



Standard Specification for Polyethylene (PE) Pipe and Fittings for Roof Drain Systems¹

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1. Scope*

1.1 This specification covers requirements for polyethylene (PE) pipe and fittings for nonpressure roof drain systems.

1.2 This specification covers pipe and fittings intended for normal residential and commercial uses and is not intended for use in unusual corrosive conditions.

NOTE 1—Before installing pipe for waste disposal use, the approval of the cognizant building code authority shall be obtained as conditions not found in normal use or temperatures approaching 140 °F (60 °C) may be encountered.

1.3 Pipe is produced in dimensions based on outside diameters of 32 mm (1.250 in.) and larger in accordance with Specification F714.

1.4 The interchangeability of pipe and fittings made by different manufacturers is not addressed in this specification. Transition fittings for joining pipe and fittings of different manufacturers is provided for in this specification.

1.5 Pipe and fittings are joined by the heat-fusion method, by the electrofusion method, or by using mechanical joints (excluding insert fittings) recommended by the manufacturer.

1.6 In referee decisions, the SI units shall be used for metric-sized pipe and inch-pound units for pipe sized in the IPS system (ANSI B36.10). In all cases, the values given in parentheses are provided for information only.

1.7 The following safety hazards caveat pertains only to the test method, 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.*

1.8 *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 F17.63 on DWV.

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2. Referenced Documents

2.1 ASTM Standards:²

D543 Practices for Evaluating the Resistance of Plastics to Chemical Reagents

D570 Test Method for Water Absorption of Plastics

D618 Practice for Conditioning Plastics for Testing

D883 Terminology Relating to Plastics

D1600 Terminology for Abbreviated Terms Relating to Plastics

D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

D2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

D2444 Practice for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

D3311 Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns

D3350 Specification for Polyethylene Plastics Pipe and Fittings Materials

D4000 Classification System for Specifying Plastic Materials

D4976 Specification for Polyethylene Plastics Molding and Extrusion Materials

F412 Terminology Relating to Plastic Piping Systems

F477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

F714 Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter

F1290 Practice for Electrofusion Joining Polyolefin Pipe and Fittings

F1498 Specification for Taper Pipe Threads 60° for Thermoplastic Pipe and Fittings

F2620 Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

2.2 ANSI Standard:³

B36.10 Standard Dimensions of Steel Pipe (IPS)

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 Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

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

2.3 ISO Standards:³

161 Thermoplastic Pipe for the Transport of Fluids—Nominal Outside Diameters and Nominal Pressures

3607 Polyethylene Pipe: Tolerances on Outside Diameters and Wall Thicknesses

2.4 Federal Standard:⁴

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)

2.5 Military Standard:⁴

MIL-STD-129 Marking for Shipment and Storage

3. Terminology

3.1 Definitions—Definitions used in this specification are in accordance with the definitions given in Terminologies D883 and F412, and abbreviations are in accordance with Terminology D1600, unless otherwise indicated. Plastic materials are classified in accordance with Classification D4000.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 toe-in, n—a small reduction of the outside diameter at the cut end of a length of thermoplastic pipe.

4. Materials and Manufacture

4.1 Polyethylene (PE) virgin material for pipe or fittings shall be from a single compound manufacturer and shall meet or exceed the requirements of Cell Classification PE345430 as defined in Specification D3350 and PE123 as defined in Specification D4976.

4.2 The polyethylene material shall contain suitable stabilizers and antioxidants and may contain pigments not detrimental to pipe and fittings provided the pipe and fittings produced meet the requirements of this specification.

4.3 Rework Materials—Clean rework material generated from the manufacturer’s own pipe or fittings products may be used by the same manufacturer, using the same type and grade resin, provided that the pipe and fittings produced meet all the requirements of this specification.

NOTE 2—See Specification D3350 for information and definitions related to both rework and recycled plastics.

5. Requirements

5.1 Dimensions and Tolerances—Pipe:

5.1.1 Outside Diameters—These shall be in accordance with Table 1 (SI units) or Table 2 (inch-pound units), and shall be measured in accordance with Test Method D2122 at any point not closer than 300 mm (11.8 in.) to the cut end of a length of pipe. Conditioning to standard temperature, but not to standard humidity, is required.

5.1.2 Wall Thickness—The minimum thicknesses shall be in accordance with Table 3 (millimetres) or Table 4 (inches) when measured in accordance with Test Method D2122. Conditioning to standard temperature, but not to standard humidity, is required.

5.1.3 Eccentricity—The wall thickness variability as measured and calculated in accordance with Test Method D2122 in any diametrical cross section of the pipe shall not exceed 12 %.

TABLE 1 Outside Diameters and Tolerances

ISO Sizing System (ISO 161/1)			
Nominal Pipe Size	Equivalent	Outside Diameter Do, mm	
		min	max ^A
32	1.260	32	32.3
40	1.575	40	40.4
50	1.969	50	50.5
55	2.165	55	55.5
56 ^B	2.205	56	56.5
63 ^B	2.480	63	63.6
65	2.559	65	65.6
75	2.953	75	75.7
90	3.543	90	90.8
110	4.331	110	111.0
160	6.299	160	161.4
200	7.874	200	201.8
250	9.843	250	252.3
280	11.024	280	282.5
315	12.402	315	317.8

^A As specified in ISO 3607.

^B Special sizes.

TABLE 2 Outside Diameters and Tolerances

IPS Sizing System (ANSI B36.10)			
Nominal Pipe Size	Equivalent	Actual Outside Diameters in.	
		Average	Tolerances, ±
1¼	45.2	1.780	0.008
1½	48.3	1.900	0.009
2	60.3	2.375	0.011
3	88.9	3.500	0.016
4	114.3	4.500	0.020
5	136.5	5.375	0.025
5 ^A	141.3	5.563	0.025
6	168.3	6.625	0.030
7	181.0	7.125	0.034
8 ^A	219.1	8.625	0.039
10	273.1	10.750	0.048
12	323.8	12.750	0.057

^A Special sizes.

5.1.4 Toe-In—When measured in accordance with 5.1.1, the outside diameter at the cut-end of the pipe shall not be more than 1.5 % smaller than the undistorted outside diameter. Measurement of the undistorted outside diameter shall be made no closer than 1.5 pipe diameter or 11.8 in. (300 mm), whichever distance is less, from the cut-end of the pipe. Undistorted outside diameter shall meet specifications in Table 1 or Table 2.

5.1.5 Special Sizes—When existing system conditions or special local requirements make other diameters or wall thickness necessary, both shall be acceptable for engineered applications when mutually agreed upon by the customer and the manufacturer, if the pipe is manufactured from plastic compounds meeting the material requirements of this specification, and the strength and design requirements are calculated on the same basis as those used in this specification. For diameters not shown in Table 1 or Table 2, the tolerance shall be the same percentage as that shown in the corresponding tables for the next smaller listed size. Minimum wall thicknesses not shown in Table 3 or Table 4 shall comply with 5.1.2, and the tolerance shall comply with 5.1.3.

⁴ DLA Document Services Building 4/D 700 Robbins Avenue Philadelphia, PA 19111-5094 http://quicksearch.dla.mil/

TABLE 3 Minimum Wall Thickness

ISO Sizing System (ISO 161/1)		
Nominal Pipe Size	Equivalent	Wall Thickness min
mm	in.	mm
32	1.260	3.0
40	1.575	3.0
50	1.969	3.0
55	2.165	3.0
56 ^A	2.205	3.0
63 ^A	2.480	3.0
65	2.559	3.0
75	2.953	3.0
90	3.543	3.5
110	4.331	4.2
160	6.299	6.2
200	7.874	6.2
250	9.843	7.7
280	11.024	8.6
315	12.402	9.7

^A Special sizes.

TABLE 4 Minimum Wall Thickness

IPS Sizing System (ANSI B36.10)			
Nominal Pipe Size	Actual Pipe Size	Equivalent Pipe Size	Wall Thickness in.
in.	in.	mm	min
1¼	1.780	45.2	0.143
1½	1.900	48.3	0.145
2	2.375	60.3	0.154
3	3.500	88.9	0.216
4	4.500	114.3	0.237
5 ^A	5.375	136.5	0.258
5	5.563	141.3	0.258
6	6.625	168.3	0.280
7 ^A	7.125	181.0	0.300
8	8.625	219.1	0.322
10	10.750	273.1	0.365
12	12.750	323.8	0.375

^A Special sizes.

5.2 Dimensions and Tolerances—Fittings :

5.2.1 *Wall Thickness*—The minimum wall thickness of the body of all fittings shall not be less than that for the corresponding pipe size and shall be measured in accordance with Test Method **D2122**.

5.2.2 *Eccentricity*—Spigot ends of fittings shall conform to the diameter requirements for pipe.

5.2.3 *Socket ends of fittings* shall conform to the dimensional requirements for size and tolerances as provided on request by the manufacturer.

5.2.4 *Threads*—For all fittings having taper pipe threads, threads shall be in accordance with Specification **F1498** and be gaged in accordance with **7.7**.

5.2.5 *Patterns*—The patterns, dimensions, and laying lengths of molded fittings, including adaptors, shall meet the requirements of Specification **D3311** or shall be of a proven design and shall allow a smooth transition of fluid flow from one direction to another. Specialty fittings or fittings with laying lengths exceed those shown in Specification **D3311** shall not be excluded. For these fittings, laying lengths shall be provided by the manufacturer.

5.2.6 *Cleanouts*—All polyethylene fitting cleanouts having female threads shall be supplied with polyethylene plugs to suit.

5.2.7 *Cleanouts, cleanout plugs, and caps*, as commonly used in the manufacturer’s drainage system, shall have a thread size and depth sufficient to ensure that the minimum waterway sizes are maintained.

5.2.8 *Traps*—All traps shall have a minimum water seal of 2 in. (50 mm).

5.3 *Chemical Resistance*—Pipe fitting materials shall be evaluated in accordance with Practices **D543**, Procedures I and II, using the chemicals listed in **7.3**. The weight change shall not exceed 2 % nor shall apparent tensile strength change by more than 10 %. In cases where there is a change in the apparent tensile strength greater than 10 %, a further evaluation shall be made after removal from the chemical, and conditioning for 72 h. If after 72 h there is a minimum of 90 % recovery of tensile strength as compared to the unexposed specimen, and that figure is within ±10 % of the original tensile strength of the unexposed specimen shall be considered acceptable.

5.4 *Water Absorption*— Pipe and fitting materials shall not change in weight more than 0.50 % when used in accordance with **7.4**.

5.5 System Integrity:

5.5.1 *Fused joints*, (including butt-fused and electrofused following practices described in Practices **F2620** and **F1290** respectively), and pipe associated with them shall withstand a pressure of 50 psi (0.35 MPa) without leaking when tested in accordance with **7.5.1**.

5.5.2 *Mechanical joints* shall withstand a pressure of 14.5 psi (0.10 MPa) without leaking when tested in accordance with **7.5.2**.

NOTE 3—Mechanical joints include transition, compression, threaded, and other mechanical type joints.

5.5.3 *Mechanical joints* shall show no evidence of separation at the joint under force *P* when tested in accordance with **7.6.1**, nor shall they leak or show any other damage when tested in accordance with **7.6.2**. Two fittings shall be tested and both shall pass.

5.6 Sealing Rings:

5.6.1 *Elastomeric sealing rings* shall meet the requirements of Specification **F477**.

5.6.1.1 The basic polymer shall be natural rubber, synthetic elastomer, or a blend of both.

5.6.1.2 The sealing rings shall be designed with an adequate compressive force, so as to affect a positive seal under all combinations of joint tolerances.

5.7 *Flattening*—There shall be no evidence of splitting, cracking, or breaking when the pipe is tested in accordance with **7.8**.

5.8 *Impact Resistance*—The impact resistance testing shall be in accordance with **7.9**.

6. Workmanship, Finish, and Appearance

6.1 The manufacture of fittings and pipe shall be in accordance with good commercial practice so as to produce fittings

meeting the requirements of this specification. Fittings and pipe shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, or injurious defects. The fittings and pipe shall be as uniform as commercially practical in opacity, density, and other physical properties.

7. Test Methods

7.1 Conditioning—Condition the test specimens prior to test at $73.4\text{ }^{\circ}\text{F} \pm 3.6\text{ }^{\circ}\text{F}$ ($23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$) and $50\% \pm 10\%$ relative humidity for not less than 40 h prior to test in accordance with Procedure A of Practice **D618**, for those tests where conditioning is required.

7.2 Test Conditions—Conduct tests in the standard laboratory atmosphere of $73.4\text{ }^{\circ}\text{F} \pm 3.6\text{ }^{\circ}\text{F}$ ($23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$) and $50\% \pm 10\%$ relative humidity, unless otherwise specified in the test methods or in this specification.

7.3 Chemical Resistance—Determine the resistance to the following chemicals using the test method detailed in Practices **D543**.

Chemical	Percent in Water
Acetic acid	5 by vol
Acetone	100
Methyl alcohol	100
Ammonium hydroxide	10 by vol
Nitric acid	40 by vol
Sodium hydroxide	10 by weight

7.4 Water Absorption—Weigh three cleanly cut specimens having smooth edges to the nearest 0.001 g and immerse in distilled water at $73.4\text{ }^{\circ}\text{F} \pm 1.8\text{ }^{\circ}\text{F}$ ($23\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$) for 24 h + $\frac{1}{2}$ –0 h, in accordance with Test Method **D570**. Remove the specimens, wipe dry with a clear, dry cloth, and reweigh immediately. Calculate the average percent gain in weight to the nearest 0.01 % on the basis of the initial weight.

7.5 Hydrostatic Pressure Test:

7.5.1 Fused Joint (Including Butt-Fused and Electrofused) Pressure Test—Select at random six specimens of pipe, each five times the nominal diameter or a maximum of 18 in. (450 mm) in length, for each size of piping and each type of system being considered. Also select three suitable couplings at random. Prepare three joined specimens by joining two pipe specimens with one coupling, using the fusion equipment and instructions supplied by the manufacturer of the system. Fill each specimen with water at $73.4\text{ }^{\circ}\text{F} \pm 3.6\text{ }^{\circ}\text{F}$ ($23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$) and cap, taking care to exclude all air from the system. Fix one end of the specimen to a pressurizing apparatus, and support the free end if necessary. Pressurize each specimen to 50 psi (0.35 MPa) for a minimum of 5 min and inspect for leaks. None of the three specimens shall leak.

7.5.2 Mechanical Joint Pressure Test—Perform the pressure test on mechanical joints on test specimens prepared in a manner similar to that described in **7.5.1**, except use appropriate pipe specimens where joint is intended to join pipes of similar or dissimilar material and sizes. Pressurize the assembly to 14.5 psi (0.10 MPa) for a period of 24 h + 15, –0.0 min and inspect for signs of leakage. Apply this test to each size and type of joint being considered.

7.6 Mechanical-Joint Pullout Test:

7.6.1 Join two sections of pipe by a coupling. Mount the assembly with the outer ends of the pipe sections fastened in the clamps of a tensile testing machine. Pull the two pipe sections apart at a rate of approximately 1 in./min (25 mm/min) until at least one pipe section has separated from the coupling. Record the maximum force F applied.

7.6.2 Using the set-up described in **7.6.1**, subject a complete joint assembled in accordance with the manufacturer's instructions to an axial pullout force P of 25 lbf (110 N) greater than force F . In no case shall this force P be less than 50 lbf (220 N). Apply force P within 5 s to 30 s and maintain for at least 60 s.

7.6.3 Remove the axial force and pressurize the complete joint assembly to 14.5 psi (0.10 MPa) hydrostatic pressure for a period of 1 h and inspect for leaks.

7.7 Threads—All taper pipe threads shall be gaged in accordance with Specification **F1498**.

7.8 Flattening—Using Test Method **D2412**, flatten three specimens of pipe 6 in. (152 mm) long, between parallel plates in a suitable press until the distance between parallel plates is 40 % of the original diameter of the pipe. The rate of vertical displacement shall be uniform and such that the flattening is completed within 2 min. to 5 min. On removal of the load, examine the specimens for evidence of splitting, cracking, or breaking.

7.9 Impact Resistance:

7.9.1 Polyethylene Pipe and Fittings—Determine and test polyethylene pipe and fitting impact values in accordance with Test Method **D2444**, using Tup A. The level of impact shall be in accordance with data provided by the manufacturer, which shall show impact values for each size at 73 °F (23 °C) that specifies adequate quality consistent with the polyethylene compound used by that manufacturer. Test ten specimens. When nine or ten specimens pass, accept the lot. When four or more specimens fail, reject the lot. When two or three specimens of ten fail, test ten additional specimens. When 17 of 20 specimens tested pass, accept the lot. When seven or more of 20 fail, reject the lot. When four, five, or six of 20 fail, test 20 additional specimens. When 32 of 40 specimens pass, accept the lot. When nine or more of 40 specimens fail, reject the lot. Failure in the test specimens shall be shattering or any crack or break extending entirely through the pipe wall visible to the unaided eye.

NOTE 4—This test is intended only for use as a quality control test, not as a simulated service test.

8. Retest and Rejection

8.1 If the results of any test(s) do not meet the requirements of this specification, the test(s) may be conducted again in accordance with an agreement between the purchaser and the seller. There shall be no agreement to lower the minimum requirement of the specification by such means as omitting tests that are a part of the specification, substituting or modifying a test method, or by changing the specification limits. In retesting, the product requirements of this specification shall be followed. If, upon retest, failure occurs, the