Water and heating

PP-R & PP-RCT
PP-R & PP-RCT

Pressure piping systems
POLYPROPYLENE RANDOM CO POLYMER (PP-R) AND POLYPROPYLENE RANDOM CRYSTALLINE TEMPERATURE (PP-RCT)

With more than twenty years of proven performance, Polypropylene Random Copolymer (PP-R) pipe and fittings have been used throughout the world in plumbing, mechanical and industrial applications. Pipes made from PP-R are lightweight, do not corrode, rust, or scale and they are joined via heat fusion for permanent, leak-free joints. These pipes are designed primarily for use inside the building but may be installed outside. (See section on UV Protection) Applications include but are not limited to the following systems: Hot and cold potable water, Food grade, Hydronics, Geothermal, Industrial, Compressed air and vacuum Rain, Gray and Reclaimed water.

Based on the success of PP-R, the next generation of Polypropylene- Random Copolymer was developed with a special crystalline structure that exhibits an improved pressure rating at elevated temperatures. It is called Polypropylene- Random Crystalline Temperature (PP-RCT). Its enhanced crystalline structure is created through a special nucleation process that enables the pipe to operate at higher pressures at elevated temperatures. This advanced resin is used in PEŞTAN’S MECHANICAL Pipes and Fittings.

In long-term pressure tests, the outstanding performance characteristics of PP-RCT vs. standard PP-R is apparent:
- PP-RCT : 50 year strength at 70 OC (158 0F) = 5.00 MPa (725 psi)
- PP-R : 50 year strength at 70 OC (158 0F) = 3.21 MPa (464 psi)

Offering more than 50% improved long-term strength, PP-RCT enables designers to achieve higher pressure ratings than with traditional PP-R pipes of the same wall thickness, or they can utilize PP-RCT’s higher pressure rating and down-gauge to a thinner wall pipe offering higher hydraulic capacities and cost savings.

For more information on applications please contact our Technical Support at tech.support@pestan.net
Material Stability

Integrity of the PP-R(CT) raw material is not affected during processing and fabrication. More importantly, the material is engineered to withstand long-term service life even at high temperatures.

Corrosion Resistance

Unlike metal piping systems that have to be upsized due to corrosion, PP-R(CT) systems do not corrode, rust or scale. No corrosion means long-term consistent flow, no decrease in pipe inside diameter, lower pumping costs and a better quality of water.

Chemical Resistance and Special Applications

PP-R(CT) is safe for the transport of drinking water and any food-grade fluids. Because of the non-polar characteristics of polypropylene and a specially designed additive package, PP-R(CT) systems are also suitable for the distribution of most chemicals*. Although PPR(CT) is resistant to a wide variety of chemicals, it is very important to select appropriate "transition" fittings (fittings with metal inserts). To determine if PEŠTAN piping is suitable for your desired application, please contact our Technical Department.

Hydrolysis

PEŠTAN PP-R(CT) pipes are completely resistant to hydrolysis meaning they will not react with water. The pipe will not break down and no chemicals will leach into the water throughout its lifecycle. Additionally, these pipes do not impart any taste or odor into the fluids they convey. This makes them ideal for the transport of water and food grade liquids.

*for more information please contact our Technical Support at support@pestanpipes.com

UV Protection

Indoor vs. Outdoor

PP-R(CT) pipe and fittings are designed for indoor use. They are not stabilized for direct Ultraviolet (UV) exposure. Over time, UV exposure causes degradation, resulting in decreases in the pipe’s physical and chemical properties and long-term performance. If the pipes are to be used outdoors, they should be buried or encased in a protective wrap or coating. Note: Coating of the system can be achieved by using PP-R(CT) safe paint, which must be properly applied and maintained. Axermarket alteration of the product, such as painting, is not covered by PEŠTAN warranty. For more information on protective coatings, please visit: PestanPipes.com/UV-Protection or contact our Technical Department.

Warning: Peštan does not recommend PP-R(CT) being used in installations where copper and highly aggressive water are present. The water attacks the copper and releases free ions that negatively affect water and any material it contacts in the system. Even inert materials such as polypropylene can be affected. To avoid the erosion/corrosion of the copper piping systems, please follow recommended design instructions from The Copper Tube Handbook, by Copper Development Association (page 11).

Note: According to the ANSI/ASME B31.3 Process Piping Code, thermoplastic piping should not be used in flammable fluid service above ground, in nominal sizes above 1 inch (32 mm). With sizes 1 inch and below, secondary containment should be provided.
Fiber Composite Pipes Integrated Expansion and Contraction Control

Temperature changes cause thermoplastic pipes to expand and contract in the linear direction. With PEŠTAN’s PP-R(CT) Fiber Composite pipes, expansion and contraction is controlled in the linear direction. This is achieved by the addition of a fiber layer co-extruded into the mid-wall of the pipe. The middle layer is comprised of oriented fibers encapsulated in PP-RCT, which does not expand when exposed to temperature changes. Therefore, overall expansion of the pipe is minimized. Not only does it reduce the need for additional expansion control, it also provides rigidity and stability.

PEŠTAN MECHANICAL pipes with the Fiber Composite layer are joined via heat fusion and use standard PEŠTAN PP-RCT fittings.

Heat Fusion Connections

PEŠTAN piping systems use the Heat Fusion process to create the homogeneous connections between the pipe and the fittings. The connections use no added solders, solvents, glues or similar products. When heat fusing PP-R(CT) components, extra material is collected at the joint which makes fusion joints the strongest points of the system. Properties of the material do not change when heat fused, so connections between pipes and fittings are strong and safe.

Premium Quality

PEŠTAN’S strict policy on quality control requires the use of premium PP-R(CT) resins produced by the world’s premier resin manufacturers. Material formulations are continuously monitored for compliance and consistency insuring the long-term performance of your PEŠTAN piping system.

50+ Year Lifetime

PEŠTAN has developed long-lasting, low maintenance piping systems. Our products are produced from proprietary resin formulations insuring long term performance. The pipes are resistant to scaling and corrosion; the walls of the pipes are extremely smooth and therefore have a low friction coefficient eliminating abrasion. Furthermore, mechanical joints, the weakest point of a traditional piping system, are eliminated by using heat fusion as the joining method. With heat fused joints, physical stresses will not damage the integrity of the joints.

Insulation and Energy Savings

A 50% improvement in heat loss or heat gain can be realized when comparing non insulated metal pipe to non insulated PEŠTAN PP-R(CT) pipe. Before starting installation, always check code requirements to make sure that your installation complies. Both past and current ICC and ASHRAE energy codes support insulation savings when using PEŠTAN pipes (see Section 4).
Low Thermal Conductivity

The value of Thermal conductivity of PP-R(CT) material is 1.67 BTU/(in/hr x °F). This low conductivity value, combined with the thickness of the pipe and fitting wall, acts as a natural insulator. Traditional metal piping systems have much higher Thermal Conductivity values. Under normal operating conditions, non-insulated PP-R(CT) pipes have less heat loss or gain and greater resistance to condensation as compared with metal and other types of plastic piping systems.

One of the objectives of Energy and Building codes is to improve operating efficiencies. They make recommendations for the required amount of insulation for piping systems. Because PEŠTAN piping systems have much lower heat losses and heat gains than traditional metal systems, our piping system is capable of operating at an equal or in most cases a more efficient level than other metal systems under the same code. If there is a need for insulation, both space and material can be saved using PP-R(CT) systems. Further details on this are given in Section 5.

Fittings Insulation Advantage

The socket fusion fittings vary from 1/2" to 4" (20 mm - 125 mm). When pipes are inserted into the socket of the fitting, thickness of the PP-R(CT) material is increased at the joint. When thickness of the over-engineered fittings and pipe are added in conjunction with natural thermal resistance of the material, need for fitting insulation is eliminated in certain applications.

Prevention of Biological Growth

Light transmission through PP-R(CT) pipe is less than 0.2%. Therefore, algae and other biofilm attachment is not supported. This benefit makes it an ideal piping system for health care facilities and food grade applications.

Natural Sound Insulation

Because of the integrated natural sound insulation, pressure bellow and water flow noise are lessened by PP-R(CT) pipes, enhancing the quality of living for the occupants of the buildings.

Safe Handling and Installations

Installation of PP-R(CT) piping system is preferred over other piping systems because they weigh less and are joined using heat fusion, instead of solders or glues (eliminating VOC’s during the process). Installers should follow all safety recommendations established by PEŠTAN as well as all project, local, state and federal (OSHA) safety guidelines when working with PEŠTAN PP-R(CT) piping systems.
PEŠTAN products are listed with ICC and IAMPO for following Standards:

- ASTM F 2389 Standard Specification for Pressure Rated Polypropylene (PP) Piping System
- NSF/ANSI 14 Plastic Piping Systems Components and Related Materials
- CSA B137.11 Polypropylene (PP-R) Pipe and Fittings for Pressure Applications
- ICC-LC1004, PP, PEX, PEX-AL-PEX and PP-AL-PP Piping, Tube and Fittings used in Radiant Heating and Water Supply

PEŠTAN products are listed with ICC and IAMPO for following Codes:

- 2012, 2009 and 2006 International Residence Code (IRC)
- 2012, 2009 and 2006 International Plumbing Code (IPC)
- 2012, 2009 and 2006 Uniform Mechanical Code (UMC)
- 2010 California Mechanical Code (CMC)
- 2010 National Plumbing Code of Canada

PEŠTAN manufacturing plant is listed with TUV for the following Standards:

- ISO 14001 for Environmental Management
- OHSA 18001:2007 for Occupational Health and Safety Management
CERTIFICATES
OWNER BENEFITS

No Maintenance

PEŠTAN PP-R(CT) piping systems are more cost effective to operate and maintain as compared to traditional metal piping systems. It is joined with heat fusion so there are no mechanical fittings or gaskets to fail. The absence of mechanical fittings substantially minimize the chance of damage related to leaks.

The pipe is resistant to corrosion and scaling so no additional chemical treatments are required. PP-R(CT) pipes have a lower coefficient of friction than metal pipes resulting in lower pumping costs.

No Toxic Elements

PEŠTAN pipes and fittings do not contain toxic materials and do not emit VOC’s or other dangerous compounds even when exposed to fire.
Reduced Heat Transfer Values

PEŠTAN PP-R(CT) pipes have a lower thermal conductivity value than traditional metal pipes:

1.67 BTU/in/hr x °F,
0.139 BTU/ft/hr °F,
0.241 W/m °K).

This provides several advantages:

» Minimized loss or gain of heat improves energy savings
» Less insulation is required
» Less condensation when used in chilled water applications
» Reduced chance of injury around exposed hot water piping

Extended Service Life

PEŠTAN offers a 10 year warranty that covers product replacement, incidental and property damages caused by product failure due to manufacturing defects. Systems must be installed and successfully tested by PEŠTAN Certified Installers and a properly recorded Pressure Test Form must be submitted.

INSTALLER BENEFITS

Compatible Piping Systems

PEŠTAN offers a full line of PP-RCT fittings keeping installation simple and providing an easy transition to other piping systems and equipment.

Heat Fusion

During installation, there are no solders, solvents or glues required. PP-R(CT) is joined via a process known as heat fusion. During the fusion process, the pipe and fittings are heated under controlled temperatures and then joined. The molecules of the polymer flow together creating a seamless, permanent leak-free bond. No open flames are required and no toxic Volatile Organic Compounds (VOC’s) are emitted during the process. Heat fusion is a quick, safe joining method that can be utilized in occupied buildings.

Freezing Conditions

Although not designed to be installed in applications repeatedly frozen and thawed, if the fluid inside the pipe freezes, it will not damage PP-R(CT) material. PEŠTAN recommends the use of anti-freeze such as glycol or glycerin, the use of plastic safe heating cables/tapes or to simply keep the minimum constant flow through pipes to protect proper function and integrity of the system.

Product Warranty

PEŠTAN offers a 10 year warranty that covers product replacement, incidental and property damages caused by product failure due to manufacturing defects. Systems must be installed and successfully tested by PEŠTAN Certified Installers and a properly recorded Pressure Test Form must be submitted.

Lightweight Material

Weighing up to 80% less than traditional metal pipes PEŠTAN pipes are easy to handle and more cost-effective to transport. Their light weight makes them easier to assemble making for a safe and less tiring installation.

Non-Shattering

Under normal operating temperatures, the pipes will not shatter when impacted or crushed. When temperatures fall to or below freezing, the impact resistance of the pipes decreases so the installers must use caution when handling.
Saddle Outlet Fusion Joints

Even after the mains are set, branch lines can be easily added using saddle fusion joints. With saddle fusion, the branch is fused directly into the wall of the main. Furthermore, saddle outlets are a great solution for easy fabrication and modification of manifolds. It is a time saver and provides lower pressure drop as compared to traditional reducing tee fittings.

Prefabrication and Transport

PEŠTAN PP-R(CT) pipes and fittings are ideal for prefabrication and transport without the risk of the pre-fab joints failing. The unique properties of PP-R(CT) pipe combined with the permanent, leak-free bonds (created by joining with heat fusion), creates a monolithic system. These characteristics also help prevent damage from seismic activity or from exposure to vibrations, such as on cruise ships, trains and in manufacturing facilities.

Pressure Testing

PEŠTAN PP-R(CT) pipes cannot be dry fitted. Final pressure testing must be done on a completed installation and documented according to pre-set guidelines established by PEŠTAN. These steps enable the installer to identify potential leaks before the system becomes operational. The installer may use water, air or a mixture of air and water as the pressure test medium. Strict adherence to safety and pressure testing procedures should be followed, especially when the test is performed using air.

Uniform and Rigid Appearance

Because of rigidity and strength, PEŠTAN PP-R(CT) piping systems maintain a uniform, professional appearance in all types of installations including wall mounted vertical and horizontal installations as well as when suspended from hangers.

Easy to Identify

PEŠTAN PP-R(CT) pipes are available in 13x straight lengths. The pipe is color coded for ease of identification. Green Pipe with four gray stripes is the MECHANICAL pipe with Fiber Composite layer. PURPLE Pipe is for Reclaim, Gray and Rainwater. The pipe has a permanent print line that is repeated at least every 5x for easy identification and inspection on the jobsite.
The straight lengths of pipe are bundled by size and packaged in UV resistant bags. If pipe is temporarily stored outside, bags will protect pipe from UV exposure up to 6 months. The content of the bundles is clearly identified with labels specifying the type of pipe, size, dimension and number of pipes per bundle. Fittings are packaged in clear plastic bags. The bags are labeled with the product description, part number and total number of fittings per bag. Both pipe bundles and fitting labels have barcodes for easy identification when shipping and receiving.

**Integrated Expansion Control**

Unlike other plastic piping systems, the integrated linear expansion control of PESTAN PP-R(CT) Fiber Composite Piping Systems do not require any additional expansion control when compared to metal piping systems. Additionally, thrust blocking is not required on buried PP-R(CT) piping systems. The exception to this is if the PP-R(CT) is connected to another type of piping product. Thrust blocking is required at the transition point.

**The Environmental Advantages**

- Contain NO toxic substances (BPA’s or dioxins)
- Contain NO heavy metals
- Has an extended service life (50+ years depending on application)
- 100% recyclable
- Non-corrosive with a low friction factor meaning less pumping energy is required
- Lightweight (8 Times lighter than steel) facilitating easier transport, handling and installation
- Heat fusible joints providing No-Leak systems
- No VOC’s are released during production or fusion.

**Engineer/designer benefits**

PESTAN PP-R(CT) piping systems provide multiple benefits for Engineers/Designers including:
- Efficient System that will not corrode and will not reduce inner diameter
- Minimal heat transfer values as compared to metal pipes
- The natural sound insulation of water flow and pressure effects
- Complete piping system components readily available
- Easy to transition to and from existing piping systems
- Cooler boiler rooms

**PESTAN and LEED Credits**

An important part of “Green” building involves designing “LEED” approved projects. Designing a “LEED” approved building not only helps insure energy efficiency and lower operating costs, it helps promote sustainability of our resources while balancing the environmental and economic impact of the project. Although there are no established LEED credits for using a particular piping material. However, installations using PESTAN PP-R(CT) can still help qualify for up to a maximum of 18 LEED points from various categories, such as innovation, sustainability, energy savings, etc.

For more information, visit our website at www.pestanpipes.com

Because PESTAN PP-R(CT) pipes offer so many advantages for the engineers, project owners, the installers and the end users, it is no surprise this product has gained acceptance throughout the world.
APPLICATIONS

Choose ideal piping system for required application

OWNER BENEFITS

No Maintenance

PEŠTAN PP-R(CT) piping systems are more cost effective to operate and maintain as compared to traditional metal piping systems. It is joined with heat fusion so there are no mechanical fittings or gaskets to fail. The absence of mechanical fittings substantially minimize the chance of damage related to leaks. The pipe is resistant to corrosion and scaling so no additional chemical treatments are required. PP-R(CT) pipes have a beker coefficient of friction than metal pipes resulting in lower pumping costs.

No Toxic Elements

PEŠTAN pipes and fittings do not contain toxic materials and do not emit VOC's or other dangerous compounds even when exposed to fire.

Fittings

Color: Green
Nominal ID Sizes: 1⁄2”– 4”

PEŠTAN fittings are made with a greater safety factor and are compatible with all PEŠTAN’s PP-R and PP-RCT pipes*. Designed with a heavy wall, the fittings are the strongest part of the system and are pressure rated higher than the compatible pipe. The heat transfer of the fittings is reduced and the need to insulate them may be eliminated in certain applications. Because of the many fittings offered, PEŠTAN piping systems are compatible and easily connected to other systems and equipment. There are two main groups of fittings, one for connections with other PP-R and/or PP-RCT components and one for connections with different materials, called “transition fittings” and/or flanges. Transition fittings are made of injection molded PP-RCT with integrated brass or stainless steel threads, depending on the designed system needs.
Pestan mechanical pipe

Material: PP-RCT with a Fiber Composite layer
Available in different wall thicknesses for following Nominal ID Sizes:
- 12” - 34” SDR7.4 Green with Four Gray Stripes (335psi at 73°F and 100psi at 180°F)
- 1” - 4” SDR9 Green with Four Gray Stripes (270psi at 73°F and 100psi at 180°F)
- 1”-4” SDR11 Solid Green (210psi at 73°F and 85psi at 180°F)

Designed for use in pressure applications with temperatures up to 180°F. Applications: Heating and cooling systems, compressed air and vacuum, industrial, geothermal and transportation of variety of chemicals**. Note: PESTAN MECHANICAL pipe is not rated for transportation of drinking water nor food grade fluids.

PESTAN MECHANICAL pipe is made of the most advanced material known as PP-RCT and the unique middle fiber layer technology. PP-RCT (Polypropylene Random Crystalline Temperature) is the newest generation of High Performance Polypropylene resins. Its enhanced crystalline structure is achieved by a special nucleation process giving the material improved temperature resistance for long term, superior performance. PESTAN pipe remains ductile throughout its service life.

The middle layer of PESTAN MECHANICAL Pipe is made of oriented fibers encapsulated in PP-RCT resin. When this special fiber composite layer is co-extruded, the outer and inner layers of PP-RCT remain unaltered. When exposed to heat, the fibers prevent the PP-RCT material from expanding in a linear direction. Therefore, the overall expansion and contraction of the pipe is reduced by 75% to 80% compared with non-fiber plastic pipes. The fiber layer improves properties of the pipe when exposed to higher heat and as a result, less support is required in comparison with other plastics.

PESTAN’s MECHANICAL Pipes do not require any additional expansion control when compared to traditional metal piping systems. Furthermore, the pipe absorbs its own stresses and does not require thrust blocking.

Pestan purple pipe

Material: PP-R(100)
Color: Purple
Nominal ID Sizes:
12” - 34” SDR7.4 and 1” - 4” SDR11

PESTAN PURPLE is designed for pressure applications at lower temperatures. Applications: Collection and transportation of recycled, gray, reclaimed and rain water systems. For non-pressure systems, PESTAN PURPLE may be used as vent piping.

Note: PEŞTAN PURPLE pipe is not rated for transportation of drinking water or food grade fluids.

Conservation of water is becoming a major focus throughout North America. Rainwater collection systems, recycled, gray and reclaimed water systems are being installed in both new construction and in retrofits. PESTAN PURPLE is rapidly becoming the pipe of choice for these applications. With leak free joints, corrosion and scaling resistance and outstanding chemical resistance, this pipe provides energy savings and pumping efficiencies throughout its service life. This is also beneficial for the project owner as the efficiencies gained by installing PESTAN PURPLE can help the project achieve or increase LEED credits.
UNDERSTANDING PP-R(CT) PIPE DIMENSIONS

Standard Dimension Ratio (SDR)

Standard Dimension Ratio is defined as the outside diameter of a pipe divided by the pipe’s wall thickness.

$$SDR = \frac{D}{S}$$

Where d = pipe outside diameter, s = pipe wall thickness.

Nominal Imperial Sizing

PEŞTAN PP-R(CT) piping systems are based on metric units of measurement. We have converted each of our metric pipe sizes to Imperial nominal diameters for the North American market.

The standard nominal diameter for each metric size of pipe is shown in the following table.

<table>
<thead>
<tr>
<th>MANUFACTURED OUTSIDE DIAMETER (METRIC)</th>
<th>NOMINAL PIPE DIAMETER (IMPERIAL)</th>
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<tr>
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### DIMENSIONS OF PEŞTAN MECHANICAL PIPE

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<tr>
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<th>SDR</th>
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<th>O.D. (MM)</th>
<th>I.D. (IN)</th>
<th>I.D. (MM)</th>
<th>WALL THICKNESS (IN)</th>
<th>WALL THICKNESS (MM)</th>
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PERMISSIBLE OPERATING PRESSURES

Determine the permissible system pressures for water based on the constant operating temperatures and the desired service life. The following values are derived from an extrapolation method and are based on the conveyance of water at a constant temperature and pressure. Shown are the permissible operating pressures for each of the pipes based on temperature and the desired service life. The permissible operating pressures of the pipes are shown with safety factors of 1.50 (per ASTM F2389) and 1.25 (typically used when designing systems for lower temperatures).

In the case of short term increases in temperature and/or pressure, PEŠTAN assumes no responsibility. The following tables are designed for water. When transporting chemicals, you must consider the effects that pressure and temperature have on the pipe. For conveyance of chemicals or compressed air, please contact Technical Support for additional information.

**DIMENSIONS OF PEŠTAN PURPLE PIPE**

<table>
<thead>
<tr>
<th>SERVICE LIFE</th>
<th>SDR</th>
<th>SAFETY FACTOR</th>
<th>50˚ F</th>
<th>68˚ F</th>
<th>73˚ F</th>
<th>86˚ F</th>
<th>104˚ F</th>
<th>122˚ F</th>
<th>140˚ F</th>
<th>160˚ F</th>
<th>180˚ F</th>
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<td>50 years</td>
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<td>1.25</td>
<td>487</td>
<td>423</td>
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<td>223</td>
<td>187</td>
<td>100*</td>
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<tr>
<td></td>
<td></td>
<td>1.5</td>
<td>406</td>
<td>352</td>
<td>335</td>
<td>303</td>
<td>260</td>
<td>221</td>
<td>186</td>
<td>155</td>
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FOR PIPE SIZE ½ AND ¾ PERMISSIBLE OPERATING PRESSURES (PSI)

<table>
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<tr>
<th>SERVICE LIFE</th>
<th>SDR 9</th>
<th>SAFETY FACTOR</th>
<th>50˚ F</th>
<th>68˚ F</th>
<th>73˚ F</th>
<th>86˚ F</th>
<th>104˚ F</th>
<th>122˚ F</th>
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<tr>
<td>50 years</td>
<td>1.25</td>
<td>387</td>
<td>335</td>
<td>324</td>
<td>289</td>
<td>248</td>
<td>211</td>
<td>177</td>
<td>147</td>
<td>100*</td>
<td>100*</td>
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<td>1.5</td>
<td>322</td>
<td>280</td>
<td>270</td>
<td>241</td>
<td>206</td>
<td>176</td>
<td>148</td>
<td>123</td>
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FOR PIPE SIZE 1” TROUGH 4” PERMISSIBLE OPERATING PRESSURES (PSI)

<table>
<thead>
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<th>SDR 9</th>
<th>SAFETY FACTOR</th>
<th>50˚ F</th>
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<th>73˚ F</th>
<th>86˚ F</th>
<th>104˚ F</th>
<th>122˚ F</th>
<th>140˚ F</th>
<th>160˚ F</th>
<th>180˚ F</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 years</td>
<td>1.25</td>
<td>300</td>
<td>266</td>
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<td>230</td>
<td>207</td>
<td>177</td>
<td>141</td>
<td>117</td>
<td>100</td>
<td>100*</td>
</tr>
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<td>222</td>
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<td>192</td>
<td>164</td>
<td>140</td>
<td>118</td>
<td>91</td>
<td>85</td>
<td>100*</td>
</tr>
</tbody>
</table>

*ASTM F2389 X1.14 requires the pressure rating at 180°F to be calculated based on an application class 5 from ISO 15874-2, but if the calculated pressure exceeds 100 psi, it has been arbitrarily lowered to 100 psi to conform with U.S. plumbing codes.