



Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter¹

This standard is issued under the fixed designation D3035; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope*

1.1 This specification covers polyethylene (PE) pipe made in thermoplastic pipe dimension ratios based on outside diameter IPS $\frac{1}{2}$ to 3, for both non-pressure and pressure rated water (see [Appendix X1](#)). Included are requirements for polyethylene compounds and PE plastic pipe, a system of nomenclature for PE plastic pipe, and requirements and test methods for materials, workmanship, dimensions, sustained pressure, and burst pressure. Methods of marking are also given.

NOTE 1—Significant changes have been made to this specification to remedy duplication of sizes with other specifications, for DIPS sizes and larger sizes refer to the appropriate standard specification such as Specification [F714](#) or AWWA C906.

1.2 For pipes produced under this specification that are intended for use in the distribution and transmission of potable water without oxidizing disinfectants, potable and non-potable water, grey water, reclaimed water, wastewater, force main and gravity municipal sewage, etc, the user should consult the manufacturer to determine whether the fluid being transported is compatible with polyethylene pipe and will not affect the service life beyond limits acceptable to the user.

1.3 For pipes produced under this specification that are intended for use in the distribution and transmission of potable water or other fluids containing oxidizing disinfectants (for example, Hypochlorous acid or chloramines), special requirements for PE compounds are specified in [5.2](#) and [5.3](#), and DR limitations are specified in [6.2.1.1](#) and [6.2.2.1](#).

NOTE 2—Refer to specification AWWA C901 for other suitable potable water options.

1.4 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.

1.5 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.

1.6 *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.*

2. Referenced Documents

2.1 ASTM Standards:²

- [D618 Practice for Conditioning Plastics for Testing](#)
- [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](#)
- [D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings](#)
- [D2290 Test Method for Apparent Hoop Tensile Strength of Plastic or Reinforced Plastic Pipe](#)
- [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](#)
- [F412 Terminology Relating to Plastic Piping Systems](#)
- [F714 Specification for Polyethylene \(PE\) Plastic Pipe \(DR-PR\) Based on Outside Diameter](#)
- [F2263 Test Method for Evaluating the Oxidative Resistance of Polyethylene \(PE\) Pipe to Chlorinated Water](#)

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 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.

TABLE 1 Polyethylene Compound Requirements

Requirement	Material Designation				
	PE1404	PE2708	PE3608	PE4608	PE4710
Required Value					
HDB at 140 °F (60 °C), psi (MPa), in accordance with ASTM D2837 and PPI TR-3	^A	800 (5.5) ^B	800 (5.5) ^B	800 (5.5) ^B	1000 (6.9) ^B
HDS for water at 73°F (23°C) psi (MPa), in accordance with ASTM D2837 and PPI TR-3 ^C	400 (2.76)	800 (5.5)	800 (5.5)	800 (5.5)	1000 (6.9)
Melt flow rate in accordance with ASTM D1238	1.0 to 0.4 g/10 min Cond. 190/2.16	≤0.40 g/10 min Cond. 190/2.16 or ≤20 g/10 min Cond. 190/21.6	≤0.15 g/10 min Cond. 190/2.16 or ≤20 g/10 min Cond. 190/21.6	≤0.15 g/10 min Cond. 190/2.16 or ≤20 g/10 min Cond. 190/21.6	≤0.15 g/10 min Cond. 190/2.16 or ≤20 g/10 min Cond. 190/21.6
Specification D3350 Cell Classification Property	Required Value				
Density (natural base resin)	1	2	3	4	4
SCG Resistance	4	7	6	6	7
Color and UV Stabilizer Code ^D	C	C, D, or E	C, D, or E	C, D, or E	C, D, or E
Oxidative Resistance Classification in accordance with Test Method F2263 ^E	E	E	E	E	E

^AHDB at 140 °F (60 °C) not required. Contact manufacturer about pipe use at temperatures other than 73 °F (23 °C).

^B Minimum value.

^CContact manufacturer or see PPI TR-4 for listed value.

^DSee 5.1.1.

^ESee 5.3 for when CC3 classification is required. Oxidative Resistance Classification (CC# rating) information is available from NSF International.

2.2 NSF International Standards:³

NSF/ANSI Standard 14 for Plastic Piping Components and Related Materials

NSF/ANSI/CAN Standard 61 for Drinking Water System Components—Health Effects

2.3 Other Documents:

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 Pipe⁴

TR-4 Listing of Hydrostatic Design Bases (HDB), Strength Design Bases (SDB), Pressure Design Bases (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe⁴

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

APWA Uniform Color Code⁵

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

AWWA C906 Polyethylene (PE) Pressure Pipe and Fittings, 4 in. (100 mm) through 65 in. (1650 mm), for Water Works

3. Terminology

3.1 Definitions—Definitions are in accordance with Terminology **F412**, and abbreviations are in accordance with Terminology **D1600**, unless otherwise specified.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 relation between dimension ratio, hydrostatic design stress, and pressure rating—the following expression, commonly known as the ISO equation,⁶ is used in this specification to relate dimension ratio, hydrostatic design stress, and pressure rating:

$$2S/P = DR - 1 \text{ or } 2S/P = (D_o/t) - 1 \quad (1)$$

where:

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

P = pressure rating, psi (MPa),

D_o = average outside diameter, in. (mm)

t = minimum wall thickness, in. (mm), and,

DR = thermoplastic pipe dimension ratio (*D_o* / *t* for PE pipe).

³ Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140, <http://www.nsf.org>.

⁴ Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, <http://www.plasticpipe.org>.

⁵ APWA, 2345 Grand Boulevard, Suite 500, Kansas City, MO 64018-2641, <http://www.apwa.net>.

⁶ ISO R 161-1960, Pipes of Plastics Materials for the Transport of Fluids (Outside Diameters and Nominal Pressure), Part 1, *1960 Series*.

TABLE 2 IPS Pipe-Outside Diameter^A and Tolerance

IPS Size	Outside Diameter, in. (mm)	Tolerances, in. (mm)
1/2	0.840 (21.34)	±0.004 (0.10)
3/4	1.050 (26.7)	±0.004 (0.10)
1	1.315 (33.4)	±0.005 (0.13)
1 1/4	1.660 (42.2)	±0.005 (0.13)
1 1/2	1.900 (48.3)	±0.006 (0.15)
2	2.375 (60.3)	±0.006 (0.15)
3	3.500 (88.9)	±0.008 (0.20)

^AFor a distance to the cut end of the pipe that is the lesser of 11.8-in (300 mm) or 1.5 times the outside diameter, a diameter reduction of up to 1.5% shall be acceptable.

4. Pipe Classification

4.1 General—This specification covers PE pipe made from PE plastic pipe materials in various dimension ratios and water pressure ratings.

4.2 Thermoplastic Pipe Dimension Ratios (DR)—This specification covers PE pipe in various dimension ratios. The pressure rating is uniform for all nominal sizes of pipe for a given PE pipe material and DR. (See [Table X1.1](#).) See [4.3](#), Special sizes for dimension ratios not listed.

4.3 Special Sizes—Where existing system conditions or special local requirements make other diameters or dimension ratios necessary, other sizes or dimension ratios, or both, shall be acceptable in engineered products when mutually agreed upon by the customer and manufacturer if (1) the pipe is manufactured from plastic compounds meeting the material requirements of this specification and (2) the strength and design requirements are calculated on the same basis as those used in this specification.

4.3.1 Piping systems smaller than IPS 4 intended for applications using oxidizing disinfectants shall not utilize a DR numerically greater than (have a wall thickness thinner than) DR 9. Refer to [1.3](#), [5.4](#), [6.2.1.1](#) and [6.2.2.1](#).

5. Materials

5.1 Polyethylene Compounds—Polyethylene compounds suitable for use in the manufacture of pipe under this specification shall meet thermoplastic materials designation codes PE1404 or PE2708 or PE3608 or PE4608 or PE4710, and shall meet [Table 1](#) requirements for PE1404 or PE2708 or PE3608 or PE4608 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 as per [5.3](#).

5.1.1 Color and Ultraviolet (UV) Stabilization—Per [Table 3](#), 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 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. Oxidative Resistance Classification of CC3 is required in specific end use applications as per [5.3](#).

5.1.2 Colors for solid color, a color shell layer, or color stripes used to identify pipe service or pipe DR—In accordance with the APWA Uniform Color Code, blue shall identify potable water service; green shall identify sewer service; purple (lavender) shall identify reclaimed water service. Yellow identifies gas service and shall not be used. Colors used to identify DR may be used in accordance with end user specifications.

5.2 Health Effects Requirements—Products intended for contact with potable water, or when otherwise required, shall be certified for conformance with NSF/ANSI Standard No. 61 or the health effects portion of NSF/ANSI/CAN Standard No. 14 by an acceptable certifying organization.

5.3 Oxidative Resistance—For pipe that is intended for use in the transport of potable water or other fluids containing oxidizing disinfectants (for example, Hypochlorous acid or chloramines), or where 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 intended pipe service life is met with respect to oxidative resistance (see [Note 3](#)). When the pipe meets these requirements, it shall be marked CC3 in accordance with [9.1.7](#). 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 service or other fluids that do not contain oxidizing disinfectants or when it is not required by the application, customer or regulatory authority having jurisdiction.

NOTE 3—See PPI TN-49 or 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 4—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, rework material from the manufacturer's own pipe production that met [5.1](#) through [5.3](#) as new compound is suitable for use when blended with new compound of the same material designation and oxidative resistance classification. Pipe containing the rework material shall meet the requirements of this specification.

6. Requirements

6.1 Workmanship—The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other defects. The pipe shall be as uniform as commercially practicable in color, opacity, density, and other physical properties.

6.2 Dimensions and Tolerances:

6.2.1 Outside Diameters—The outside diameters and tolerances shall be as shown in [Table 2](#) when measured in accordance with Test Method [D2122](#). For diameters not shown in [Table 2](#), the tolerances shall be the same percentage of the outside diameter as those for the closest listed diameter.