

## Specification Sheet: Polyethylene (PE) plastic pipe and fittings for water service

### 1. PRODUCT NAME

Polyethylene (PE) Plastic Pipe and fittings for cold water service systems

### 2. MANUFACTURER

For a list of member manufacturers, contact the Plastic Pipe and Fittings Association, 800 Roosevelt Road, Building C, Suite 20, Glen Ellyn, IL 60137; (630) 858-6540; fax (630) 790-3095; www.ppfa.org.

### 3. PRODUCT DESCRIPTION

**Basic Use:** The basic use is in water service systems. However, PE pipe can be used in residential, commercial and industrial applications. Pipe and fittings are joined by heat fusion or with mechanical fittings designed for and recommended by the manufacturer for water service. There is a full complement of PE fittings and valves available for potable water applications. Connections between PE pipe and other piping materials are accomplished by use of adapter fittings or factory assembled transition fittings. Adapter fittings connect by threaded joints or compression connections.

**Composition and Materials:** PE used in the manufacture of water service pipe is a thermoplastic material produced from the polymerization of ethylene monomer and are listed in PPI (Plastics Pipe Institute) TR4. PE plastics are described in accordance with the appropriate cell classification as defined in ASTM D 3350.

Note 1: PE pipe is intended for

*use in the transport of potable water and should be evaluated and certified as safe for this purpose by a testing agency acceptable to the local health authority. The evaluation should be in accordance with requirements for chemical extraction, taste and odor, that are no less restrictive than those included in NSF Standard 61. The seal or mark of the laboratory making the evaluation should be included on the pipe and fittings.*

**Grades:** PE pipe is available in a variety of wall thicknesses, based on three distinct sizing conventions:

1. Iron Pipe Size Outside Diameter controlled, IPS-OD (SDR);
2. Iron Pipe Size Inside Diameter controlled, IPS-ID (SIDR); and
3. Copper Tube Size Outside Diameter controlled, CTS (SDR).

PE pipe for water service ranges in size from 1/2 inch CTS to 6 inches IPS in nominal diameters with larger sizes available from most manufacturers. SDR PE pipes have outside diameters that correspond to Schedule 40 steel pipe with wall thicknesses that vary in accordance with the ratio to the outside diameter. SIDR PE pipes have controlled inside diameters (ID) with varying outside diameters (OD) based on the ratio of the wall's thickness. PE tubing is produced in accordance with the outside diameters established for copper tubing sizes.

The minimum pressure rating for PE water service pipe is 160 psi at 73.4 ° F as recommended by

AWWA C901. PE piping with other pressure ratings is also available from the pipe manufacturers. AWWA C901 lists various PE pipe pressure classes for water at 73.4° F ranging from PC 80 (80 psi) up to and including PC 200 (200 psi).

Black PE pipe produced in accordance with the requirements of AWWA C901 and/or AWWA C906 may be stored or utilized in direct sunlight for extended periods of time.

Properly engineered and compounded, PE pipe produced in colors other than black may be stored or utilized in direct sunlight for limited periods of time. Manufacturers of the pipe should be consulted regarding the storage or suitability of non-black PE pipe in potable water service applications.

### 4. TECHNICAL DATA

**Applicable Standards:** PE pipe and fittings are manufactured and installed in accordance with the following standards specifications:

ASTM D 2239  
ASTM D 2683  
ASTM D 2737  
ASTM D 2609  
ASTM D 2774  
ASTM D 3035  
ASTM D 3261  
ASTM F 1055  
AWWA C901  
AWWA C906  
AWWA C651

CSA CAN/CSA B1 37.1 (Canada)

**Quality Control.** PE pipe and fittings for water service are listed and inspected by a third party and

conform to NSF 14 and/or NSF 61.

**Chemical Resistance:** PE pipe and fittings are resistant to normal chemicals encountered in disinfecting potable water. PE pipe resists certain chemical actions on the exterior of the pipe when located in hazardous environments. Contact manufacturer for a detailed chemical resistance listing.

*Note 2: The selection of materials is critical for water service and distribution piping in locations where there is a likelihood the pipe will be exposed to significant concentrations of pollutants comprised of low molecular weight petroleum products or organic solvents or their vapors. Research has documented that pipe materials such as PE, PB, PVC and asbestos cement, and elastomers such as used in jointing gaskets and packing glands, may be subject to permeation by lower-molecular weight organic solvents or petroleum products. If a water pipe must pass through such a contaminated soil environment or an area subject to contamination, consult with pipe manufacturers regarding permeation of the pipe walls, joining materials, and so forth, before selecting materials for use in that area.*

**Temperature Rating:** PE pipe and fittings are pressure rated for various temperatures. Most plumbing codes stipulate a minimum pressure rating of 160 psi at 73.4°F. PE pipe is designed to accommodate temperatures normally associated with a water service piping installation. PE pipe that can meet the plumbing code requirements of 160 psi at 73.4°F have wall thicknesses of SDR 5.3, SDR 7, SDR 9, SDR 7.3, SDR 9, or SDR 11.

**Flow Characteristics:** PE pipe does not rust, rot, pit, corrode or accumulate mineral deposits when used in accordance with accepted

installation design. As a result, the interior wall of PE pipe remains extremely smooth over its life. This equates to extremely low pressure losses through a PE piping system. The common equation used to size a pressure water pipe system is the Hazen-Williams Equation. The C value for PE plastic pipe using the Hazen-Williams equation is 150. The Hazen-Williams Equation is as follows:

$$f = 0.2083 \left( \frac{100}{C} \right)^{1.852} \frac{Q^{1.852}}{d^{4.8655}}$$

where: f = friction loss per 100 feet in feet of water

C = roughness coefficient

Q = flow rate in gpm

d = inside diameter of pipe in inches

Friction loss for flow through fittings is based on equivalent length of pipe.

**Water Hammer.** PE water service pipe installations are normally designed with a flow rate less than eight feet/second. Higher flow velocities are normally avoided in small diameter water service pipe so as to reduce the impact of water hammer generation during operation. Please refer to AWWA C901 or AWWA C906 for further information.

**Laying Lengths:** PE pipe is available in coils of various lengths and in straight lengths of up to 40 feet. Refer to manufacturer's literature for further information.

**Trenching and Bedding:** PE service pipe should be installed underground in accordance with ASTM D 2774. Pipe trenches should be as narrow as possible but of sufficient width to properly bed, install and backfill the pipe. PE pipe must be installed below the recorded frost line.

When rock, hard pan, boulders, or other material of a deleterious na-

ture are encountered, trenches should be excavated at least an additional 4 inches for installation of selected bedding prior to laying the pipes. Bedding of the trench may consist of evenly graded, free-flowing granular material free from stones or rocks greater than  $\frac{3}{4}$  inch in diameter. Backfill material less than  $\frac{1}{2}$  inch in diameter should be placed in 6 inch "lifts" or layers around the pipe, with each layer tamped in place. Final compaction is recommended to be 85 percent Standard Proctor Density or greater per ASTM recommended practice.

**Expansion and Contraction:** The coefficient of linear expansion for PE pipe is approximately  $1.2 \times 10^{-4}$  inch/inch/Degree F. This characteristic translates to an expansion of roughly 3.0 inches for every 100 feet of pipe per 30° F temperature change.

While the rate of expansion is somewhat high compared to metallic pipe, the modulus of elasticity is significantly lower. The result is that the unrestrained PE will move freely and in significant amounts. However, the forces generated in this process are extremely low compared to metallic materials and may be easily controlled through frictional resistance of the surrounding soil, thrust block design or mechanical joining device design.

When PE pipe is installed in long straight lengths, compensation for expansion and/or contraction must be provided by "snaking" the pipe in the trench prior to backfill. In this way, the expansive or contractive stress resulting from elongation or contraction in response to temperature variation can be transferred to surrounding soil without the need for extensive thrust block or mechanical connection design. Refer to the manufacturer's literature for more information.

## 5. INSTALLATION

**Preparatory Work:** PE pipe must be cut square with a plastic tubing cutter, miter saw, or power saw designed for that use. Pipe ends must be deburred and wiped clean and dry.

**Methods:** PE water service pipe may be joined using any of the various industry-accepted techniques described as follows:

- Various heat fusion techniques exist by which to join PE pipe. These include butt fusion, socket fusion and electro-fusion. Refer to ASTM standards D 3261, D 2683 and F 1055 for a complete description of the fittings involved.

The actual steps for joining PE pipe using any of these techniques are available from the manufacturer. However, the basic process is described in ASTM D 2657. It consists initially of heating the pipe and fittings to a specified melt temperature with a heat fusion tool designed for such use. The molten components are then joined together under pressure and allowed to cool. Properly formed, the resulting joint is as strong as the pipe itself.

- PE water service pipe can also be joined using any of the various mechanical fittings designed specifically for this purpose.

Insert fittings can be metallic or plastic in construction. See ASTM D 2609. Stainless steel or other corrosion resistant metal compression bands are first fitted over the pipe ends to be joined. The ribbed male “insert” portion of the fitting is then inserted into the PE pipe ends being joined. Care should be taken to ensure that the pipe profile is positioned flush with the stops designed into the fittings. The compression band is then positioned over the ribbed section of the fitting inside of the pipe and tightened in accordance with the fittings manufacturer’s guidelines.

When practical, two compression bands are placed over the pipe profile and tightened in order to provide additional joint security.

*Note 3: Insert fittings and compression clamps are not recommended for class 160 psi and 200 psi pipe at diameters above 1 1/4 inches.*

Compression connections are made with a ferrule and compression nut fitting. An insert stiffener is placed into the tube to make the connection properly by providing a bearing surface against which the compression nut will lock the PE pipe. The compression nut and lock ring are placed over the pipe profile and the nut is then hand tightened. The compression nut is then usually tightened to 1/4 to 1/2 turn past hand tight. *Note 4: Care should be taken to ensure that the insert stiffener does not extend beyond the body of the compression fitting within the pipe profile.*

A third type of compression fitting is of the “stab type.” These fittings have loosely held, self-contained, insert stiffeners which extend from the end of the fitting body. Stress relief is built into these fitting designs to mitigate shear forces. As is the case with all joints in PE piping systems, excessive bending at the joint must be avoided. The “stab-type” joint is accomplished by cutting the pipe ends square, chamfering the ends of the pipes, marking the stab depth and then simply stabbing the pipe into the fitting. Follow the manufacturer’s written, qualified installation instructions. Stab-type fittings are available in sizes 1/2 inch CTS through 2 inch IPS.

Threading of unreinforced PE water service is not recommended. However, threaded connections to various system appurtenances can

be made with compression nut threaded adapters. When threaded adapter fittings are installed, apply joint tape or thread sealant compound compatible with PE pipe to male threads of the metal fitting. Adapter fittings shall be installed in accordance with manufacturer’s installation instructions.

**Precautions:** Protect pipe from coming in contact with large rocks or stones upon installation. Refer to ASTM D 2774. Care should be taken to avoid excessive rough handling or abrasion of the pipe and fittings prior to or during installation. Excessive bending at joints should be avoided. The pipe manufacturer should be contacted for bending guidelines. As a general rule, gouges or abrasions in excess of 10 percent of the wall thickness of the pipe should result in removal and replacement of that section of pipe.

PE water service pipe should be thoroughly cleaned and disinfected in accordance with the requirements of AWWA C651 prior to placing into service.

**Plumbing Codes:** PE pipe may be used in any water service system, in accordance with the following model codes: BOCA National Plumbing Code, IAPMO Uniform Plumbing Code, IPC International Plumbing Code, NAPHCC National Standard Plumbing Code, SBCCI Standard Plumbing Code and various state codes.

Verify acceptance and installation of PE piping systems with the local code enforcement authorities having jurisdiction.

## 6. AVAILABILITY AND COST

**Availability.** PE pipe and fittings are available through local plumbing supply wholesalers and various hardware retailers throughout the United States and Canada.

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*Cost:* PE plastic pipe is less expensive than metallic piping materials used in water service systems.

## **7. WARRANTY**

PE pipe and fittings manufacturers generally warrant that their pipe and fittings are free from defects and conform to designated standards. However, most warranties contain limitations such as, for example, they are only applicable to pipe and fittings installed in accordance with manufacturer's installation instructions. Warranties should be read carefully. The manufacturer of the pipe and fittings is not responsible for improper use, handling, or installation of the product.

## **8. MAINTENANCE**

Normal maintenance as required.

## **9. TECHNICAL SERVICES**

Manufacturers of PE pipe and fittings will provide technical manuals & engineering data upon request.

## **10. MORE INFORMATION**

Additional product information is available from the Plastic Pipe and Fittings Association, 800 Roosevelt Road, Building C, Suite 20, Glen Ellyn, IL 60137; (630) 858-6540; f a x ( 6 3 0 ) 7 9 0 - 3 0 9 5 ; w w w . ppfahome.org.

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