



Standard Specification for 12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile- Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications¹

This standard is issued under the fixed designation F 2306/F 2306M; 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.

1. Scope

1.1 This specification covers requirements and test methods for annular, corrugated profile wall polyethylene pipe and fittings with an interior liner. The nominal inside diameters covered are 12 to 60 in. [300 to 1500 mm].

1.2 The requirements of this specification are intended to provide pipe and fittings suitable for underground use for gravity-flow storm sewer and subsurface drainage systems.

NOTE 1—Pipe and fittings produced in accordance with this specification shall be installed in compliance with Practice D 2321.

1.3 This specification covers pipe and fittings with an interior liner using a corrugated exterior profile (Fig. 1).

1.4 *Units*—The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text the SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.5 The following precautionary caveat pertains only to the test method 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

- D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing
- D 1600 Terminology for Abbreviated Terms Relating to Plastics
- D 2122 Test Method for Determining Dimensions of Ther-

moplastic Pipe and Fittings

- D 2321 Practice for Underground Installation of Flexible Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 - D 2412 Test Method for External Loading Properties of Plastic Pipe by Parallel-Plate Loading
 - D 2444 Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
 - D 3212 Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
 - D 3350 Specification for Polyethylene Plastic Pipe and Fittings Materials
 - F 412 Terminology Relating to Plastic Piping Systems
 - F 477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
 - F 2136 Test Method for Notched, Constant Ligament-Stress (NCLS) Test to Determine Slow-Crack-Growth Resistance of HDPE Resins or HDPE Corrugated Pipe
- 2.2 *AASHTO Standard:*
LRFD, Section 12 AASHTO LRFD Bridge Design Specifications Section 12 – Buried Structures and Tunnel Liners³
- 2.3 *Department of Agriculture Standard:*
Standard 606 Soil Conservation Service Engineering⁴
- 2.4 *Federal Standard:*
Fed. Std. No. 123 Marking for Shipment (Civil Agencies)⁵
- 2.5 *Military Standard:*
MIL-STD-129 Marking for Shipment and Storage⁵

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology F 412 and abbreviations are in accordance with Terminology D 1600, unless otherwise specified. The abbreviation for polyethylene is PE.

3.2 *Definitions of Terms Specific to This Standard:*

¹ This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.62 on Sewer. Current edition approved April 1, 2005. Published April 2005.

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 Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001.

⁴ Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401.

⁵ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098.

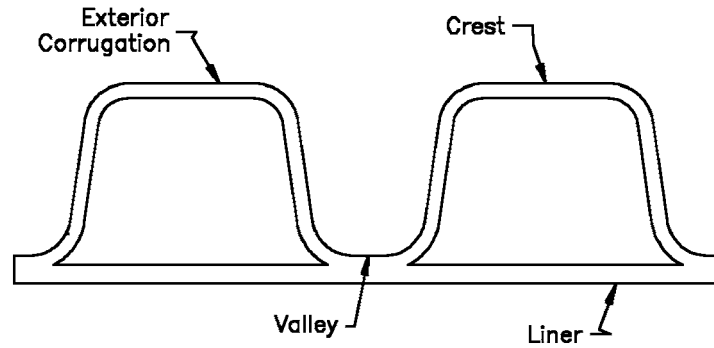


FIG. 1 Typical Annular Corrugated Pipe Profile

3.2.1 *design diameter, n*—the manufacturer’s stated inside diameter.

3.2.2 *mold line, n*—a line formed on the product as a result of the mold blocks coming together during manufacturing.

3.2.3 *profile wall, n*—a pipe wall construction that presents an interior liner in the waterway but includes ribs, corrugations, or other shapes, which can be either solid or hollow, that helps brace the pipe against diametrical deformation.

4. Ordering Information

4.1 Orders for product made to this specification shall include the following information to adequately describe the desired product:

- 4.1.1 This ASTM designation and year of issue,
- 4.1.2 Perforations:
 - 4.1.2.1 With perforations,
 - 4.1.2.2 Without perforations,
- 4.1.3 Diameters,
- 4.1.4 Total footage of each pipe diameter involved,
- 4.1.5 Pipe laying length,
- 4.1.6 Fitting type(s):
 - 4.1.6.1 Size and type of fittings, including mainline and branch diameters, and
 - 4.1.6.2 Number of fittings per diameter.

5. Materials and Manufacture

5.1 Basic Materials:

5.1.1 *Pipe and Blow-Molded Fittings*—The pipe and fittings shall be made of virgin PE plastic compound meeting the requirements of cell classification 335400C or 335400E as defined in Specification **D 3350**, except that carbon black content shall not exceed 4 %. Compounds that have a higher cell classification in one or more properties shall be permitted provided the density of the base resin shall not exceed 0.955 g/cm³ and all other product requirements are met. For slow crack-growth resistance, resins shall be evaluated using the notched constant ligament stress (NCLS) test according to the procedure described in 7.8. The average failure time of the five test specimens shall exceed 24 h with no single test specimen’s failure time less than 17 h.

5.1.2 *Rotationally Molded Fittings and Couplings*—Compounds used in the manufacture of rotationally molded fittings and couplings shall be virgin PE having a cell classification of 213320C or 213320E as defined in Specification

D 3350, except that the carbon black content shall not exceed 4 %. Compounds that have a higher cell classification in one or more properties shall be permitted provided the density of the base resin shall not exceed 0.940 g/cm³ and all other product requirements are met.

5.1.3 *Injection-Molded Fittings and Couplings*—Compounds used in the manufacture of injection molded fittings and couplings shall be made of virgin PE plastic compound meeting the requirements of cell classification 314420C or 314420E as defined in Specification **D 3350**, except that the carbon black content shall not exceed 4 %. Compounds that have a higher cell classification in one or more properties shall be permitted provided all other product requirements are met.

5.2 *Rework Material*—Clean rework material generated from the manufacturer’s own pipe and fittings production shall be permitted to be used by the same manufacturer, provided that the material meets the requirements of 5.1.1 or 5.1.2 as applicable for the intended part and pipe or fittings produced meet all the requirements of this specification.

6. General Requirements

6.1 *Workmanship*—The pipe and fittings shall be homogeneous throughout and be as uniform as commercially practical in color, opacity, and density. The pipe walls shall be free of cracks, holes, blisters, voids, foreign inclusions, or other defects that are visible to the naked eye and that may affect the wall integrity. The ends shall be cut cleanly and squarely. Holes intentionally placed in perforated pipe are acceptable.

6.1.1 Visible defects, cracks, creases, splits, obstruction to flow in perforations, or in pipe are not permissible.

6.2 Dimensions and Tolerance:

6.2.1 *Nominal Size*—The nominal size for the pipe and fittings shall be the inside diameter shown in **Table 1**.

6.2.2 *Inside Diameter*—The average inside diameter for pipe and fittings shall not vary more than ± 1 % from the design diameter when measured in accordance with 7.4.1.

NOTE 2—The outside diameters and the corrugation pitch of products manufactured to this specification are not specified; therefore, compatibility between pipe and fittings from different manufacturers or the same manufacturer shall be verified.

6.2.3 *Length*—The pipe shall be supplied in any length agreeable to both the owner and the manufacturer. Length shall

TABLE 1 Pipe Stiffness and Pipe Dimensions

Pipe Inside Diameter		Minimum Pipe Stiffness at 5 % Deflection		Minimum Inner Liner Thickness	
in.	[mm]	lb/in./in.	[kPa]	in.	[mm]
12	[300]	50	[345]	0.035	[0.9]
15	[375]	42	[290]	0.040	[1.0]
18	[450]	40	[275]	0.051	[1.3]
21	[525]	38	[260]	0.060	[1.5]
24	[600]	34	[235]	0.060	[1.5]
27	[675]	30	[205]	0.060	[1.5]
30	[750]	28	[195]	0.060	[1.5]
36	[900]	22	[150]	0.067	[1.7]
42	[1050]	20	[140]	0.071	[1.8]
48	[1200]	18	[125]	0.071	[1.8]
54	[1350]	16	[110]	0.079	[2.0]
60	[1500]	14	[95]	0.079	[2.0]

not be less than 99 % of stated quantity when measured in accordance with 7.4.2.

6.2.4 *Minimum Inner-Liner Thickness*—The minimum inner-liner thickness of the pipe shall meet the requirements given in Table 1 when measured in accordance with 7.4.3.

6.2.5 *Perforations*—Perforations shall be cleanly cut, placed in the valley of the corrugation rib, and uniformly spaced along the length and circumference of the pipe. Dimensions of the perforations and the minimum perforation inlet area shall be as listed in Table 2. Other perforation dimensions and configurations shall be permitted, where required to meet the needs of the specifier. All measurements shall be made in accordance with 7.4.4. Pipe connected by bell and spigot joints shall not be perforated in the area of the bells and spigots.

NOTE 3—For perforated pipe applications, the size of the embedment zone and permeability of the embedment material provide the desired level of infiltration or exfiltration. The pipe or embedment zone shall be wrapped with a geotextile designed to prevent migration of fine soils into the pipe or embedment zone. Where a geotextile is not used, the gradation of the embedment material shall be compatible with the perforation size to avoid backfill migration into the pipe.

6.3 *Pipe Stiffness*—Minimum pipe stiffness at 5 % deflection shall meet the requirements given in Table 1 when tested in accordance with 7.5.

TABLE 2 Perforation Dimensions

Pipe Inside Diameter		Type of Perforation			
		Circular			
in.	[mm]	Maximum Diameter	Minimum Inlet Area	in. ² /ft	[cm ² /m]
12	[300]	3/8	[10]	1.5	[30]
15	[375]	3/8	[10]	1.5	[30]
18	[450]	3/8	[10]	1.5	[30]
21	[525]	3/8	[10]	2.0	[40]
24	[600]	3/8	[10]	2.0	[40]
27	[675]	3/8	[10]	2.0	[40]
30	[750]	3/8	[10]	2.0	[40]
36	[900]	3/8	[10]	2.0	[40]
42	[1050]	3/8	[10]	2.0	[40]
48	[1200]	3/8	[10]	2.0	[40]
54	[1350]	3/8	[10]	2.0	[40]
60	[1500]	3/8	[10]	2.0	[40]

NOTE 4—The 5 % deflection criterion, which was selected for testing convenience, is not a limitation with respect to in-use deflection. The engineer is responsible for establishing the acceptable deflection limit.

6.4 *Pipe Flattening*—There shall be no evidence of splitting, cracking, breaking, separation of seams, separation of the outer and inner wall, or combinations thereof, when tested in accordance with 7.6. Additionally, at or below the 20% deflection limit, the specimen shall be considered as failing this test when the load does not increase continuously with increasing deflection. The maximum load point shall not be at less than 20% deflection and inspection for splitting, cracking, or delamination shall continue to the 40% deflection limit.

6.5 *Pipe Impact Strength*—There shall be no evidence of splitting, cracking, breaking, separation of seams, separation of the outer and inner wall, or combinations thereof, when tested in accordance with 7.7.

6.6 *Fittings and Joining Systems:*

6.6.1 Only fittings supplied or recommended by the pipe manufacturer should be used. Fittings shall be installed in accordance with the manufacturer’s recommendations.

6.6.2 The joining system(s) shall be of a design that preserves alignment during construction and prevents separation at the joints. Bell and spigot, external snap or split couplers are examples of typical designs.

6.6.3 Fittings shall be supplied with joints compatible with the overall system. All joints for gravity-flow Sewer systems shall meet the requirements of 6.6.3.3. All other joints shall meet the requirements of a soil-tight joint unless otherwise specified by the owner/designer.

6.6.3.1 Soil-tight joints are specified as a function of opening size, channel length, and backfill particle size. If the size of the opening exceeds 3 mm, the length of the channel shall be at least four times the size of the opening. A backfill material containing a high percentage of fine-graded soils requires investigation for the specific type of joint to be used to guard against soil infiltration. Information regarding joint soil tightness criteria can be found in AASHTO’s Standard Specifications for Highway Bridges, Division II, Section 26, “Metal Culverts.”

NOTE 5—The ability of a joint to resist soil infiltration (soil tightness) shall be considered. Soil tightness is a function of opening size, channel length, and backfill particle size. A backfill material containing a high percentage of Class III and Class IVA material as defined in Practice D 2321 requires consulting with the manufacturer for the specific type of joint to be used to guard against soil infiltration. Alternatively, the joint shall be permitted to be wrapped with a geotextile designed to prevent migration of these fine soils into the pipe.

6.6.3.2 Silt-tight joints shall be used where the backfill material has a high percentage of fines. Silt tight joints shall meet laboratory test in accordance with Test Method D 3212 except that the joint be tested using 2.0 psi (14 kPa) and utilize a bell and spigot joint with a gasket meeting Specification F 477.

6.6.3.3 Watertight joints shall meet a 10.8 psi (74 kPa) laboratory test in accordance with Test Method D 3212 and utilize a bell and spigot design with a gasket meeting Specification F 477.