

PPI TN-27/2009

Frequently Asked Questions

**HDPE Pipe for Water
Distribution and Transmission Applications**

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Foreword

This report was developed and published with the technical help and financial support of the members of the PPI (Plastics Pipe Institute, Inc.). The members have shown their interest in quality products by assisting independent standards-making and user organizations in the development of standards, and also by developing reports on an industry-wide basis to help engineers, code officials, specifying groups, and users.

The purpose of this technical note is to provide answers to commonly asked questions about use of HDPE (high density polyethylene) piping systems for water applications.

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A. GENERAL

Q. 1 Is HDPE pipe safe for drinking water? Yes. HDPE pipes certified for potable water applications are produced from pressure rated polyethylene compounds approved by NSF for public drinking water service.

Q. 2 Is HDPE pipe available in both ductile iron pipe size and iron pipe size outside diameters? Yes, HDPE pipe is available both in iron pipe (IPS) and ductile iron pipe sizes (DIPS), sometimes also known as cast-iron pipe sizes (CIPS). IPS sized HDPE pipe has the same outside diameter as black iron or carbon steel pipe. DIPS sized HDPE has the same outside diameter as cast/ductile iron pipe. Typically, ductile iron pipe sizes are available from 4- inch to 36-inch diameters. Iron pipe sizes are available from ¾- inch to 65-inch diameters.

Q. 3 Is small diameter HDPE pipe and tubing available in both iron pipe size inside diameter controlled and copper tube size? Yes, small diameter HDPE pipe products are available in both inside diameter controlled (SIDR) and copper tube size outside diameter controlled (CTS-SDR). Typically, SIDR pipe is available from ½-inch to 3-inch diameter while copper tube size products are typically available in sizes ¾-inch to 2-inch.

Q. 4 Where can dimensional information such as outside diameter, wall thickness and inside diameter of the various sizes of HDPE pipe be found? Normally, they will be found in the published literature of the HDPE pipe manufacturer and in ASTM standards. They can also be found in the Appendix to Chapter 6 of PPI's Handbook of Polyethylene Pipe, 2nd ed.

Q. 5 What does the acronym HDPE stand for? HDPE stands for High Density Polyethylene.

Q. 6 How does the use of HDPE pipe save money for a utility? HDPE pipe provides the lowest life cycle cost when compared to other systems due to significantly reduced or no leakage, increased billable dollars, water conservation, fewer new water-treatment plants, reduced maintenance crews, reduced seasonal water-main breaks, and no loss in flow capacity over the long term. Refer to paper by CSIRO, Life Cycle Analysis of Water Networks, presented at Plastics Pipe XIV, Budapest, 2008.

Q. 7 Is HDPE pipe a green solution for piping? Yes. It is safe when manufactured, used, or incinerated. It helps preserve water and electricity as there is no loss of water through the fused joint.

Q. 8 What do the terms DR and SDR mean? DR stands for Dimension Ratio which is the average outside diameter (note: DR is also used for PVC pipe) divided by the minimum wall thickness. A Standard

Dimension Ratio (SDR) is a specific DR based on ANSI preferred number series. The use of SDR's enables manufacturers to produce pipe to a set of standardized DR's. SDR's include 9, 11, 13.5, 17, 21, 26, and 32.5. All SDR's are DR's, but not all DR's are SDR's.

Q. 9 Why is a fusion joint better than a gasket joint? A fusion joined pipeline may be thought of as a continuous pipeline without joints. On the other hand, gasket joints are a potential source of leakage and lost water in many water systems. Leaks may occur if the gasket is improperly installed, if dirt or grit sticks to the gasket, if the gasket is not properly lubricated, if negative pressure (vacuum) occurs in the pipeline, if ground movement or sub-trench consolidation occurs, if significant thermal change occurs and if gaskets are blown out due to surge pressures. Fused joints are far superior to gasket joints for leak prevention.

Q. 10 Will trenchless installation save money over open cut trenching? Everyday more utilities realize the advantages of trenchless technologies. More trenchless projects are being installed than in the past because of cost savings. Savings can result from quicker installations, faster permitting and design time, fewer disruptions to business and residents, less damage to parks and tress, and less disturbance to road beds (and subsequent road repair.)

B. Engineering Properties & System Design

Q. 11 Is thermal expansion and contraction of HDPE pipe a problem? No. All pipes expand and contract with change in temperature. The key is management of the resultant thermal strain. As with all materials, expansion and contraction must be taken into consideration when designing a HDPE piping system. Buried pipelines usually do not move due to soil friction. However, thermal effects must be considered for above grade applications. The unrestrained coefficient of thermal expansion for HDPE pipe is approximately 9×10^{-5} in/in/ $^{\circ}$ F. Information regarding thermal calculations for restrained and unrestrained above-ground and slip-lined pipelines can be found in PPI's Handbook of Polyethylene Pipe, 2nd ed.

Q. 12 After HDPE has been buried and allowed to relax, will the pipe continue to expand and contract a great amount with temperature variations? No. When HDPE pipe is buried, the temperature of the system becomes much more stable than an above ground pipeline and therefore will exhibit far less dimensional change. In most systems, buried HDPE pipe does not move after it is buried.

Q. 13 Why is there a difference in pressure rating (PR) and working pressure rating (WPR) when comparing HDPE pipe and PVC pipe? The term pressure rating (PR) refers to the static pressure rating of the pipe, calculated from the hydrostatic design basis (HDB) with an appropriate design factor (DF) and is for a pipeline with no flow. However, all municipal water systems involve flowing water. For example, HDPE (PE4710) DR 17 pipe has a static pressure rating for water of 125 psig. The working pressure rating (WPR) is based on actual system requirements and is a dynamic pressure rating, that is, a pressure rating for pipe with flowing water. The WPR includes an allowance for water hammer surge pressures. At a daily recurring average flow surge velocity of 5 fps and at 80 $^{\circ}$ F, the working pressure rating of HDPE (PE4710) DR 17 pipe is also 125 psig; similarly, the working pressure rating for PVC DR 18 is 120 psig per AWWA C900-07, Equation 4. As such, PE 4710 has a higher working pressure rating than PVC at these common conditions. A summary is shown below:

Working Pressure Rating (WPR) for HDPE and PVC per answer to Q. 13	
WPR for PVC DR 18 per C900-07	WPR for PE 4710 DR 17 per C901-08
120 psig	125 psig

Also, based on AWWA C900-07, Example B.2 modified with 5 fps recurring surge velocity, the estimated number of cycles to failure for the DR18 PVC pipe is less than 1 million cycles and the Fatigue Life is about 20 years which is less than half of the 50 year Design Life that was required in the example; in addition, the assumed 55 cycles per day may not be adequate; assuming 1 surge cycle every 15 minutes (96 cycles per day) and the 5 fps recurring surge velocity results in a Fatigue Life of about 11 years. On the other hand, IGN 4-37-02, "Design Against Surge and Fatigue Conditions for Thermoplastic Pipes", can be used to show that under the same conditions, an HDPE DR17 pipe has a fatigue life of 10,000,000 cycles or in excess of 100 years. This striking difference is due to HDPE's toughness and fatigue resistance.

Q. 14 Where can I find engineering properties such as the modulus and tensile strength values for HDPE pipes? Engineering data for HDPE pipes may be found in Chapter 3 of the PPI's Handbook* of Polyethylene Pipe, 2nd ed.

Q. 15 Do I have to be concerned with the long-term effects of creep? All plastic materials, including HDPE and PVC, are subject to creep. Proper design, such as using the long-term modulus of the material where appropriate, accounts for creep effects.

Q. 16 Is there a flow loss in HDPE pipe due to the inner bead resulting from the butt fusion process? The fusion bead has very little effect on the flow as it is basically rounded and protrudes very little on the inside surface of the pipe. Secondly, the Hazen-Williams C-factor of 150 takes into account the inner bead. Field tests confirm that a 150 C- factor used in the Hazen- Williams equation properly calculates actual flow and that the bead is of no hydraulic significance for either pressure or flow. The Hazen-Williams Friction Factor, C, for PE pipe was determined in a hydraulics laboratory using heat fusion joined lengths of pipe with the inner bead present.

Q. 17 Will sunlight adversely affect HDPE pipe? Sunlight is not a concern if black pipe is used. Carbon black, utilized in most all HDPE pipe is the most effective ultraviolet stabilizer and therefore, black is the recommended pipe color for exposed long term service or storage. Pipe of this color will provide decades of outdoor use similar to that of black power-line cable jacketing. HDPE pipe produced in non-black colors may also be supplied for outdoor exposure (storage and use) but its life expectancy is much less and is usually specified for a particular time period. Questions on this topic should be referred to the pipe manufacturer.

Q. 18 What is the life expectancy of HDPE pipe in water applications? Many installations of HDPE pipe in water applications are already reaching 50 years of successful service. The polyethylene pipe industry estimates a service life for HDPE pipe to conservatively be 50-100 years. This relates to savings in replacement costs for generations to come.

Q. 19 Will HDPE pipe float in water? Yes, HDPE pipe, due to its density being slightly less than water, will float even when full of water. When it is desired to ensure flotation of the line, various forms of collars, saddles, and strap-on flotation devices are available. For underwater anchored pipeline installations, it is important to specify the proper weights and spacing of the weights. Screw-anchors are a practical alternative. Whenever possible, an underwater pipeline should be installed in a trench with protective crushed rock cover. Refer to Chapter 10 of the PPI Handbook of Polyethylene Pipe, 2nd ed.

Q. 20 What is the max-min temperature range across which HDPE pipe for water pressure applications may be used? HDPE pipe's typical operating temperature range is from -40°F (-40°C) to 140°F (60°C) although some products may be pressure rated for service as high as 180°F (82°C). Since water freezes below 32°F (0°C) the practical lower temperature limit for water is 32°F (0°C). Consult with the pipe producer for information on applications.

Q. 21 When using HDPE pipe, will the pipe deliver the same flow-rate as the modestly larger ID ductile-iron pipe with the same outside diameter? The inside surface of HDPE pipe is devoid of any