



Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter¹

This standard is issued under the fixed designation D2239; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This specification covers polyethylene (PE) pipe made to standard inside dimension ratios (SIDR) and pressure rated for water (see appendix). Included are requirements for PE compounds and requirements and test methods for workmanship, dimensions, elevated temperature sustained pressure, burst pressure, and marking.

NOTE 1—Refer to specification AWWA C901 and PPI Technical Note 49 (TN-49) for further information on pipe suitability for potable water end use applications. Oxidative Resistance Classification (CC# rating) information is available from NSF International.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 The text of this specification references notes, footnotes, and appendixes which provide explanatory material. These notes and footnotes shall not be considered as requirements of the specification. Notes and footnotes in tables and figures, and Supplementary Requirements are requirements of the specification.

1.4 The following safety hazards caveat pertains only to the test methods portion, Section 7, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

¹ This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.26 on Olefin Based Pipe.

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2. Referenced Documents

2.1 ASTM Standards:²

- D618 Practice for Conditioning Plastics for Testing
- D638 Test Method for Tensile Properties of Plastics
- D1238 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
- D1598 Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
- D1599 Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings
- D1600 Terminology for Abbreviated Terms Relating to Plastics
- D1603 Test Method for Carbon Black Content in Olefin Plastics
- D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
- D2565 Practice for Xenon-Arc Exposure of Plastics Intended for Outdoor Applications
- D2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
- D3350 Specification for Polyethylene Plastics Pipe and Fittings Materials
- D4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
- F412 Terminology Relating to Plastic Piping Systems
- F2263 Test Method for Evaluating the Oxidative Resistance of Polyethylene (PE) Pipe to Chlorinated Water
- G154 Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials
- G155 Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials

2.2 APWA Standard:³

- APWA Uniform Color Code

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ APWA, 2345 Grand Boulevard, suite 500, Kansas, City, MO 64108-2641.

*A Summary of Changes section appears at the end of this standard

2.3 AWWA Standards:⁴

C901 Polyethylene (PE) Pressure Pipe and Tubing, ¾ in. (19 mm) through 3 in. (76 mm), for Water Service

2.4 NSF Standards:⁵

NSF/ANSI Standard No. 14 for Plastic Piping Components and Related Materials

NSF/ANSI/CAN Standard No. 61 for Drinking Water Systems Components—Health Effects

2.5 PPI Publications:⁶

PPI TR-3 Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe

PPI TR-4 HDB/SDB/PDB/MRS Listed Materials, PPI Listing of Hydrostatic Design Basis (HDB), Strength Design Basis (SDB), Pressure Design Basis (PDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe

PPI TN-49 Recommendations for AWWA C901 Service Tubes in Potable Water Applications

3. Terminology

3.1 Definitions—Definitions are in accordance with Terminology **F412**, and abbreviations are in accordance with Terminology **D1600**, unless otherwise specified. The abbreviation for polyethylene plastic is PE.

4. Pipe Classification

4.1 General—This specification covers inside diameter controlled PE pipe made from PE compounds in standard inside dimension ratios and pressure rated for water. Pressure ratings for water are dependent on the PE compound in accordance with the following relationship:

$$PR = \frac{2 \times HDS}{(SIDR + 1)} \quad (1)$$

where:

PR = pressure rating for water, psi (kPa)

HDS = hydrostatic design stress for water at 73 °F (23 °C), psi (kPa)

SIDR = standard inside dimension ratio

NOTE 2—PR and HDS must have the same units. See **Appendix X1** for maximum pressure ratings for water.

5. Materials

5.1 Polyethylene Compound—Polyethylene compounds suitable for use in the manufacture of pipe under this specification shall meet thermoplastic materials designation codes PE2708 or PE3608 or PE4710, and shall meet **Table 1** requirements for PE2708 or PE3608 or PE4710, and shall meet thermal stability, brittleness temperature and elongation at

break requirements in accordance with Specification **D3350**. Oxidative Resistance Classification of CC3 is required in specific end use applications in accordance with **5.3**.

5.1.1 Color and Ultraviolet (UV) Stabilization—in accordance with **Table 1**, polyethylene compounds shall meet Specification **D3350** code C, D or E. In addition, Code C polyethylene compounds shall have 2 to 3 percent carbon black, and Code D or E polyethylene compounds shall have sufficient UV stabilizer to protect pipe from deleterious UV exposure effects during unprotected outdoor shipping and storage for at least eighteen (18) months.

NOTE 3—Pipe users should consult with the pipe manufacturer about the outdoor exposure life of the product under consideration. Evaluation of UV stabilizer in Code E color PE compound using Practice **D2565** or Practice **G154** or Practice **G155** may be useful for this purpose.

5.1.2 Colors for solid color, an external color layer or color stripes—In accordance with the APWA Uniform Color Code, blue shall identify potable water service; green shall identify sewer service; and purple (lavender) shall identify reclaimed water service. Yellow identifies gas service and shall not be used. The base resin that is used for an external color layer or color stripes shall be the same base resin as the body of the pipe in accordance with **Table 1**.

5.2 Health Effects Requirement—PE compound intended for contact with potable water, or when otherwise required, shall be evaluated, tested, and certified for conformance with NSF/ANSI Standard No. 61 or the health effects portion of NSF/ANSI/CAN Standard No. 14 by a certifying organization acceptable to the regulatory authority having jurisdiction.

5.3 Oxidative Resistance—For pipe that is intended for use in the transport of potable water containing oxidizing disinfectants (for example, hypochlorous acid or chloramines), or when required by the application, customer or regulatory authority having jurisdiction, the PE compound shall have an oxidative resistance classification of CC3 in accordance with Specification **D3350**. The oxidative resistance classification of CC3 is used in conjunction with pipe dimensions in accordance with **6.2.1.1** and **6.2.2.1** to ensure the intended pipe service life is met with respect to oxidative resistance (see **Note 4**). When the pipe meets these requirements, it shall be marked CC3 as in accordance with **9.1.8**. When the pipe does not meet the compound and dimensional requirements as above it shall not be marked CC3. An oxidative resistance classification is not required for other potable water services that do not contain oxidizing disinfectants or when it is not required by the application, customer or regulatory authority having jurisdiction.

NOTE 4—See www.plasticpipe.org for further information on potable water disinfectants in small diameter PE pipe and the use of oxidative resistance classification for specific applications.

NOTE 5—Pipe failure analysis for the oxidative resistance **5.3** is based on Type 2 failures and the brittle failure line extrapolation. See ASTM **F2263** Standard Test Method for Evaluating the Oxidative Resistance of Polyethylene (PE) Pipe to Chlorinated Water for brittle failure definition and **Fig. 1** for a pictorial lifetime representation.

5.4 Rework Material—Clean polyethylene compound from the manufacturer's own pipe production that met **5.1** through **5.3** as new PE compound is suitable for re-extrusion into pipe

⁴ Available from American Water Works Association (AWWA), 6666 W. Quincy Ave., Denver, CO 80235, <http://www.awwa.org>.

⁵ Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140, <http://www.nsf.org>.

⁶ Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, <http://www.plasticpipe.org>.