## PIPE PRODUCTS

# **Knowing Your Pipe**

#### 2008 Trenchless Technology Pipe Selection Guide

#### By Leanne Butkovic

ith the cornucopia of pipe available on the market, discerning which type of conduit is best for your application can be an overwhelming decision. *Trenchless Technology* contacted pipe associations and manufacturers to create profiles of their respective stocked pipe in order to help you overcome the great puzzle of pipes.

The following pages offer initial insight into piping styles, from steel, clay and iron to plastic, fiberglass and concrete. All information was provided by the associations or manufacturers.

This guide merely scratches the surface of the endless pool of knowledge that is piping. It is by no means intended to be the end-all description for pipe. To learn more about each kind of underground channels and their uses, please contact the manufacturers, associations or your consulting engineers.

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#### High Density Polyethylene (HDPE)

#### **Trenchless Applications:**

Directional drilling; pipe bursting; pipe splitting; microtunneling; sliplining.

**Best Suited For:** All underground utilities including gas, water, sanitary sewer, electrical and communication duct, storm sewer, water service connection. Industrial applications where abrasion, corrosion and chemical resistance is critical



**Ill Suited For:** Due to the wide applications HDPE pipe can be used in, consultation with the manufacturer for specific applications is encouraged.

**How It Is Delivered:** Pipe can be coiled from ½ to 6 in. IPS with lengths varying from 250 ft to 2,000 ft, depending upon pipe diameter. For pipe sizes 2 to 63 in., straight lengths are supplied with typical lengths of 40-or 50-ft joints. Pipe can be provided on reels, but the size of the reel will vary for each manufacturer.

**How It Is Joined:** Pipe can be either fused or mechanically joined; Bell and spigot for corrugated pipe

**Available Diameters:** 1/2 to 63 in. (solid wall); 2 to 60 in. (corrugated); up to 120 in. for spiral-profile wall

**Design Life:** Up to 100 years, depending on design requirements and application.

**Applicable Standards:** AWWA C901 for PE water service lines; AWWA C906 for PE water distribution and transmission lines; AWWA Design Manual M55; Various ASTM standards including but not limited to F1962, F2620, D232, F477, F2306 and D2321. NSF Standard 14 "Plastic Piping components and related material;" NSF Standard 61 "Drinking Water System Components;" Factory Mutual Standard "Plastic Pipe and Fittings for Underground Fire Protection Service," FM1613. ISO Technical Committee 138;AASHTO M294, M252; PPI TR33.

Latest Developments over the Last Five Years: Development of high performance polymers designated as PE4710: Properties include higher tensile strength and higher working pressure as compared to PE3408. Large diameter electrofusion couplings up to 24 in. (larger are in development).

**Quotable:** "Our country must face the reality of replacing its crumbling underground infrastructure and address the ever increasing demand of limited natural resources. HDPE pipe, with its exceptional physical properties and leak free / water tight joining systems, offers communities and utilities a time tested product that they can design with confidence," Tony Radoszewski, Plastic Pipe Insititute executive director

Source: Plastics Pipe Institute Web: www.plasticpipe.org

#### Vitrified Clay Jacking Pipe (VCP)

**Trenchless Applications:** 

Pilot tube microtunneling, slurry microtunneling, static pipe bursting and sliplining casing.

**Best Suited For:** Gravity flow sanitary sewers.

Ill Suited For: Pressure applications.

**How It Is Delivered:** VCP is available in stock or custom lengths, depending on diameter. The maximum length is 10 ft.

**How It Is Joined:** Low profile compression joints utilizing stainless steel collars.

Available Diameters: 8- to 48-in. diameters.

Design Life: 200 years.

Applicable Standards: ASTM C-1208, EN 295-7.

Latest Developments Over the Last Five Years: Higher compressive strengths due to improvements in firing (vitrification).

**Quotable:** "Vitrified clay jacking pipe has been the predominant jacking pipe material in the diameters manufactured due to its high compressive strength (18,000-psi average), low-profile zero-leakage joint and affordability in the typical



1- or 2-m pipe lengths. The chemical resistance of VCP is unsurpassed, making it the only choice in industrial/ commercial applications. The nature of the ceramic material prevents it from changing properties with age, compared to limited life products, which experience degradation over time. Every city in the United States over 100 years old probably has VCP sewer lines still in service today. These pipelines have endured, despite having been made with outdated manufacturing technology and having been installed without the benefit of current construction practices. With today's high tech vitrified clay jacking pipe and today's installation methods, municipalities are able to design and construct systems that will provide excellent service for centuries to come," said Michael VanDine, the National Clay Pipe Institute.

Source: National Clay Pipe Institute Web: www.ncpi.org

#### **Polyvinyl Chloride (PVC)**

**Trenchless Applications:** Segmental sliplining, directional drilling, close-fit pipe lining and pipe bursting.

**Best Suited For:** Buried water, buried reclaimed water, buried force mains, buried sanitary sewer and buried storm sewer.

**Ill Suited For:** Extremely high temperature applications where the temperature of the fluid conveyed is consistently greater than 140 F. Extremely high-pressure applications where the pressure consistently exceeds 300 psi.

**How It Is Delivered:** Standard lengths for pressure pipe are 20 or 22 ft. Sewer pipe lengths can be 13, 14 or 20 ft long. The pipe is sent bundled and is provided straight.

**How It Is Joined:** Slipliner pipe has a gasketed joint. Close-fit and pipe bursting is butt fused. HDD uses butt fusion, a spline-locked gasketed coupler or a bell-and-spigot joint locked together with steel pins.



**Available Diameters:** Gasketed PVC pipe starts at 1.5 in. and is available up to 60 in. for gravity sewer and up to 48 in. for pressure pipe.

**Design Life:** A properly designed, installed and operated system will last well in excess of 100 years.

**Applicable Standards:** Pressure Pipe and Fittings: ASTM D2241, AWWA C900, AWWA C905, AWWA C907 and AWWA C909. Sewer Pipe and Fittings: ASTM D3034, ASTM F679, ASTM F794, ASTM F949 and ASTM F1803.

Latest Developments Over the Last Five Years: Manufacturing improvements have increased the size range available for PVC pipe. Technological advancements have made possible the option of butt fusing in the field, which has opened a number of trenchless applications. Innovations have resulted in alternative joint designs more suitable for sliplining, as well as directional drilling and pipe bursting.

**Quotable:** "PVC is the proven material when performance counts. It has an impressive track record for longevity, durability, low maintenance and ease of assembly. Owners attribute its exceptional performance to its corrosion resistance, chemical resistance and deep-insertion, bell-andspigot, gasketed joints," said Craig Fisher, technical director for the Uni-Bell PVC Pipe Association.

Source: Uni-Bell PVC Pipe Association Web: www.uni-bell.org

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#### **Polymer Concrete**

**Trenchless Applications:** Pipe jacking and microtunneling applications.

**Best Suited For:** Sanitary gravity sewer applications.

Ill Suited For: Pressure applications.

How It Is Delivered: Truck, closed container for ocean freight or rail in 8- or 10-ft lengths.

**How It Is Joined:** The joint consists of a flush stainless steel sleeve that utilizes an EPDM or SBR gasket system. A wooden distribution ring is provided to distribute eccentric loads during the installation of the pipe.

**Available Diameters:** Polymer concrete is available in diameters ranging from 8 to 102 in.



**Design Life:** More than a 50-year design life.

**Applicable Standards:** ASTM D6783.

Latest Development Over the Last Five Years: Polymer concrete pipe is designed for the typical sanitary sewer system. Within the past couple of years, a steel reinforced polymer concrete pipe has been made available to the U.S. municipal and industrial market. Previously, only non-reinforced polymer concrete pipe was available. The polymer concrete pipes available can be installed by means of direct bury, jacking or microtunneling and can be joined to standard manholes and structures, as well as polymer concrete manholes and structures by typical joining methods. Since the introduction of polymer concrete pipe more than 15 years ago, more than 1 million ft of pipe has been installed around the world.

**Quotable:** "When selecting a pipe material, owners should consider the application for which the pipe material will be utilized, the installation method, the pipe characteristics required for the chosen installation method and the required maintenance over the design life of the pipe – not just initial costs. When all of these factors are considered, we believe polymer concrete pipe is one of the best values available in the marketplace," said Jeff LeBlanc, engineering department manager for U.S. Composite Pipe South, LLC.

Source: U.S. Composite Pipe South, LLC Web: www.uscpsouth.com

#### Concrete

**Trenchless Applications:** Jacking and microtunneling.

**Best Suited For:** Jacking and microtunneling applications where pipe with high strength is needed for the jacking forces. Box culvert sections can be used for applications where square or rectangular shapes may be more beneficial such as low clearance areas, pedestrian tunnels, etc.

**Ill Suited For:** Concrete pipe is not suited for applications having high internal pressure.

**How Is It Delivered:** Pre-cast concrete pipe is delivered in pre-cast units that are ready for installation.

**How Is It Joined:** Pre-cast concrete pipe used for trenchless applications typically has a bell-and-spigot joint utilizing a rubber gasket.



**Available Diameters:** Circular reinforced concrete pipe is available in sizes from 12 to 144 in. Elliptical and Arch shapes are also available for locations with limited vertical or horizontal clearance. Additionally, square and rectangular shapes are available in standard dimension up to 12 by 12 ft, with larger nonstandard sizes also available.

**Design Life:** Concrete pipe has a proven design life in excess of 100 years.

Applicable Standards: ASTM C 14 (AASHTO M 86) Nonreinforced Pipe; ASTM Concrete С 985 Nonreinforced Concrete Pipe. Specified Strength; ASTM C 76 (AASHTO M 170) Reinforced Concrete Pipe; ASTM C 655 (AASHTO M 242) Reinforced Concrete Pipe Specified Strength; ASTM C 506 (AASHTO M 206) Reinforced Concrete Arch Pipe: ASTM C 507 (AASHTO M 207) Reinforced Concrete Elliptical Pipe; ASTM C 1433 Reinforced Concrete Box Culverts;ASTM C 1577 Reinforced Concrete Box Culverts; ASTM C 443 (AASHTO M 315) Joints for Concrete Pipe and Manholes; and ASTM C 1628 Joints for Concrete Pipe.

Latest Development Over the Last Five Years: The concrete pipe industry continues to enhance its product through new innovations in concrete admixtures and production automation to develop a quality product with durable performance.

Source: American Concrete Pipe Association Web: www.concrete-pipe.org

#### **Fiberglass Reinforced** Pipe

Trenchless **Applications:** microtunneling, Sliplining, directional drilling, pipe jacking, pipe bursting, tunnel lining and casings.

Best Suited For: Potable water transmission, force main or gravity sewer systems and all applications where there is a corrosive carrier or external environment.



Ill Suited For: Gas transmission hydrocarbon other and transmission lines.

How It Is Delivered: The typical delivered length is 20 ft; however, both short sections (e.g., 5 and 10 ft) and longer lengths of up to 40 ft are available to minimize the number of joints.

How It Is Joined: Fiberglass pipe utilizes a number of different gasket-sealed joints. Typically, the pipe joints are push-together coupling or bell-spigot joints. Restrained joints are available from some manufacturers for curved or otherwise stressed pipe sections.

Available Diameters: The pipe is available from 18 to 158 in. in diameter, depending on the manufacturer.

Design Life: In excess of 50 vears.

Applicable Standards: ASTM D3262 for gravity systems and AWWA C950 for pressure applications. Fiberglass pipe can be utilized in a wide range of service conditions. Extreme cold does not affect the material and the pipe can be manufactured for operating temperatures up to 180 degrees F and pressures up to 250 psi. Each pipe is designed for soil burden, external water pressure and live loading conditions. The pipe is extremely repairable and easy to modify in the field should conditions warrant. Hydraulic analysis shows superb flow characteristics, Manning's of n=0.009 and Hazen Williams of C=155. In addition. the pipe is extremely abrasion resistant.

#### Latest Development Over the

Last Five Years: The U.S. market entry of additional municipal and industrial fiberglass pipe and manhole manufacturers to provide the capacity to serve an emerging large diameter pipe market. The Fiberglass Tank & Pipe Institute represents the following manufacturers listed alphabetically: Ameron International, Containment Solutions Inc., Fiber Glass Systems, Future Pipe Industries, Hobas Pipe USA and L. F. Mfg.

Quotable: "Fiberglass pipe has universal applications with leakfree joints, inherent corrosion resistance, superior low friction hydraulic characteristics and long life service. While costsavings accrue from using smaller diameter high flow rate pipe, there are also installation savings from reduced transportation/ on-site handling costs (i.e., high strength/weight ratio pipe) and reduced labor and installation time (i.e., longer pipe with fewer joints). Fiberglass pipe is an engineered product that may be manufactured custom with fiberglass manways and fittings



## ICON'S exclusive Patented Water Auger Adaptor

Until now, only imaginary Super Heroes could achieve this kind of pinpoint precision under a heavy water table in soft ground! But now, ICON'S exclusive Patented Water Auger Adaptor can do just that...making it more possible than ever to ensure the accuracy required for a gravity sewer installation!

- Allows for a water tight seal while "going trenchless"
- Accurate up to a ¼" line and grade
- Works safely under wetlands, environmentally sensitive areas or stream beds
- Field proven to operate in the wettest conditions, even flowing sand
- Works in up to 10' of water above proposed alignment
- Designed for use only with Bohrtec Pilot machines



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to meet the most difficult jobsite applications," said Sully Curran, P.E., executive director, Fiberglass Tank & Pipe Institute.

Source: Fiberglass Tank & Pipe Institute Web: www.fiberglasstankandpipe.com

#### **Ductile Iron Pipe**

**Trenchless Applications:** Horizontal directional drilling, pipe bursting, microtunneling and pipe jacking.

**Best Suited For:** Installations that require the pipe to have tremendous columnar and tensile strengths, gravity to high-pressure applications and installations that require a robust/ strong pipe.

**How It Is Delivered:** Normally, 18or 20-ft lengths. However, shorter lengths can be obtained by cutting the pipe.



**How It Is Joined:** Push-on gasketed joints with allowable deflection up to a 5-degree deflection. Push-on flexible restrained gasketed joints. Push-on/ Push-bar gasketed joints. Bell-less gasketed joints.

Available Diameters: 3- to 64-in. diameter (3-, 4-, 6-, 8-, 10-, 12-, 14-, 16-, 18-, 20-, 24-, 30-, 36-, 42-, 54-, 60- and 64-in. diameters).



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DesignLife:Indefinitewhenproperly installed.

Applicable Standards: ANSI/ AWWAC150/A21.50 - Thickness Design of Ductile-Iron Pipe. ANSI/AWWA C151/ A21.51 - Ductile-Iron Pipe, Centrifugally Cast, For Water. ANSI/AWWA C111/ A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings. ANSI/AWWA C104/ A21.4 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water. ASTM A746 Ductile Iron Gravity Sewer Pipe. ASTM A716 Ductile Iron Culvert Pipe.

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

ANSI/AWWA C110/A21.10 – Ductile-Iron and Gray-Iron Fittings for Water. ANSI/AWWA C153/A21.53 – Ductile-Iron Compact Fittings for Water Service.

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

Latest Development Over the Last Five Years: In the past five years, the ductile iron pipe industry partnered with Corrpro and developed a riskbased matrix for determining the appropriate corrosion control for ductile iron pipe. Also, the application of ductile iron pipe for horizontal directional drill applications has developed.

**Quotable:** "Successful trenchless installations have firmly established ductile iron pipe as a viable, and in many instances, superior pipe option. With the increasing demand for water and wastewater infrastructure and a movement to reduce the social-economic impact on rate payers that is often associated with open-cut construction, trenchless installation will certainly play an increasing role. For these installations, public works personnel and contractors have the option of installing superior ductile iron pipe."

Source: Ductile Iron Pipe Research Association Web: www.dipra.com

#### **Steel Pipe**

**Trenchless Applications:** Directional drilling, jack-and-bore and horizontal driving (pipe ramming).

**Best Suited For:** Gas transmission, water transmission, water well drilling, pile driving and caisson sleeves.

**Ill Suited For:** Chemical or corrosive service without protective coatings.

**How It Is Delivered:** Steel pipe is delivered in full 20- or 40-ft random lengths from stock. Some sizes of pipe can be manufactured in lengths up to 100 ft without a midweld.

**How It Is Joined:** Steel pipe is joined by welding, threading-and-coupling or compression fittings.

**Available Diameters:** Steel pipe is available in stock sizes from 1/8- to 60-in. outside diameter (OD). Any size and wall thickness that is feasible to transport is available through special order.

**Design Life:** The design life of steel pipe will vary depending on the size, grade and coating application.

**Applicable Standards:** The most common ASTM standards for steel pipe are A-53, A-106, A-139, A-572, A-252 and A-500. The most common API standards for steel pipe are API 5L Grades B, X-42, X-52, X-56, X-60, X-65, and for Oil Country Pipe, API 5CT H-40, J-55, N-80, P-110. The AWWA designation for water pipe is C-200. There is also an AWWA manual M-11 for steel water pipe design.

Latest Developments Over the Last Five Years: Steel pipe has the highest strength-to-weight ratio in relation to cost in the pipe industry. By ordering variations to the content of the raw material, steel pipe can be used in the most extreme of conditions. Steel pipe can also be bent and coiled and is capable of carrying extremely high pressures and volume. Steel pipe has increased its strength by reducing carbon and increasing yields and tensile strengths. Some sizes can be produced to 100 ksi yield strength. Largediameter pipe can also be regularly produced and shipped in 80-ft lengths, and with special equipment, in lengths up to 100 ft.

**Quotable:** "When consideration is given to selection of pipe materials, the economy of steel pipe will stand out," said Bill Buckland, president of the National Association of Steel Pipe Distributors. "It has the lowest cost in relation to its strength-to-weight ratio of any other material. Most sizes are readily available from local distributors and it can be ordered in special sizes, grades and lengths for difficult applications. Fittings are available for any size pipe."

Source: National Association of Steel Pipe Distributors Association Web: www.naspd.com



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