The History of Ductile Iron Pipe

Ductile Iron Pipe is a pipe that takes advantage of a metallurgical improvement invented in 1943 by Keith Millis, an American metallurgical engineer. On October 25, 1949, Millis, Albert Paul Gagnebin and Norman Boden Pilling received U.S. patent 2,485,760 for a Cast Ferrous Alloy. Their development reshaped the flaked graphite inherent in gray iron into spheroids or nodules. This simple difference allowed the iron, itself, to dominate physically, greatly increasing the strength of the material used to make Ductile Iron Pipe. Modern Ductile Iron Pipe not only has twice the ultimate strength of gray iron, but it has a tensile yield point, which gray iron did not have.

Since its introduction into the marketplace in 1955, Ductile Iron Pipe has been recognized as the industry standard for strength and durability in modern water and wastewater systems. More than five decades of field experience have proven its reliability for transporting raw and potable water, reclaimed water, and sewage.

The first official record of the use of iron pipe shows that the pipe was installed in 1455 in Siegerland, Germany. Two centuries later, King Louis XIV of France ordered the construction of a cast iron pipeline to extend 15 miles from a pumping station at Marly-on-Seine to the town and palace at Versailles. Today, on the palace grounds, that original pipe still serves to provide water to the palace fountains and gardens, more than 350 years after its installation.

Today, there are over 560 North American water utilities in DIPRA’s Century Club that have enjoyed 100 years or more of continuous service from their pipelines.
Production Process

Ductile Iron Pipe is produced by adding a controlled amount of magnesium alloy to molten iron of low phosphorous and low sulfur content. The magnesium produces changes to the internal structure of the molten iron by causing the graphite in the iron to become spherical or nodular in shape. In contrast, the graphite in cast iron pipe manifests as flakes, making it less strong and adaptable than Ductile Iron Pipe. The magnesium also produces a finer-grained iron matrix in the surrounding ferrite structure of Ductile Iron Pipe.

The pipe is manufactured in 18- or 20-foot nominal laying lengths and 3- through 64-inch diameters in a range of standard pressure classes. Ductile Iron Pipe is furnished with several different types of joints and a wide variety of standard fittings are available — no special ordering is necessary. Although Ductile Iron Pipe is usually furnished with cement-mortar lining, optional internal linings are also available for special applications.

And, Ductile Iron Pipe’s generally larger than nominal inside diameters, combined with its high flow coefficient (C = 140), offers substantial savings on pumping and power costs over the life of the pipeline.

In fact, a 30,000 foot-long 24-inch Pressure Class 200 Ductile Iron Pipeline could result in savings of $1,213,307 in energy costs over 100 years compared to DR 18 PVC pipe of the same size.
Benefits of Ductile Iron

Strength and Longevity
- Ductile Iron Pipe has minimum requirements of 60,000 psi tensile strength, 42,000 psi yield strength, and 10 percent minimum elongation.
- Ductile Iron Pipe resists damage during handling and shipping. Once installed, it withstands the most demanding operating conditions, including high-pressure application, water hammer, frozen ground, deep trenches, areas of high water table and heavy traffic, river crossings, pipe on supports, rocky trenches, and areas of shifting, expansive, and unstable soils.
- It is resistant to corrosion in most soils, and typically requires only effective, economical polyethylene encasement in more aggressive environments.
- It has tremendous burst strength, making it ideal for high-pressure applications and protection against sudden pressure surges.
- With its conservative design and high safety factor, it can also accommodate increased pressure loadings over the years.

Life-Cycle Cost Analysis (LCCA)
Making the right decision means looking beyond the short-term, and this is where Ductile Iron Pipe has an advantage over PVC and other substitutes. With LCCA, the estimated total cost of material acquisition, installation, operating and maintenance favors Ductile Iron Pipe. It is easy to appreciate the value of Ductile Iron Pipe. That is why forward-thinking engineers, who look beyond the cost to install, specify Ductile Iron Pipe.

Public Health
The EPA Says PVC Leaches Vinyl Chloride into Drinking Water
Ductile Iron Pipe is not prone to permeation and the resulting contamination of drinking water that may result, whereas plastic pipe is susceptible to permeation that can damage the pipe and contaminate the water. In fact, in a study prepared for the EPA, plastic pipe was involved in 98% of permeation incidents.

According to the EPA’s website, “The major sources of vinyl chloride in drinking water are leaching from PVC piping and the discharge from plastics factories. Some people who drink water containing vinyl chloride well in excess of the maximum contaminant level (MCL) for many years may have an increased risk of cancer.” The EPA’s maximum contaminant level goal (MCLG) is zero.
Benefits of Ductile Iron Pipe

**Energy Usage**

With its larger than nominal inside diameter and smooth interior lining, it takes considerably less energy to pump water through Ductile Iron Pipelines than other pipe materials. The increased flow capacity of Ductile Iron Pipe leads to lower pumping costs and significant energy savings. In fact, pumping through Ductile Iron Pipe instead of PVC can result in as much as a 38% savings in energy consumption. These energy savings result in less CO₂ production, thereby reducing greenhouse gas emissions into the environment.

**Manufactured from Recycled Materials**

The shredded scrap iron and steel used to manufacture Ductile Iron Pipe is primarily pulled from recycled materials. As a result, Ductile Iron Pipe has a recycled content of up to 98%. One standard length of 24-inch pipe can contain up to one recycled car’s worth of iron.

Ductile Iron Pipe is only the second product in the buried infrastructure industry to earn a coveted Gold rating in the Institute for Market Transformation to Sustainability’s SMaRT® certification. It earned high marks for recycled content, exceedingly long life, and the industry’s commitment to innovation in conserving energy and water resources while controlling emissions.

**Testimonials**

“Ductile Iron Pipe offers flexibility for us in implementing our infrastructure needs and our infrastructure plans.”

Gwendolyn Ruff, Vice President, Strategic Planning and Employee Services, Columbus Water Works, Columbus, GA

“In my 33 years in the water infrastructure industry, I have not found any material stronger than Ductile Iron Pipe.”

Gregg Loesch, Utilities Engineer, Akron Water Bureau, Akron, OH

“We have not had any instances of failure with Ductile Iron Pipe since we started using it in the 1970s.”

Chandrika Winston, Manager, Memphis Light, Gas and Water, Memphis TN

“We had the lowest amount of main breaks per mile in Montana. Ductile Iron has proven itself to be the pipe of choice.”

John Alston, Public Service Water and Sewer Superintendent, Bozeman Water and Sewer Department, Bozeman, MT
V-Bio® Enhanced Polyethylene Encasement and Corrosion Control

The Ductile Iron Pipe Research Association (DIPRA) and its member companies are constantly working to improve the products and services they provide to the water and wastewater industries. This includes finding new ways to maintain the long service life municipalities have come to expect from their Ductile Iron Pipelines. Polyethylene encasement is the most popular, economical, and successful method of corrosion control for Ductile Iron Pipe. Since it was first installed in a water system in 1958, polyethylene encasement has been used to protect hundreds of millions of feet of Ductile Iron Pipe in aggressive environments.

The Ductile Iron Pipe industry has always been innovative; one result, V-Bio® Enhanced Polyethylene Encasement, is a method that specifically addresses the potential influence of anaerobic bacteria and inhibits the formation of corrosion cells under the wrap.

**Key facts about the V-Bio® Enhanced Polyethylene Encasement:**

- Builds upon a proven method of corrosion control — polyethylene encasement — that has been protecting iron pipe from aggressive soils since it was first installed in 1958.
- Represents a significant advancement in corrosion protection for Ductile Iron Pipe.
- Consists of three co-extruded layers of linear low-density polyethylene (LLDPE) film that are fused into one.
- Features an inside surface that is infused with a proprietary blend of an anti-microbial to mitigate microbiologically influenced corrosion (MIC) and a volatile corrosion inhibitor (VCI) to actively control galvanic corrosion.
- Protects against corrosion without involving consumption or degradation of either the anti-microbial or the corrosion inhibitor. The film’s enhanced properties will not wear out.
- Meets all requirements of the American National Standards Institute/American Water Works Association (ANSI/AWWA C105/A21.5) standard for polyethylene encasement.
- Provides an active component to a proven, successful method of corrosion control.
Enhanced Polyethylene Encasement
Anti-microbial
Corrosion Inhibitor

COMPLIES WITH AWWA C105 AND AWWA C600 STANDARDS
The Real Truth About Pipe

Ductile Iron Pipe vs PVC
Engineers have long supported Ductile Iron Pipe’s superior durability and high quality when compared to PVC pipe.

Strength
Ductile Iron Pipe’s superior strength resists damage during shipping, handling, and installation.

PVC has only 10% of the impact strength and only 25% of the burst strength of Ductile Iron Pipe.

Cost
Ductile Iron Pipe has a larger inside diameter resulting in a lower head loss.

The cost to pump water through PVC is as much as 38% more than that of Ductile Iron Pipe.

Temperature Change
Ductile Iron Pipe is not affected by typical variations of temperature change.

PVC becomes more brittle in colder temperatures and weaker in higher temperatures.

Tapping
Direct tapping of Ductile Iron Pipe is easier, safer, less expensive, and faster.

Tapping PVC can result in cracked pipes, injured workers, and costly flooding.

Public Health
Ductile Iron Pipe is proven to be safe.

PVC leaching is a major source of potentially dangerous vinyl chloride in drinking water, according to the EPA.
Ductile Iron Pipe Standards

ANSI/AWWA C104/A21.4  
Cement-Mortar Lining for Ductile Iron Pipe and Fittings

ANSI/AWWA C105/A21.5  
Polyethylene Encasement for Ductile Iron Pipe Systems

ANSI/AWWA C110/A21.10  
Ductile Iron and Gray Iron Fittings

ANSI/AWWA C111/A21.11  
Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings

ANSI/AWWA C115/A21.15  
American National Standard for Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges

ANSI/AWWA C116/A21.16  
Protective Fusion-Bonded Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings

ANSI/AWWA C150/A21.50  
Thickness Design of Ductile Iron Pipe

ANSI/AWWA C151/A21.51  
Ductile Iron Pipe, Centrifugally Cast

ANSI/AWWA C153/A21.53  
Ductile Iron Compact Fittings

ANSI/AWWA C600  
Installation of Ductile Iron Water Mains and Their Appurtenances

ASTM A674  
Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids

ASTM A716  
Standard Specification for Ductile Iron Culvert Pipe

ASTM A746  
Standard Specification for Ductile Iron Gravity Sewer Pipe
The Ductile Iron Pipe Research Association is a technically based, research-oriented organization providing a variety of resources and services, including representation on standards-making committees, technical research on a variety of applications-based topics, and personal technical services through our Regional Engineer Program.

Social Media
Get in the flow with Ductile Iron Pipe by connecting with us on Facebook, Twitter, and LinkedIn.

Over 30 Publications
DIPRA has brochures to address virtually every aspect of the application of Ductile Iron Pipe. They are available in PDF format on topics including design, corrosion control, tapping, material comparisons, interactive tools, thrust restraint, and installation. To download any of the brochures, visit www.dipra.org/publications.

Paper copies of some brochures may be ordered at www.dipra.org/contact-us.

Calculators
DIPRA has a number of online calculators to help you with Design of Pipe on Supports, Hydraulic Analysis, Thickness Design, and Thrust Restraint. Find them at www.dipra.org/interactive-tools.

Videos and Webinars
Visit our website, www.dipra.org/videos, and click on the YouTube icon for informational videos on Ductile Iron Pipe’s ease of use, economic benefits, strength and durability, advantages over PVC, and more.
Ask an Engineer
If you have any questions about Ductile Iron Pipe, one of our expert engineers can provide answers and information. Visit www.dipra.org for contact information.

Member Companies
DIPRA is a non-profit association supported by all of the Ductile Iron pressure pipe manufacturers in North America. While DIPRA member companies have different names and locations, they all have one thing in common: a commitment to produce and deliver the finest quality water and wastewater pipe material in the world — Ductile Iron Pipe.
For more information contact DIPRA or any of its member companies.

**Ductile Iron Pipe Research Association**

An association of quality producers dedicated to the highest pipe standards through a program of continuing research and service to water and wastewater professionals.

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**Member Companies**

AMERICAN Ductile Iron Pipe
P.O. Box 2727
Birmingham, Alabama 35202-2727

Canada Pipe Company, Ltd.
1757 Burlington Street East
Hamilton, Ontario L8N 3R5 Canada

McWane Ductile
P.O. Box 6001
Coshocton, Ohio 43812-6001

United States Pipe and Foundry Company
Two Chase Corporate Drive
Suite 200
Birmingham, Alabama 35244

**Social Media**

Get in the flow with Ductile Iron Pipe by connecting with us on Facebook, Twitter, and LinkedIn.

Visit our website, [www.dipra.org/videos](http://www.dipra.org/videos), and click on the YouTube icon for informational videos on Ductile Iron Pipe’s ease of use, economic benefits, strength and durability, advantages over PVC, and more.

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*Strength and Durability for Life*®