mm	Small/large heater kit		SmartFab 125			Small/large heater kit	Hornet
¾" - 25 mm	Small/large heater kit		SmartFab 125			Small/large heater kit	Hornet
1" - 32 mm	Small/large heater kit		SmartFab 125			Small/large heater kit	Hornet
1¼" - 40 mm	Small/large heater kit		SmartFab 125			Small/large heater kit	Hornet
1½" - 50 mm	Small/large heater kit		SmartFab 125			Small/large heater kit	Hornet
2" - 63 mm	Small/large heater kit	Spider 125/Polygon	SmartFab 125	Acrobat 160/250	Polygon	Small/large heater kit	Hornet/Hornet XL
2½" - 75 mm	Large heater kit	Spider 125/Polygon	SmartFab 125	Acrobat 160/250	Polygon	Large heater kit	Hornet XL
3" - 90 mm	Large heater kit	Spider 125/Polygon	SmartFab 125	Acrobat 160/250	Polygon	Large heater kit	Hornet XL
4" - 125 mm	Large heater kit	Spider 125/Polygon	SmartFab 125	Acrobat 160/250	Polygon	Large heater kit	Hornet XL
6" - 160 mm				Acrobat 160/250	Polygon		Hornet XL
8" - 200 mm				Acrobat 250/315			
10" - 250 mm				Acrobat 250/315			
12" - 315 mm				Acrobat 315			
14" - 355 mm				Acrobat QuickFit			
16" - 400 mm				Acrobat QuickFit			
18" - 450 mm				Acrobat QuickFit			
20" - 500 mm				Acrobat QuickFit			
24" - 630 mm				Acrobat QuickFit			

Table 9: McElroy tool recommendations

*When two tools are listed, the first tool is the primary recommendation; the second is compatible but not required.

*Be sure to select the properly sized inserts for the pipe.

Ritmo tool recommendations

Pipe size	Socket fusion*			Butt fusion*		Outlet fusion*	
	Socket kit	Socket assist	Socket fabrication	Butt fusion	Butt fusion / miters	Outlet (by outlet size)	Outlet assist (by outlet size)
½" - 20 mm	R-63 TFE Hand Held/ R125q TFE Hand Held	Prisma jig with reducing jaws	Prisma jig with reducing jaws			Small/large heater kit	Prisma Up 90 (20MM-90MM)
¾" - 25 mm	R-63 TFE Hand Held/ R125q TFE Hand Held	Prisma jig with reducing jaws	Prisma 125			Small/large heater kit	Prisma Up 90 (20MM-90MM)
1" - 32 mm	R-63 TFE Hand Held/ R125q TFE Hand Held	Prisma jig with reducing jaws	Prisma 125			Small/large heater kit	Prisma Up 90 (20MM-90MM) or UP 125 (32MM-125MM)
1¼" - 40 mm	R-63 TFE Hand Held/ R125q TFE Hand Held	Prisma jig with reducing jaws	Prisma 125			Small/large heater kit	
1½" - 50 mm	R-63 TFE Hand Held/ R125q TFE Hand Held	Prisma jig with reducing jaws	Prisma 125			Small/large heater kit	
2" - 63 mm	R-63 TFE Hand Held/ R125q TFE Hand Held	Prisma jig with reducing jaws	Prisma 125			Small/large heater kit	
2½" - 75 mm	R125q TFE Hand Held	Prisma jig – standard set up	Prisma 125			Large heater kit	
3" - 90 mm	R125q TFE Hand Held	Prisma jig – standard set up	Prisma 125	Easy Life 160/ GAMMA 160	GAMMA 160– Manual BF	Large heater kit	
4" - 125 mm	R125q TFE Hand Held	Prisma jig – standard set up	Prisma 125	Easy Life 160/ GAMMA 160	GAMMA 160 – Manual BF	Large heater kit	UP 125 (32MM-125MM)
6" - 160 mm				Easy Life 160/ GAMMA 160	GAMMA 160 – Manual BF		
8" - 200 mm				Easy Life 200/250/315			
10" - 250 mm				Easy Life 250/315			
12" - 315 mm				Easy Life 315/355			
14" - 355 mm				Easy Life 355/500			
16" - 400 mm				Easy Life 500/630			
18" - 450 mm				Easy Life 500/630			
20" - 500 mm				Easy Life 500/630			
24" - 630 mm				Easy Life 630			

Table 10: Ritmo tool recommendations

*When multiple tools are listed, the first tool is the primary recommendation; the second (or third) are compatible but not required.

*Be sure to select the properly sized inserts for the pipe.

Widos tool recommendations

Pipe size	Socket fusion*			Butt fusion*		Outlet fusion*	
	Socket kit	Socket assist	Socket fabrication	Butt fusion	Butt fusion / miters	Outlet (by outlet size)	Outlet assist (by outlet size)
½" - 20 mm	Weld-it small/ large		W3511			Weld-it small/ large	
¾" - 25 mm	Weld-it small/ large		W3511			Weld-it small/ large	
1" - 32 mm	Weld-it small/ large		W3511			Weld-it small/ large	
1¼" - 40 mm	Weld-it small/ large		W3511			Weld-it small/ large	
1½" - 50 mm	Weld-it small/ large		W3511			Weld-it small/ large	
2" - 63 mm	Weld-it small/ large	Socket jig	W3511			Weld-it small/ large	
2½" - 75 mm	Weld-it large	Socket jig	W3511			Weld-it large	
3" - 90 mm	Weld-it large	Socket jig	W3511			Weld-it large	
4" - 125 mm	Weld-it large	Socket jig	W3511	4400/4600	Maxiplast	Weld-it large	
6" - 160 mm				4400/4600	Maxiplast		
8" - 200 mm				4600/4900			
10" - 250 mm				4600/4900			
12" - 315 mm				4900/5100			
14" - 355 mm				5100/5500			
16" - 400 mm				5100/5500			
18" - 450 mm				5100/5500			
20" - 500 mm				5500/6100			
24" - 630 mm				6100			

Table 11: Widos tool recommendations

*When two tools are listed, the first tool is the primary recommendation; the second is compatible but not required.

*Be sure to select the properly sized inserts for the pipe.

Pipe size	Welding depth		Heating time (sec)		Welding time (sec)	Cooling time (min)
	mm	Inches	Above 40°F	Below 40°F		
½" (20 mm)	13	½"	5	8	4	2
¾" (25 mm)	14	9/16"	5	8	4	2
1" (32 mm)	15	5/8"	7	11	4	2
1¼" (40 mm)	16.5	1/16"	8	12	6	4
1½" (50 mm)	18	¾"	12	18	6	4
2" (63 mm)	24	15/16"	24	36	8	6
2½" (75 mm)	26	1"	30	45	8	6
3" (90 mm)	29	1 1/8"	40	60	8	8
4" (125 mm)	40	1 9/16"	60	90	10	8

Table 12: Socket fusion specifications as defined in DVS 2207-11: 2017, ½" (20 mm) to 4" (125 mm)

Socket fusion

For socket fusion connections of 2" (63 mm) and larger, Uponor recommends the use of mechanically assisted fusion machines to aid the installer and provide faster, more precise connections. The primary types of socket fusion machines are jigs, portable machines and stationary bench tops.

Jigs and portable machines

Use jigs and portable machines for jobsite connections of 2" (63 mm) to 4" (125 mm) pipe and fittings. Along with a hand-iron and the appropriate-size adapters, portable socket fusion tools are ideal for overhead connections as well as vertical piping and branches.

Ovaling in machine-assisted fusions

Ovaling can occur when a mechanical-assist tool's clamps exert too much force on the socket fitting. Use caution when tightening the clamps. The clamps should be snug, but not so tight that they distort the fitting.

Stationary bench-top machines

Bench-top socket fusion machines connect 2" (63 mm) to 4" (125 mm) pipe and fittings. These machines assist the installer by holding the pipe and/or fitting in place, providing precise and consistent fusion joints. They also create a platform for prefabrication of smaller spools like offsets and expansion loops.

Socket fusion checklist

Note: The following steps are abbreviated and for reference only. Installers must be trained and carry a current qualification from the tool manufacturer or Uponor for the specific fusion tool(s) being used.

Socket fusion – ½" (20 mm) to 4" (125 mm) pipe and fittings

Required heating and fusion temperature:
482°F (250°C) to 518°F (270°C)

Socket fusion using mechanically assisted machines

Follow the seven steps below to fuse ½" (20 mm) to 4" (125 mm) Uponor PP-RCT pipe and socket fittings.

Note: Hand-held irons are ideal for pipe sizes up to 1½" (50 mm) while larger pipe sizes should use mechanically assisted machines.

1. **Clean** – Using a dry, lint-free cloth, clean the pipe and fitting ends with 94% or greater isopropyl alcohol.
2. **Chamfer [2" (63 mm) and smaller connections only]** – Using a chamfer tool, chamfer the pipe end to aid in insertion.
3. **Mark weld depth** – Using the chamfer tool or depth gauge, mark the required welding depth in a minimum of two places on the pipe.
4. **Heat** – Clean the heater adapters with a clean, dry, lint-free cloth. Do NOT use isopropyl alcohol on the heater adapters. Verify the heater temperature with a contact pyrometer to ensure it is within the acceptable range: 482°F (250°C) to 518°F

(270°C). Firmly seat the fitting onto the male adapter of the tool, while simultaneously inserting the pipe into the female end of the tool. Once both are fully inserted, heat for the required time shown in **Table 12**.

5. **Fuse** – After waiting the appropriate time, remove the pipe and fitting from the tool and quickly inspect the melts before connecting the pieces together to the required depth. Do not twist!
6. **Cool** – Let the assembly cool undisturbed for the required time shown in **Table 12**.
7. **Inspect** – After cooling is complete, inspect the weld. Look for two distinct beads, free of any voids, gaps or debris.

Saddle outlet fusion

One of the greatest benefits of PP-RCT piping is the ability to use saddle outlets in place of traditional tees. Saddle outlet fusions are created by welding a curved saddle outlet fitting to the pipe's sidewall, providing a branch connection for various needs, including pipe and gauges. Saddle outlets also produce less pressure loss than traditional reducing tees, resulting in better system performance.

Saddle outlets are available in ½" (20 mm) to 4" (125 mm) outlet sizes for up to 12" (315 mm) pipe in various transition types, including PP-RCT, ProPEX, and NPT.

Outlet fusion checklist

Saddle outlet fusion – ½" (20 mm) to 4" (125 mm) outlet fittings

Required heating and fusion temperature: 482°F (250°C) to 518°F (270°C)

Follow the steps below to fuse ½" (20 mm) to 4" (125 mm) Uponor PP-RCT pipe and socket fittings.

Note: Hand-held irons are ideal for pipe sizes up to 1½" (50 mm) while larger pipe sizes should use mechanically assisted machines.

1. **Clean** – Using a dry, lint-free cloth, clean the pipe and saddle outlet ends with 94% or greater isopropyl alcohol.
2. **Mark** the outlet location on the pipe.
3. **Drill** the outlet hole with the proper-sized bit for the outlet.
4. **Check alignment** of the saddle outlet to the pipe sidewall. Mark a reference line for ease of locating when fusing.
5. **Heat**
   - Clean the heater adapters with a clean, dry, lint-free cloth. Do NOT use isopropyl alcohol on the heat plates.
   - Verify the heater temperature with a contact pyrometer to ensure it is within the acceptable range: 482°F (250°C) to 518°F (270°C).
   - Firmly seat the male end of the heater into the hole while simultaneously inserting the saddle outlet into the female end of the tool.

- Once both are fully inserted, heat until a full bead appears on the pipe sidewall.
- Do not twist!

6. **Fuse** – After the appropriate bead has been met, separate the pipe and fitting. Quickly inspect the melts and then connect the pieces.
7. **Cool** – Let the assembly cool undisturbed for the required time shown in **Table 12**.
8. **Inspect** – After cooling is complete, inspect the weld. Look for two distinct beads, free of any voids, gaps, or debris.

Note: Use caution when torquing threaded fusion outlets. Be sure to hold the fusion outlet while applying torque and tightening a threaded adapter.

Butt fusion

Butt fusion, in its simplest form, is the process of joining two pipes (or pipe and fitting) of the same SDR together using heat and pressure. The machines used for butt fusion can be either manual or hydraulic, with the primary difference being how pressure is regulated (e.g., manual force vs. hydraulic). Butt fusion tools are typically designed for a specific pipe size range, so verify compatibility before performing fusions.

An important detail that needs to be taken into account when performing butt fusions is **drag**. Drag is defined as the forces acting in the opposite direction of the fusion process

(e.g., friction between the pipe being fused and the pipe stands or supports). Therefore, pressure may need to be added to the fusion calculations to ensure adequate pressure is achieved.

Definitions

Machine pressure – Minimum pressure required per machine to fuse material before accounting for drag.

Drag pressure – The minimum amount of force required to overcome the inertia of the material and machine carriage.

Full fusion pressure – Machine pressure plus drag pressure.

Butt fusion checklist

1. Ensure the tool being used is appropriate for the pipe sizes to be fused.
2. Ensure adequate power is available for the tool. Inadequate power can result in cold fusions that will fail.
3. Verify the tool's inserts are compatible with the pipe and/or fittings to be fused.
4. Familiarize yourself with the tool, and ensure it is in proper working order before performing fusions.

Refer to the following steps on **pages 33-34** to fuse 6" (160 mm) through 12" (315 mm) Uponor PP-RCT pipe and/or fittings. Note that all butt fusion connections are made using mechanically assisted machines that use precise pressures for accurate connections.

Butt fusion – 6" (160 mm) to 12" (315 mm) pipe

Required heating and fusion temperature:
392°F (200°C) to 428°F (220°C)

5. **Clean** – Using a dry, lint-free cloth, clean the pipe and fitting ends with 94% or greater isopropyl alcohol. Secure the pipes with the jaws, leaving approximately 1½" of the ends exposed for facing.
6. **Face** – Using a facer, face the ends of the pipe until the jaws reach the facer stops. Look for full ribbons of pipe material as a sign of complete facing.
7. **Align** – After facing, bring the pipe ends together to ensure proper alignment. There is a 10% allowance. If adjustment is required, the pipe may need to be refaced.

8. **Heat*** – Clean the heat plates using a clean, dry, lint-free cloth. Do NOT use isopropyl alcohol to clean the heat plates. Once bead-up is met, switch to heating pressure and allow the pipes to heat soak for the required time shown in **Table 13**.
9. **Fuse*** – After the heat time has been met, separate the pipes. Quickly inspect the melts and connect the pieces under fusion pressure.
10. **Cool** – Let the assembly cool for the required time per **Table 13**.
11. **Inspect** – After cooling is complete, inspect the weld. Look for one uniform bead, free of any voids, gaps or debris.

*__Important!__ Be sure to calculate drag pressure for every connection and add that to the theoretical fusion pressure.

Notes

Pipe size	SDR	Bead size (mm)	Heat soak time (min:sec)	Heater removal time (sec)	Cooling times			
					Ambient below 60°F (mins)	Ambient 60°F–80°F (mins)	Ambient 80°F–105°F (mins)	Special conditions* (mins)
4" (125 mm)	9	1	2:34	0:07	11	14	18	9
	11	1	2:08	0:06	9	11	15	8
	17.6	1	1:22	0:06	6	8	10	5
6" (160 mm)	9	1	3:14	0:08	13	17	23	11
	11	1	2:41	0:07	11	14	19	9
	17.6	1	1:44	0:06	7	9	12	6
8" (200 mm)	9	1	3:56	0:09	16	21	28	28
	11	1.5	3:18	0:08	13	17	23	23
	17.6	1	2:08	0:06	9	11	18	15
10" (250 mm)	11	1.5	4:01	0:10	17	21	28	14
	17.6	1	2:37	0:07	11	14	18	9
12" (315 mm)	11	2	4:43	0:11	21	26	35	18
	17.6	1	3:15	0:08	13	17	23	11

*Special conditions = no load on joint, properly supported for the full duration of the standard cooling time

Table 13: Butt fusion specifications as defined in DVS 2207-11: 2017

Note: For butt fusion specifications smaller than 4", please refer to DVS 2207-11: 2017 for applicable heat soak, cooling times, etc.

Dimension ND (OD mm)	SDR	Machine pressure, pounds per square inch (psi)						
		Rolling and TracStar® 250	Acrobat™ 160	Acrobat 250	Acrobat 315	Polygon™	Rolling, TracStar® 412 and 618	MegaMc® 824 TracStar® 630
4" (125 x 7.1)	17.6	36	66	66	–	59	19	–
4" (125 x 11.4)	11	55	101	101	–	91	29	–
4" (125 x 14.0)	9	66	121	121	–	109	35	–
6" (160 x 9.1)	17.6	58	108	108	–	–	31	–
6" (160 x 14.6)	11	90	166	166	–	–	48	–
6" (160 x 17.9)	9	108	198	198	–	–	57	–
6" (160 x 21.9)	7.4	127	235	235	–	–	67	–
8" (200 x 11.4)	17.6	91	–	168	103	–	48	16
8" (200 x 18.2)	11	141	–	259	159	–	74	25
8" (200 x 22.4)	9	168	–	310	190	–	89	30
8" (200 x 27.4)	7.4	199	–	367	225	–	105	35
10" (250 x 14.2)	17.6	142	–	263	161	–	75	25
10" (250 x 22.7)	11	220	–	405	248	–	116	39
10" (250 x 27.9)	9	263	–	484	296	–	139	46
10" (250 x 34.2)	7.4	311	–	573	351	–	164	55
12" (315 x 17.9)	17.6	–	–	–	255	–	120	40
12" (315 x 28.6)	11	–	–	–	394	–	184	61
12" (315 x 35.2)	9	–	–	–	471	–	220	73
12" (315 x 43.1)	7.4	–	–	–	557	–	261	87

Table 14: Machine pressure for McElroy tools

Note: This table is based on the tool manufacturer's information that was available to Uponor at the time of this document's printing. Always refer to the tool manual to calculate the machine pressure. If there is any discrepancy between the information in this document and the information provided by the tool manufacturer, the tool manufacturer's information takes precedence.

Full fusion pressure = machine pressure + drag

McElroy contact information

918.836.8611
fusion@mcelroy.com
mcelroy.com

Dimension ND (OD mm)	SDR	[N]	Machine pressure, pounds per square inch (psi)				
		Gamma 160	Basic/Delta Dragon 160	Basic/Delta Dragon 200	Basic/Delta Dragon 250B	Basic/Delta Dragon 315B	Basic/Delta Dragon 355B
4" (125 x 7.1)	17.6	263	196	121	65	–	–
4" (125 x 11.4)	11	407	303	187	100	–	–
4" (125 x 14.0)	9	732	361	223	119	–	50
6" (160 x 9.1)	17.6	431	327	198	106	94	44
6" (160 x 14.6)	11	667	497	306	164	145	68
6" (160 x 17.9)	9	1199	591	365	195	172	81
6" (160 x 21.9)	7.4	950	707	436	234	206	97
8" (200 x 11.4)	17.6	–	–	310	166	147	69
8" (200 x 18.2)	11	–	–	477	256	226	107
8" (200 x 22.4)	9	–	–	570	305	269	127
8" (200 x 27.4)	7.4	–	–	682	366	322	152
10" (250 x 14.2)	17.6	–	–	–	366	228	108
10" (250 x 22.7)	11	–	–	–	399	352	166
10" (250 x 27.9)	9	–	–	–	477	421	199
10" (250 x 34.2)	7.4	–	–	–	571	503	238
12" (315 x 17.9)	17.6	–	–	–	–	363	171
12" (315 x 28.6)	11	–	–	–	–	558	264
12" (315 x 35.2)	9	–	–	–	–	668	316
12" (315 x 43.1)	7.4	–	–	–	–	799	378

Table 15: Machine pressure for Ritmo tools

Note: This table is based on the tool manufacturer's information that was available to Uponor at the time of this document's printing. Always refer to the tool manual to calculate the machine pressure. If there is any discrepancy between the information in this document and the information provided by the tool manufacturer, the tool manufacturer's information takes precedence.

Full fusion pressure = machine pressure + drag

Ritmo contact information

863.679.8655
info@ritmoamerica.com
ritmoamerica.com

Dimension ND (OD mm)	SDR	lb	Machine pressure, pounds per square inch (psi)					
		Maxiplast	4400	4600	4900	4911	5100 and 5500	6100
4" (125 x 7.1)	17.6	60	11	6	–	–	–	–
4" (125 x 11.4)	11	90	17	8	–	–	–	–
4" (125 x 14.0)	9	108	20	10	9	–	–	–
6" (160 x 9.1)	17.6	97	18	9	8	8	–	–
6" (160 x 14.6)	11	148	27	13	12	12	–	–
6" (160 x 17.9)	9	176	32	16	14	14	–	–
6" (160 x 21.9)	7.4	212	39	19	17	17	–	–
8" (200 x 11.4)	17.6	–	–	13	12	12	5	–
8" (200 x 18.2)	11	–	–	20	18	18	8	–
8" (200 x 22.4)	9	–	–	25	22	22	9	–
8" (200 x 27.4)	7.4	–	–	29	26	26	11	–
10" (250 x 14.2)	17.6	–	–	21	18	18	8	–
10" (250 x 22.7)	11	–	–	32	28	28	12	–
10" (250 x 27.9)	9	–	–	38	33	33	14	–
10" (250 x 34.2)	7.4	–	–	45	40	40	17	–
12" (315 x 17.9)	17.6	–	–	–	29	29	12	10
12" (315 x 28.6)	11	–	–	–	44	44	19	15
12" (315 x 35.2)	9	–	–	–	53	53	22	18

Table 16: Machine pressure for Widos tools

Note: This table is based on the tool manufacturer's information that was available to Uponor at the time of this document's printing. Always refer to the tool manual to calculate the machine pressure. If there is any discrepancy between the information in this document and the information provided by the tool manufacturer, the tool manufacturer's information takes precedence.

Full fusion pressure = machine pressure + drag

Widos contact information

678.766.1250
info@widoswelding.com
widoswelding.com

Flange connections

Refer to the following instructions and bolt torque specifications when installing Uponor PP-RCT flange adapters for transitioning to other piping materials or installing inline valves.

1. Remove all foreign material and debris from seating surfaces, fasteners (bolts or studs), washers, and nuts.
2. Position the flange adapter to the mating flange or valve to ensure proper alignment. If a flange gasket is required, use a black EPDM or red SBR full-face rubber gasket with a minimum 1/8" thickness. Ensure the gasket has an inside diameter (ID) consistent with the flange adapter ID.
   Note: Consult the gasket manufacturer regarding chemical compatibility.
3. Refer to **Table 17** for the number of bolts and bolt-diameter recommendations. For bolt length, ensure it meets the required length for the depth of the valve or mating flange.
4. Install the bolts, nuts, and washers (as needed), and hand tighten.
5. When using butterfly valves, open the valve to ensure the wafer (or disc) can move to the “full open” position.

Uponor PP-RCT flange adapter bolt information

Nominal Pipe Size	Ft.-Lbs.	Ft.-Lbs.	Number of Bolts	Bolt Diameter	Bolt Tighten Pattern
¾"	10	12	4	½"	Refer to **Figure 2** on the next page.
1"	11	14	4	½"	
1¼"	15	18	4	½"	
1½"	22	27	4	½"	
2"	26	32	4	⅝"	
2½"	30	36	4	⅝"	
3"	30	36	8	⅝"	Refer to **Figure 3** on the next page.
4"	37	45	8	⅝"	
6"	44	53	8	¾"	
8"	55	66	8	¾"	
10"	70	84	12	⅞"	Refer to **Figure 4** on the next page.
12"	74	89	12	⅞"	

Table 17: Uponor PP-RCT flange adapter bolt information

Tightening

After hand tightening the bolts, refer to the **Bolt Tighten Pattern** column in **Table 17** along with **Figures 2, 3, and 4** on the next page for the correct pattern in which to tighten the bolts. Following this pattern helps the flange adapter seal uniformly.

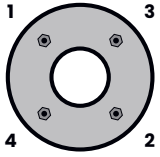


Figure 2: 4-bolt pattern

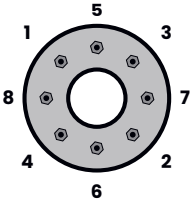


Figure 3: 8-bolt pattern

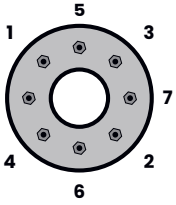


Figure 4: 12-bolt pattern

1. Use a torque wrench to properly apply the right amount of force to the bolt connection.
2. Tighten all bolts to 60-75% of recommended force following the bolt pattern for the flange size.
3. Tighten all bolts to the full torque (following the pattern) until all torque is uniform.

Troubleshooting

If the flange does not completely seal during system pressurization, retighten the bolts to the maximum-recommended values in **Table 17**. If the connection still does not seal properly, disassemble it, and inspect surfaces for debris or abnormalities

Mechanical and cold potable pipe sizing by flow rate

Uponor PP-RCT mechanical and cold potable pipes are designed for velocities at 8 fps. The pipe diameter and wall thickness determine the flow rate shown in gallons per minute (gpm). Refer to **Table 18** for approximate flow rates based on 8 fps.

Hot potable pipe sizing by flow rate

Ensure the correct pipe size for the DHW and/or DHW-R application. Refer to the Uponor Online Pipe Sizing Calculator at uponor.com/calculator for details.

DHW – If the design requires booster pumps to increase system pressure, ensure the delivered pressure does not exceed 80 psi (5.5 bar). If higher pressures are necessary, implement pressure zones or contact Uponor Construction Services at design.services@uponor.com for recommendations.

DHW-R – Ensure proper sizing of pumps for the 2 fps limit stated above for DHW-R lines. Uponor recommends installing balancing valves to ensure the velocity limit is not exceeded. Balancing valves also help reduce energy consumption and increase service life.

Flow rates for PP-RCT mechanical and cold potable pipe based on flow velocity of 8 fps					
Dimension		SDR 7.4	SDR 9	SDR 11	SDR 17.6
N.D.	O.D.				
½"	20 mm	6			
¾"	25 mm	9			
1"	32 mm		18	20	
1¼"	40 mm		28	31	
1½"	50 mm		44	49	
2"	63 mm		71	78	
2½"	75 mm		101	112	
3"	90 mm		145	161	
4"	125 mm		281	312	366
6"	160 mm		460	512	600
8"	200 mm		719	801	938
10"	250 mm		1,126	1,248	1,467
12"	315 mm		1,793	1,982	2,329

Table 18: Flow rates for PP-RCT mechanical and cold potable pipes at 8 fps

Determining pipe size by head loss

After determining the required pipe sizes, calculate the pressure drop of the system and size up the pump. When calculating for pressure loss, the recommended safety factor is 20%, taking into account the age of the pipe and quality of workmanship.

The Hazen-Williams formula is designed for water systems and may be used to calculate pressure loss, the conversion of pressure loss to head loss and the calculation of flow velocity.

$$P_L = \frac{452}{di^{4.87}} \cdot \left(\frac{Q}{C}\right)^{1.85}$$

Consult Uponor Technical Services at 888.594.7726 if designing a system using fluids other than water.

Where
P_L = Pressure loss, psi/100 ft. of pipe
Q = Flow rate (gpm)
di = Inside diameter of pipe, inches
C = Flow coefficient = 150 for PP-RCT piping

Conversion from pressure loss to head loss (ft. of head loss per 100 ft. of pipe)

Where H_L = Head loss, ft./100 ft. of pipe

$$H_L = 2.31 \cdot P_L$$

Calculation of flow velocity

Where v = Flow velocity, ft./sec

$$V = 0.4084 \cdot \left(\frac{Q}{di^2} \right)$$

Pipe support

When selecting pipe support, it is important to choose products which have been proven safe for use in the given application. Uponor recommends using non-metal hangers and clamps.

Note: Uponor recommends rubber or felt-lined clamps and supports for all hot-water and cold-water piping systems.

Note: Uponor recommends using metric clamps. If metric clamps are unavailable, refer to **Table 19** for the actual inch and millimeter pipe sizing for guidance on choosing the proper clamp size.

Clamp and hanger sizing

Table 19 provides size recommendations for pipe supports based on the pipe's outside diameter only. If insulating the pipe, consider the pipe's total diameter including insulation.

Note: Uponor's warranty does not cover damage caused by hangers or clamps.

Nominal Size		Actual (Inch)		Actual (Metric)	
Inch	Metric	Min.	Max.	Min.	Max.
½	20	0.787	0.799	20	20.3
¾	25	0.984	0.996	25	25.3
1	32	1.26	1.272	32	32.3
1¼	40	1.575	1.591	40	40.4
1½	50	1.969	1.988	50	50.5
2	63	2.48	2.504	63	63.6
2½	75	2.953	2.98	75	75.7
3	90	3.543	3.579	90	90.9
4	125	4.921	4.969	125	126.2
6	160	6.299	6.358	160	161.5
8	200	7.874	7.945	200	201.8
10	250	9.842	9.941	250	252.5
12	315	12.401	12.5	315	317.5

Table 19: Nominal vs. actual pipe sizes

Support spacing

General rules apply to the positioning of pipe support for both fixed and sliding points. Maximum support spacing depends on the pipe's outside diameter and anticipated temperature difference between ambient and operating temperature of the fluid. Refer to the table below for maximum recommended support spacing for Uponor PP-RCT mechanical and hot potable pipe.

Nominal pipe size[1]	Maximum horizontal support spacing[2]	Maximum vertical support spacing
1½" (50 mm) and smaller	6 feet (1.8 m)	5 feet (1.5 m)
2" (63 mm) to 3" (90 mm)	8 feet (2.4 m)	10 feet (3 m)
4" (125 mm) and larger	10 feet (3 m)	

Notes:

[1]Applies to all mechanical and hot potable fiber-layer pipe.

[2]Applies to systems with Delta Ts (ΔT) up to 100°F. For systems outside of that range, contact Uponor Technical Services.

Table 20: Support interval for Uponor PP-RCT mechanical and hot potable pipe

Expansion controls

Linear expansion and contraction

Linear expansion and contraction is an important factor when designing a piping system. It is the responsibility of the engineer or designer to dictate the allowable amount of linear growth over a set distance. Pipe expansion and contraction is based on the difference between ambient temperature and the maximum temperature of the fluid in the pipe.

ΔT = **T** operating temperature – **T** installation temperature

When transporting cold fluids, the **ΔT** value is minimal and the contraction of the pipe caused by the cold fluid will have no impact on the fused connections.

Piping systems transporting hot fluids, however, typically experience a greater **ΔT** value. Therefore, the system may require compensating devices, such as expansion loops and sliding elbows, to prevent pipe deformation. It is suggested that for high **ΔT** systems, the PP-RCT pipe should be guided at the standard support points, with an expansion compensator added mid-run to compensate for the movement. The size of the expansion compensator depends on the **ΔT** and length of run. See **Table 22** for detailed information on linear expansion of Uponor PP-RCT mechanical and hot potable pipes, which feature a fiber-composite layer to help minimize linear expansion and contraction.

Support spacing for PP-RCT cold potable pipe

Note: This is for cold-water applications with the ambient temperatures below 85°F (29.4°C).

Outside pipe diameter N.D. and O.D.												
½" 20 mm	¾" 25 mm	1" 32 mm	1¼" 40 mm	1½" 50 mm	2" 63 mm	2½" 75 mm	3" 90 mm	4" 125 mm	6" 160 mm	8" 200 mm	10" 250 mm	12" 315 mm
Maximum support spacing – distance in feet												
4	4	4	4	4	4.5	5	5	6.5	7	7.5	8	8.5

Table 21: Support spacing for PP-RCT cold potable pipe

Linear expansion of Uponor PP-RCT mechanical pipe with fiber composite layer

Uponor PP-RCT mechanical and hot potable pipe with fiber composite has a high level of stability. The linear expansion decreases to almost one-fifth the value of non-fiber composite PP-RCT pipes.

Linear expansion **ΔL** (inches)
Uponor pipes with fiber –**α** = 0.035 mm/mK = 2.367 x 10-4 in/ft. °F

Pipe length (ft.)	Difference in temperature ΔT (°F)							
	10	20	30	40	50	60	80	100
	Linear expansion ΔL (in)							
10	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2
20	0.0	0.1	0.1	0.2	0.2	0.3	0.4	0.5
30	0.1	0.1	0.2	0.3	0.3	0.4	0.6	0.7
40	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.9
50	0.1	0.2	0.3	0.5	0.6	0.7	0.9	1.2
60	0.1	0.3	0.4	0.6	0.7	0.8	1.1	1.4
70	0.2	0.3	0.5	0.7	0.8	1.0	1.3	1.6
80	0.2	0.4	0.6	0.7	0.9	1.1	1.5	1.9
90	0.2	0.4	0.6	0.8	1.0	1.3	1.7	2.1
100	0.2	0.5	0.7	0.9	1.2	1.4	1.9	2.3
150	0.3	0.7	1.0	1.4	1.7	2.1	2.8	3.5
200	0.5	0.9	1.4	1.9	2.3	2.8	3.7	4.7

Table 22: Linear expansion of Uponor PP-RCT mechanical and hot potable fiber-composite pipe

Pipe movement

Based on the application and environment, calculate the pipe's linear expansion and contraction and select the proper pipe supports to compensate for the movement.

In concealed installations, allow enough additional pipe to compensate for expansion and contraction. In open installations, use expansion or sliding elbows to enhance the visual uniformity of the system.

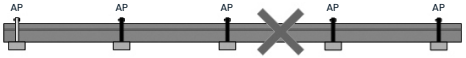
Plan for linear expansion/contraction by securely tightening specific clamps in appropriate locations. For example, securely tightening a clamp in the middle of a pipe run will cause equal expansion/contraction on both piping ends. If securing the pipe on one end, all expansion/contraction will be forced to the opposite end.

Important! Do not over tighten the other clamps on the piping run. It is important the pipe can move through these clamps during expansion/contraction.

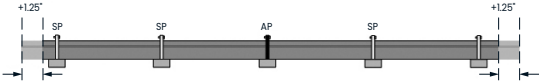
Refer to **Figure 5** on the following page for an example of a 150-foot run of 2" PP-RCT pipe with 140°F design temperature and a 70°F Delta T that produces a linear expansion of 2.5".

The sliding point (SP) is allowed to move, but the anchor point (AP) is tightened to restrict movement.

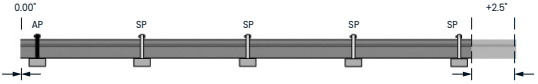
Note: Drawings are not to scale and are for representation purposes only.



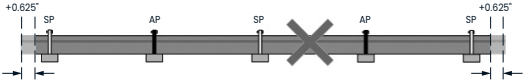
Installing tight clamps (AP) at the support intervals will cause pipe to deflect and not remain straight.



AP clamp in the middle is tight and will cause pipe to expand equally in both directions, provided other clamps are loosely tightened to simply "guide" the pipe.



AP clamp at left is tight and will cause pipe to expand all the way to the right, provided the clamps at right are all loosely tightened.



AP clamps are tight and SP clamps are slightly more loose to allow pipe movement. This installation will reduce pipe expansion on both ends due to the alternating tight and loose clamps.

Figure 5: Clamp guidance for pipe movement

Fixed-point and sliding-point supports

There are two types of point supports — fixed and sliding. Fixed points allow the pipe to move to or from the fixed point. Sliding points allow pipe movement and expansion through the support without damaging the pipe. It is important to control linear expansion via directional changes or expansion loops. Refer to the following pages for examples.

Accommodating pipe expansion with directional changes

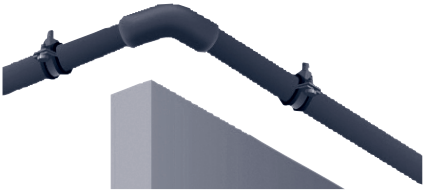


Figure 6: Expansion with directional changes

Calculate linear expansion with directional changes using the formula below:

$$LBS = K \times \sqrt{d \times \Delta l}$$

Where
LBS is the length of bending side in inches
K is material-specific dimensionless constant (constant of Uponor PP-RCT pipes is 2.98)
d is outside pipe diameter in millimeters
Δl is previously estimated longitudinal pipe expansion in inches

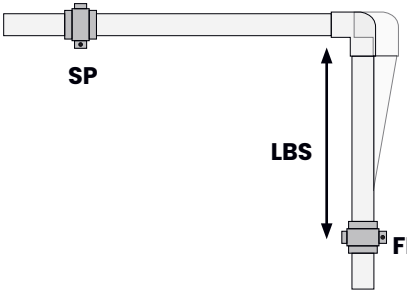


Figure 7: Linear expansion with directional changes

Figure 7 shows correct accommodation of linear expansion with directional changes (SP stands for sliding point, FP for fixed point and LBS is necessary length of bending side).

Note: Install branch lines at 90° angles as shown in **Figure 8**.

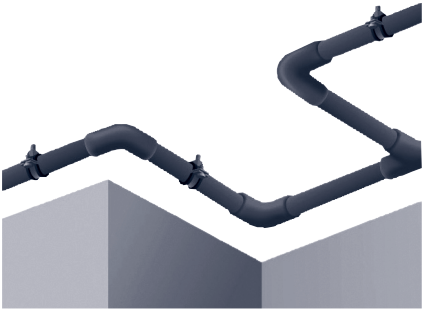


Figure 8: Using expansion loops

Install expansion loops when linear expansion cannot be controlled through directional changes in the piping system. Use four 90° elbows and refer to the following formula for the necessary expansion-loop parameters.

$$LBS = K \times \sqrt{d \times \frac{\Delta l}{2}}$$

Where
LBS is the length of bending side in inches
K is material-specific dimensionless constant (Uponor PP-RCT pipes constant is 2.98)
d is outside pipe diameter in millimeters
Δl is previously estimated longitudinal pipe expansion in inches

It is also important to estimate the expansion loop width (A_{min}) using the following equation:

$$A_{min} = 2 \times \Delta l + SA$$

Where
A_{min} is the width of expansion loop in inches
Δl is previously estimated longitudinal pipe expansion in inches
SA is a safety distance of 6" (152.44 mm)

Note: Install a compensating branch line at 90° angles as shown in **Figure 6**.

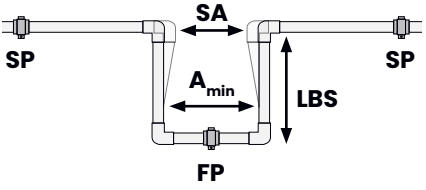


Figure 9: Expansion loops

Correct accommodation of linear expansion with expansion loops (SP stands for sliding point, FP for fixed point, LBS is necessary length of bending side, A_{min} is the width of the pipe bow and SA is safety distance).

Notes

Pipe dimension N.D. to O.D.		Linear expansion (inches)											
		1	2	3	4	5	6	7	8	9	10	11	12
		Minimum length of bending side (inches)											
½"	20 mm	13	19	23	27	30	33	35	38	40	42	44	46
¾"	25 mm	15	21	26	30	34	37	40	42	45	47	50	52
1"	32 mm	17	24	29	34	38	42	45	48	51	54	56	59
1¼"	40 mm	19	27	33	38	42	46	50	54	57	60	63	66
1½"	50 mm	21	30	37	42	47	52	56	60	64	67	70	73
2"	63 mm	24	34	41	48	53	58	63	67	71	75	79	82
2½"	75 mm	26	37	45	52	58	64	69	73	78	82	86	90
3"	90 mm	28	40	49	57	64	70	75	80	85	90	94	99
4"	125 mm	34	47	58	67	70	82	89	95	101	106	111	116
6"	160 mm	38	54	66	76	85	93	100	107	114	120	126	131
8"	200 mm	42	60	73	85	95	104	112	120	127	134	141	147
10"	250 mm	47	67	82	95	106	116	125	134	142	150	157	164
12"	315 mm	53	75	92	106	119	130	141	151	160	168	177	184

Table 23: Minimum length of bending side in expansion arms/directional changes

Pipe dimension N.D. to O.D.		Linear expansion (inches)											
		1	2	3	4	5	6	7	8	9	10	11	12
		Minimum length of bending side (inches)											
½"	20 mm	9	13	16	19	21	23	25	27	28	30	31	33
¾"	25 mm	11	15	18	21	24	26	28	30	32	34	35	37
1"	32 mm	12	17	21	24	27	29	32	34	36	38	40	42
1¼"	40 mm	13	19	23	27	30	33	35	38	40	42	44	46
1½"	50 mm	15	21	26	30	34	37	40	42	45	47	50	52

Table 24: Minimum length of bending side for expansion loops

Vertical installation

Uponor recommends supporting vertical PP-RCT piping:

- At the base and at each floor penetration
- Every 5 ft. for 2" (63 mm) and smaller pipe

Supports shall be free of sharp edges and sized appropriately. Uponor requires lined clamps or supports for all hot and cold water piping.

Insulation

The coefficient of thermal conductivity for PP-RCT pipe is 1.67 (BTU•in)/(ft^2•hr•°F) at 68°F (20°C).

Refer to the following table for insulation recommendations based on application.

Note: Be sure to follow all local and national codes as well as engineer requirements prior to installation.

System	Thermal insulation	
	Commercial	Residential
Domestic cold water	No	No
Domestic hot water	Yes	Yes
Heating hot water and hot water return	Yes	Yes
Aboveground chilled water	Yes	Yes
Underground chilled water	No	No

Table 25: Commercial and residential insulation recommendations

All piping serving as part of a heating or cooling system shall be thermally insulated in accordance with the 2021 International Energy Conservation Code (IECC) **Table C403.12.3** and ASHRAE Standard 90.1-2019 (see **Tables 26**, **27**, and **28** on the following pages).

Fluid operating temperature range and usage (°F)	Insulation conductivity		Nominal pipe or tube size (in.)				
	Conductivity Btu*in/(h•ft²•°F)[b]	Mean rating temperature, °F	< 1	1 to < 1½	1½ to < 4	4 to < 8	> 8
> 350	0.32 - 0.34	250	4.5	5.0	5.0	5.0	5.0
251-350	0.29 - 0.32	200	3.0	4.0	4.5	4.5	4.5
201-250	0.27 - 0.30	150	2.5	2.5	2.5	3.0	3.0
141-200	0.25 - 0.29	125	1.5	1.5	2.0	2.0	2.0
105-140	0.21 - 0.28	100	1.0	1.0	1.5	1.5	1.5
40-60	0.21 - 0.27	75	0.5	0.5	1.0	1.0	1.0
< 40	0.20 - 0.26	50	0.5	1.0	1.0	1.0	1.5

Table 26: 2021 IECC Table C403.12.3: Minimum pipe insulation thickness (thickness in inches)[a,b]

[a]For piping smaller than 1½" (38 mm) and located in partitions within conditioned spaces, it is permissible to reduce these thicknesses by 1" (25 mm) (before thickness adjustment required in footnote b) but not to a thickness less than 1" (25 mm).

[b]For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows:
$T = r[(1+t/r)^{K/k}-1]$

Where

T = Minimum insulation thickness

r = Actual outside radius of pipe

t = Insulation thickness listed in the table for applicable fluid temperature and pipe size

K = Conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu•in./h•ft²•°F), and

k = The upper value of the conductivity

Fluid operating temperature range and usage (°F)	Insulation conductivity		Nominal pipe or tube size (in.)				
	Conductivity Btu*in/ (h•ft²•°F)	Mean rating temperature (°F)	< 1	1 to < 1½	1½ to < 4	4 to < 8	≥ 8
Insulation thickness (in.)							
> 350	0.32 - 0.34	250	4.5	5.0	5.0	5.0	5.0
251 - 350	0.29 - 0.32	200	3.0	4.0	4.5	4.5	4.5
201 - 250	0.27 - 0.30	150	2.5	2.5	2.5	3.0	3.0
141 - 200	0.25 - 0.29	125	1.5	1.5	2.0	2.0	2.0
105 - 140	0.22 - 0.28	100	1.0	1.0	1.5	1.5	1.5

Table 27: ASHRAE 90.1-2022 Table 6.8.3-1: Minimum Pipe Insulation Thickness Heating and Hot-water Systems[a,b,c,d]

[a]These thicknesses are based on *energy efficiency* considerations only. Additional insulation is sometimes required relative to safety issues/surface temperature.

[b]For *piping* smaller than 1.5 in. and located in partitions within *conditioned spaces*, reduction of these thicknesses by 1 in. shall be permitted (before thickness adjustment required in footnote [a]), but not to thickness below 1 in.

[c]For direct-buried heating and hot-water *system piping*, reduction of these thicknesses by 1.5 in. shall be permitted (before thickness adjustment required in footnote [a]), but not to thicknesses below 1 in.

[d]*Piping* that also *serves service water heating systems* shall comply with Section 7.4.

Fluid operating temperature range and usage (°F)	Insulation conductivity		Nominal pipe or tube size (in.)				
	Conductivity Btu*in/ (h•ft²•°F)	Mean rating temperature (°F)	< 1	1 to < 1½	1½ to < 4	4 to < 8	≥ 8
Insulation thickness (in.)							
40 - 60	0.21 - 0.27	75	0.5	0.5	1.0	1.0	1.0
< 40	0.20 - 0.26	50	0.5	1.0	1.0	1.0	1.5

Table 28: ASHRAE 90.1-2022 Table 6.8.3-2: Minimum pipe insulation thickness for cooling systems (chilled water, refrigerant, and brine)[a,b]

[a]These thicknesses are based on *energy efficiency* considerations only. Issues such as water vapor permeability or surface condensation sometimes require vapor retarders or additional insulation.

[b]For direct-buried cooling *system piping*, insulation is not required.

Insulation exceptions

There may be exceptions regarding insulation requirements. Refer to the latest code requirements for guidance.

HVAC system piping insulation exceptions

Per 2021 IECC, Section C403.12.3:

1. Factory-installed piping within HVAC equipment tested and rated in accordance with a test procedure referenced by this code.
2. Factory-installed piping within room fan-coils and unit ventilators tested and rated according to AHRI 440 (except that the sampling and variation provisions of Section 6.5 shall not apply) and AHRI 840, respectively.
3. Piping that conveys fluids that have a design operating temperature range between 60°F (15°C) and 105° F (41°C).
4. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electric power.
5. Strainers, control valves, and balancing valves associated with piping 1 inch (25 mm) or less in diameter.
6. Direct-buried piping that conveys fluids at or below 60°F (15°C).
7. In radiant heating systems, sections of piping intended by design to radiate heat.

Per ASHRAE Standard 90.1-2022, Section 6.4.4.1.3:

1. Factory-installed piping within HVAC equipment tested and rated in accordance with Section 6.4.1.
2. Piping that conveys fluids having a design operating temperature range between 60°F and 105°F, inclusive.
3. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electricity (such as roof and condensate drains, domestic cold-water supply, and natural-gas piping).
4. Where heat gain or heat loss will not increase energy use (such as liquid refrigerant piping).
5. In piping 1 in. or less, insulation is not required for strainers, control valves, and balancing valves.

Recommended preformed insulation sizes

Uponor recommends using metric-size preformed insulation for PP-RCT pipes. Refer to **Table 19** for actual pipe sizes to provide guidance for metric-size insulation.

Fire-resistive construction

Overview

PP-RCT pipes will burn, but are not classified as flammable. The NFPA classifies these products as a 1 (slow burning) on a scale of 0 to 4, with 4 being the quickest to burn. When burning, these pipes emit CO_2 and H_2O vapor. In an underdeveloped combustion situation, small amounts of CO_2 can be emitted, just as it is from wood or wood-based products.

Return-air plenums

Uponor PP-RCT, when installed with approved rated insulation, complies with code requirements for combustibles installed within ducts or plenums. Uponor's listing can be found at uponor.com under the listing QAI P321-5. This listing certifies that Uponor PP-RCT pipe and accessories up to 12" nominal diameter, when installed with approved rated ½" pipe insulation, does not exceed a maximum flame spread index (FSI) of 25 and a maximum smoke-developed index (SDI) of 50 when tested in accordance with ASTM E84. Always be sure to review project and local code requirements before beginning installation.

Fire-rated assemblies and penetrations

For projects requiring Uponor PP-RCT to penetrate through or run within fire-rated assemblies, take care to use the appropriate approved materials.

Uponor PP-RCT is tested and listed by Hilti® to firestop systems approved to ASTM E814/UL 1479 and CAN/ULC S115. For details, visit the UL website to view Hilti listings that include Uponor PP-RCT.

For special requirements, contact Uponor Technical Services at 888.594.7726.

Direct burial

When burying Uponor PP-RCT, it is important to plan ahead. Be sure to follow all recommendations in this instruction sheet for best installation practices.

General guidelines

1. Excavate trenches to line and grade as indicated by contract documents and in accordance with applicable safety standards.
2. Decide whether pipe joining is occurring inside or outside the trench. If joining inside the trench, excavate the trench wide enough to accommodate space for the fusion equipment as well as the installers performing the fusion.
3. Always ensure the trench walls are stable under all working conditions. Provide sloped walls and trench wall support where appropriate to provide safety.
4. Minimum trench size for pipes smaller than 3" nominal diameter (N.D.) is 12". For pipes 3" and larger, minimum trench size is 6" on each side of the pipe outside diameter (O.D.).

Minimum trench width

N.D. pipe size	Minimum trench width
< 3"	12"
3" to 24"	Pipe O.D. + 6" on either side of pipe

Table 29: Minimum trench width based on pipe size

Trench bottom requirements

Ensure the trench bottom is native soil that is free from rocks and provides uniform support along the entire length of the pipe. If the trench bottom has rock or boulders, add a minimum 6" of fine, granular sand. If the trench bottom is made of silt and/or clay, compact the trench bottom prior to laying the pipe.

Piping embedment

Pipe embedment is crucial for distribution of the superimposed loadings. Ensure the embedment material is a coarse, grained soil, such as gravel or sand, or a coarse, grained soil containing silty sand or sand with clay. These can include sands and gravels classified as soil types GM, GC, SM, and SC or gravel and sands classified as soil types GW, GP, SW, and SP, or by a dual-soil classification beginning with one of these symbols, in accordance with Test Method D2487, Standard Practice for Classification of Soils for Engineering Purposes). Refer to the table below for maximum particle size surrounding the pipe.

Maximum particle size

N.D. pipe size	Maximum particle size
½" to 4"	½"
6" to 8"	¾"
10" to 16"	1"
18" and larger	1½"

Table 30: Maximum particle size based on pipe size

Place haunching material so as not to disturb the pipe from its line and grade while ensuring it is in firm contact with the entire bottom surface of the pipe. Uponor recommends using a vibratory compactor to compact the material. This has less tendency to disturb the pipe than an impact tamper.

Place initial compacted backfill in lifts that are evenly placed on each side of the pipe or as specified by local code. The final backfill may consist of the excavated material, provided it is free from rocks, boulders, large lumps of clay, organic material, or construction debris. When installing pipe beneath a road, pavement, or sidewalks, place backfill in lifts and compact to 95% standard Proctor density. Light traffic requires a minimum 18" cover; heavy traffic requires a minimum 24" cover.

Expansion controls

Following Uponor installation recommendations typically eliminates the need for expansion controls in direct-burial applications. However, always follow local code for installation requirements.

Thrust restraints

In direct-burial applications, heat-fusion joining requires no thrust restraints. Use anchors in cases where pipe movement requires restraint. Some examples include when pipes are entering a building foundation and/or other parts of the structure. There is no issue installing the pipe within concrete.

Trace wire

Since Uponor PP-RCT is made of non-conductive materials, Uponor recommends installing an electrically conductive wire along the buried pipe to trace the pipe in the future using an electronic pipe locator.

Freezing conditions

In locations susceptible to ground freezing, consider the pipe depth to avoid potential freeze damage of the pipe or fluids within the piping system.

Trenchless installations

For trenchless installation techniques, contact Uponor Technical Services at 888.594.7726 for the allowable pulling forces.

Trench installation example

Important notes to remember:

- New street surface shall comply with all jurisdiction requirements.
- Support trench walls as required by local code.
- Minimum trench width of 12" for pipes smaller than 3"; 6" on each side for larger pipe sizes.
- Minimum cover for light traffic is 18"; heavy traffic is 24".

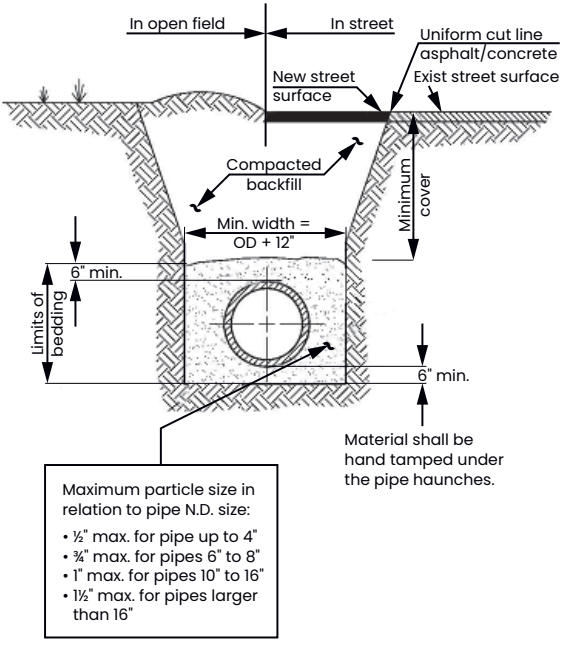


Figure 10: Typical trench

Minimum coverage for concrete embedment

Uponor requires a 6" minimum coverage of concrete to avoid surface cracking due to thermal expansion and contraction of the pipe. This is directly related to the temperature differential of the system (Delta T).

Requirements

- Ensure the slab depth or thickness provides a 6" minimum coverage above the top of the pipe installed.
- If the job site or project does not allow for at least 6" of concrete above the piping, move the pipe location into the substrate material that provides the minimum coverage. Note that the material should be of fine particulate (e.g., not stone).
- Install welded wire reinforcement (WWR) to help avoid concrete cracking. Consult a concrete specialist for proper installation. When using WWR, ensure the ties connecting the pipe to the WWR mesh do not puncture the pipe. Additionally, ensure steel wraps do not push into the pipe.

Installation

When pouring the concrete, do not pour directly onto the pipe. Instead, pour along the sides of the pipe to fill the space. Additionally, use caution when tamping the concrete with shovels or other sharp-edged tools as to not damage the pipe below.

Flushing

If flushing the piping system after installation, ensure the flushing medium is approved for use with PP-RCT piping systems and is specified under local codes, engineering specifications and/or by the needs of the mechanical equipment in the system. If no flushing methods are specified, use water, air or a mixture of both. Refer to the Uponor Chemical Compatibility form for more information on compatible flushing agents.

System disinfection

Water system disinfection

Uponor recommends water system disinfection via chemical methods only. Uponor does not recommend use of its PP-RCT pipe and fittings as part of any water distribution system that employs thermal disinfection.

Chemical disinfection

When adding chemicals to a plumbing system, disinfection chemicals are strong oxidizing agents and have the potential to reduce system life of the piping system. See **Table 31** for recommended maximum concentration of common chemicals used for disinfection, and corresponding duration and temperature.

Important: Flush the system with clean, potable water after disinfection in an effort to avoid long-term pipe performance issues.

Chemical disinfection treatment methods should not exceed 80 psi system pressure or the maximum guidelines stated in **Table 31**.

Chemicals not for use

Do not use chlorine dioxide, ozone, bromine, copper-silver, or on-site copper ion generation for system disinfection.

Notes

Chemical	Symbol	Concentration of free chlorine	Maximum	
			Duration	Temperature
Sodium hypochlorite	NaOCl	200 mg/L (ppm)	3 hours	77°F (25°C)
		50 mg/L (ppm)	24 hours	
Chlorine (liquid or gas)	Cl_2	200 mg/L (ppm)	3 hours	
		50 mg/L (ppm)	24 hours	
Hydrogen peroxide	H_2O_2	200 mg/L (ppm)	3 hours	
		50 mg/L (ppm)	24 hours	
Chloramines	NH_2Cl	200 mg/L (ppm)	3 hours	
		50 mg/L (ppm)	24 hours	

Table 31: Uponor disinfection guidelines

Important system disinfection notes

- Uponor does NOT recommend long-term or continuous-dosing chemical treatments.
- Limit chemical disinfection to four cycles over life of the piping system.
- Do not use especially high oxidizing agents, such as ozone, chlorine dioxide, bromine, etc.
- Do not use copper-silver ionization methods of disinfection.
- These guidelines are for disinfection treatment and do not supersede normal operating parameters.
- Do not utilize the water from chemical disinfection and the subsequent rinsing for consumption (e.g., drinking water, etc.).

These guidelines are set forth for informational purposes only, and it remains the responsibility of the facility manager, water management contractor and end user to maintain system health and to ensure compatibility and effectiveness of the disinfection treatment with the entirety of the plumbing system. If other treatments or chemicals not included in this document are intended for use, contact Uponor Technical Services for compatibility prior to system exposure. If necessary, have the chemical manufacturer approve the suitability of the disinfectant for all components of the plumbing system and installation. Note that these guidelines are subject to change. Please contact Uponor Technical Services at 888.594.7726 to confirm the latest guideline information.

Water additive guidelines

The building industry widely uses Uponor PP-RCT-based systems in hydronic piping applications, mostly for conveying water between water heating/cooling devices (e.g., boilers, chillers) and terminal units such as fan coils.

Uponor PP-RCT pipe offers advantages such as lightweight, corrosion resistance, ease-of-assembly and cost effectiveness. In addition to Uponor PP-RCT pipe, these applications also use various configurations of Uponor fittings (e.g., tees, ells, couplings, etc.) made from brass or EP for connection purposes.

Most hydronic piping systems incorporate metallic components supplied by third parties, which require corrosion protection. When copper components are utilized in conjunction with PP-RCT in the system, care should be taken to rigorously follow the guidelines of the Copper Association to ensure the operating conditions to not cause erosion/corrosion of the copper. This is based on the limited industry data available for the long-term effects of copper on PP-RCT piping systems in hydronic applications.

Consideration must also be given to external factors, such as temperature and induced stresses, in addition to water conditions, such as pH, impurity control, and buffering. Thus, various additives are typically added to the water being conveyed throughout hydronic piping systems. To avoid damage to Uponor PP-RCT pipe and fittings, all of these variables must be considered, and only additives that are chemically compatible with the Uponor components should be employed.

As a means of providing guidance in selecting an additive that is chemically compatible with Uponor PP-RCT pipe and fittings, we recommend that the attributes of the treated water should be in the ranges indicated in **Table 32**.

Attribute	Low	High
pH	7	9.1
Nitrite	0 ppm	≤2,000 ppm
Soluble metal – iron	0 ppm	≤ 2 ppm
Soluble metal – copper	0 ppm	≤ 1 ppm
Azole – TTA	0 ppm	≤ 100 ppm
Molybdate	0 ppm	≤ 500 ppm

Table 32: Recommended attributes of treated water

It is also important to give consideration when selecting a cleaning agent. Cleaning the hydronic system is common upon initial startup. With Uponor PP-RCT-based systems, the cleaning process should:

- Not exceed 72 hours
- Use non-petroleum based cleaners
- Not exceed a pH of 11
- Have water temperatures less than 140°F (60°C)
- Prior to cleaning the hydronic system, ensure the water management contractor is informed of the above guidelines.

Note that these guidelines are subject to change. Please contact Uponor Technical Services at 888.594.7726 to confirm the latest guideline information.

Important: When pressure testing hybrid systems (i.e., those that include both thermoplastic piping materials, such as CPVC or PP-R, and Uponor PEX and ProPEX fittings), isolate the Uponor system from the other thermoplastic materials in the system before following the recommended procedure. Also, consult the appropriate pipe manufacturer's installation recommendations when testing systems comprised of other thermoplastic materials.

Pressure testing

Approved methods of pressurizations

A **hydrostatic** pressure test utilizes water or water/glycol mix as the test medium. **It is the preferable choice** of pressurization, as it does not store high levels of energy given its incompressibility nature.

A **pneumatic** pressure test utilizes non-toxic, non-flammable gas **(e.g., air, nitrogen)**. When a hydrostatic test is not feasible (e.g., availability of supply or disposal of water, freeze vulnerability, and/or structural support issues because water weighs more than gas), **pneumatics are an approved alternative pressurization method**.

Safety first

Perform a thorough visual inspection with extra attention on the joints prior to a pneumatic pressure test. A pressurized gas contains high levels of stored energy that can instantaneously damage its surroundings given the chance to escape. **Isolate equipment (or parts)** not integral to the test which cannot withstand the pressure. **Include vents, drains, relief valves** as needed to mitigate against overpressure.

Maximum design pressure vs. maximum working pressure

Maximum design pressure indicates **the maximum pressure the system will see in its lifetime.** *It is the design pressure designated by the engineer or person in charge of the project.*

Maximum working pressure indicates **the maximum pressure that the system can handle.** *It is the maximum pressure designated by the engineer who designed the system.*

Determining test pressure

Method	Test pressure	Pipe system
Hydrostatic	1.5 x Design Pressure	SDR 7.4, 9, 11
Pneumatic	1.25 x Design Pressure; *Maximum: 150 psi*	
Hydrostatic	1.5 x Design Pressure	SDR 17.6
Pneumatic	1.5 x Design Pressure if > 65 psi, 100 psi if ≤ 65 psi	

Table 33: Determining test pressure

If the system contains multiple-size SDRs, use the test pressure corresponding to the largest SDR (thinnest-wall pipe).

Procedure guidelines

1. Ensure safety prior to starting the pressure test. Refer to the "Safety First" section for examples.
2. Begin test by applying pressurization in increments of 25% of test pressure.

3. Allow the gauge to stabilize before each incremental increase in pressure.
4. If test pressure cannot be reached, locate the leak(s) and make repair(s).

   Note: If pneumatic, inspect for leaks by utilizing soap bubbles or other suitable means.
5. After repairing any leaks, return to Step 2 and repeat steps until test pressure is met.
6. Once test pressure is met, sustain for two hours or the time required by the local authority having jurisdiction, whichever is more stringent.
7. If pressure remains stable throughout the required time, then the pressure test is complete.
8. After completing the pressure test, fill out and email this form to the Uponor North America Warranty Department at warrantyclaims@uponor.com within **30 days** after completing piping installation.

Estimate for total number of compressed gas containers

Use the following equation to estimate how many containers will be needed for your project:

$$\#\text{ of compressed gas containers} = \frac{(\text{Desired pressure})_{psi} \times 0.068 \times (\text{Total Volume})_{\text{cubic feet}}}{(\text{Container size})_{\text{cubic feet}}}$$

$$\text{Total Volume} = 0.785 \times (\text{inside pipe diameter}_{feet})^2 \times (\text{total length of pipe})_{feet}$$

Final checklist

Date _____

Project name _____

Project type _____

Project address _____

City _____

State, ZIP _____

Completed by _____

Customer _____

Uponor rep agency _____

The following is a PP-RCT quality assurance/quality control checklist for the installation of Uponor products in hydronic heating and cooling systems. This is a review intended to help identify issues with installations, concerns with the product, and highlight best practices. This is a guide only, and is not intended to be an exhaustive list of all responsibilities, duties, or requirements associated with the installation of Uponor products, nor does it replace governing codes, specifications and/or standards. Please contact your local Uponor manufacturer representative with any questions regarding this checklist.

Notes

Floor: _____

Area/unit: _____

☐ Qualified installer

☐ Pressure test form completed and submitted to Uponor at warrantyclaims@uponor.com within 30 days of completing the piping installation

Fittings, connections	Riser	Horiz.	Notes and comments
Ensure proper storage/avoid UV exposure	☐	☐	
Socket-fused connection (two beads and a depth mark)	☐	☐	
Butt-fused connection (one single bead with uniform size)	☐	☐	
Outlet connection (full-melt indication with no visible gaps)	☐	☐	
No visible stress cracks or impact indicators on the pipe or fittings	☐	☐	
Hangers | horizontal	**Riser**	**Horiz.**	**Notes and comments**
Proper horizontal support distance per piping manual with PP-RCT supports	☐	☐	
Use of proper expansion compensation at recommended intervals	☐	☐	
Hangers are properly sized and/or proper clamps used	☐	☐	
All-thread rod is properly sized	☐	☐	
Hangers | vertical	**Riser**	**Horiz.**	**Notes and comments**
Support at the base and each floor	☐	☐	
Mid-story guide (max. 5 ft.) on 2" and smaller	☐	☐	
Use of proper expansion compensation at recommended intervals	☐	☐	

Fire penetrations/insulation	Riser	Horiz.	Notes and comments
Recommend customer verifies fire penetration compatibility[1]	☐	☐	
Recommend customer verifies insulation requirements	☐	☐	
Recommend customer verifies ASTM E84 requirements	☐	☐	

[1]Intent is to check compatibility of material/device with PP-RCT. Uponor is not responsible for providing/determining appropriate fire-rated assemblies.

Areas for improvement

Additional information

Notes

Moving
> Water

uponor

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

T 800.321.4739
F 952.891.2008

uponor.com

PP-RCT_PipingSystems_InstallationGuide_0924