

# PVC VS. DUCTILE IRON (DI) PRESSURE PIPE FOR WATER MAINS

## A COMPARISON BASED ON 70 YEARS OF WATERWORKS EXPERIENCE

In North America today, most new installations of drinking-water distribution pipe are PVC. More than one million miles are in service, including some 290 million gasketed joints and 42 million taps. PVC pipe has been on the market for more than 70 years and is used in over 50,000 municipalities. PVC users are enjoying the benefits of an easy-to-install, long-life, maintenance-free, and cost-effective product which meets all North American health and safety regulations. Some 10 million quality control tests have been conducted on water carried through PVC pipe since it was introduced – confirming the product is safe and beneficial to public health.

### PVC Pipe: Unsurpassed Longevity and Sustainability

In addition, the longevity and sustainability of PVC pipe are unsurpassed:

- PVC pipe's life expectancy is 100+ years (AWWARF study).
- PVC pipe's long life results in the most favorable life cycle-costs.
- PVC requires less energy to manufacture, ship and install than iron products.
- PVC has a smooth inner surface that reduces pumping costs.
- PVC is immune to internal corrosion, so no liners are needed to maintain water quality and flow characteristics.
- PVC is immune to external corrosion, so no coatings, plastic encasement, or cathodic protection are needed.
- PVC is recyclable.

During 70 years of sustained growth for PVC water pipe, iron pipe has seen its market share decrease. Two factors have driven the move from iron to PVC:

- The growing focus on decaying water infrastructure, primarily as a result of iron-pipe corrosion.
- The thinner walls of DI compared to traditional cast iron products. Thinner-walled DI corrodes and breaks sooner than cast iron pipe (*Water Main Break Rates In the USA and Canada: A Comprehensive Study*, Utah State University, 2012 & 2018).

### Transitioning from Iron to PVC Pipe: A Smooth and Seamless Process

The DI industry has tried to convince utilities that a transition to PVC pipe is so difficult it's better to stay with iron. In fact, almost every utility using PVC made a transition from some other pipe material. Further, the typical move from DI to PVC has been smooth and seamless. Here are the facts:

- Outside diameter – for the municipal water market, PVC pipe and DI pipe are manufactured in the same cast-iron outside diameter regimen.
- Fittings, valves, and appurtenances – the same slip-on or mechanical joint fittings, valves, and appurtenances used with DI can be used with PVC pipe in the same manner, ensuring that the styles of product and installation procedures will be familiar to the waterworks professional.
- Suppliers – all items needed for PVC water systems are available from the same suppliers that provide the DI alternatives.

In reaction to their loss of market share, the DI industry has focused on raising concerns about PVC as the pipe of choice. We thought it was time to review this old list of competitive claims. On the reverse is information that addresses some important criteria for comparing PVC and DI pressure pipe.

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Item	PVC Pipe	Ductile Iron Pipe	Comments
<b>Pipe Material</b>	PVC is homogeneous.	DI is a composite material with a cement-mortar lining, which can chip during installation and tapping.	PVC is made from sustainable and abundant resources: chlorine (from salt) and domestically produced natural gas or recycled PVC material. DI is made from recycled scrap iron, but still requires twice the energy to produce as PVC.
<b>Pressure Pipe Standards</b>	<ul style="list-style-type: none"> <li>ASTM D2241-15</li> <li>AWWA C900-16</li> </ul>	AWWA C151-17 wall thickness has been continually reduced, resulting in premature corrosion and reduced durability.	PVC and DI came into use at about the same time.  PVC is available in pressure classes up to 305 psi, much higher than typical water systems require.
<b>Potability</b>	Proven safe - listed to NSF Standard 61.	DI not listed for potability - must be lined with NSF 61 listed material.	See NSF 61 listings: <a href="http://www.nsf.org/certified/pwscomponents/">www.nsf.org/certified/pwscomponents/</a>
<b>Backfill</b>	PVC pipe uses same backfill as DI pipe.	DI pipe uses same backfill as PVC pipe.	The same five trench types are found in the PVC and DI pipe AWWA installation standards.
<b>Pipe Stiffness</b>	Flexible pipe with consistent pipe stiffness for each DR across all pipe sizes.	Flexible pipe that uses thickness design - pipe stiffness declines as size increases.	Pipe-stiffness example for 16-inch size: <ul style="list-style-type: none"> <li>DI - PC250 Pipe Stiffness = 196 psi</li> <li>PVC - PC235 Pipe Stiffness = 364 psi</li> </ul>
<b>Hydraulics</b>	Hazen-Williams C Factor = 150 for new and used pipe; does not decrease during service.	Hazen-Williams C Factor = 130 for new pipe; decreases as pipe corrodes.	Higher C Factor means better flow for PVC.  DI hydraulics rely on linings that deteriorate over time.
<b>Fittings</b>	AWWA C900 pipe is compatible with PVC fittings as well as DI fittings, valves, and appurtenances.	DI pipe is used only with DI fittings, valves, and appurtenances.	PVC pipe can use DI fittings, valves, and appurtenances, so dual inventories are not required. Installation practices for PVC pipe are similar to DI pipe.
<b>Tapping</b>	Direct taps, saddle taps, and connections available to size-on-size.	Direct taps, saddle taps, and connections available to size-on-size.	PVC direct taps limited to 6" - 12" DR 14 & DR 18 pipe.  More than 36 million PVC taps in North America.
<b>Locating</b>	Locator wire is recommended for PVC pipe installation.	For locating, DI is required to be electrically continuous.	To reduce corrosion, properly installed DI pipe is electrically discontinuous, yet requires electrical continuity to be located. Tracer wire is necessary for locating.
<b>Corrosion - Internal</b>	Immune to corrosion - no tuberculation.	Lining required to reduce internal corrosion and tuberculation.	Cement-mortar linings are subject to deterioration over time. Some utilities require double cement mortar linings. Thicker, costlier linings recommended to decrease internal corrosion (per AWWA C104 A21.4).
<b>Corrosion - External</b>	Immune to corrosion - longer life; reduced costs for operations and maintenance.	Standard asphaltic coating provides no meaningful corrosion protection - costly corrosion mitigation methods required as recommended by NACE.	Substandard performance of thinner-walled, corrosion-prone DI became apparent in 1970s.  Required DI corrosion mitigation options are field-applied, costly and subject to installation error and damage.
<b>Sustainability</b>	<ul style="list-style-type: none"> <li>Lower embodied energy.</li> <li>Lighter to transport.</li> <li>Easier to install.</li> <li>Immune to corrosion.</li> </ul>	<ul style="list-style-type: none"> <li>Twice embodied energy.</li> <li>Heavier to transport.</li> <li>More difficult to install.</li> <li>Corrodes</li> </ul>	PVC much more sustainable than DI.
<b>Longevity</b>	<ul style="list-style-type: none"> <li>AWWA WRF study: 110-year life expectancy.</li> <li>European study: 150-year life expectancy.</li> </ul>	AWWA WRF study - "Long - term Performance of DI Pipe" - 8-inch PC350 life expectancy in moderately corrosive soils = 11 to 14 years.	Utah State University "Water Main Break Rates In the USA and Canada: A Comprehensive Study," (2012 & 2018) shows that thinner-walled DI fails quicker than older, thicker CI.