Designation: F2947 – 12ε1

AnAmerican National Standard

Standard Specification for 150 to 1500 mm [6 to 60 in.] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Sanitary Sewer Applications[1]

This standard is issued under the fixed designation F2947; 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.

ε[1] NOTE—Section 2 and 5.1 were editorially revised in November 2013.

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 150 to 1500 mm [6 to 60 in.].

1.2 The requirements of this specification are intended to provide pipe and fittings suitable for underground use for non-pressure sanitary sewer systems. Pipe and fittings produced in accordance with this specification shall be installed in compliance with Practice D2321.

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 SI or inch-pound units are to be regarded separately as standard. Within the text the Imperial (inch-pound) 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]

A666 Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

D618 Practice for Conditioning Plastics for Testing

D1600 Terminology for Abbreviated Terms Relating to Plastics

D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

D2321 Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

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

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

D2990 Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics

D3212 Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

D3350 Specification for Polyethylene Plastics Pipe and Fittings Materials

D4389 Specification for Finished Glass Fabrics Woven From Rovings

D4703 Practice for Compression Molding Thermoplastic Materials into Test Specimens, Plaques, or Sheets

D6992 Test Method for Accelerated Tensile Creep and Creep-Rupture of Geosynthetic Materials Based on Time-Temperature Superposition Using the Stepped Isothermal Method

F412 Terminology Relating to Plastic Piping Systems

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

[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.

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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.

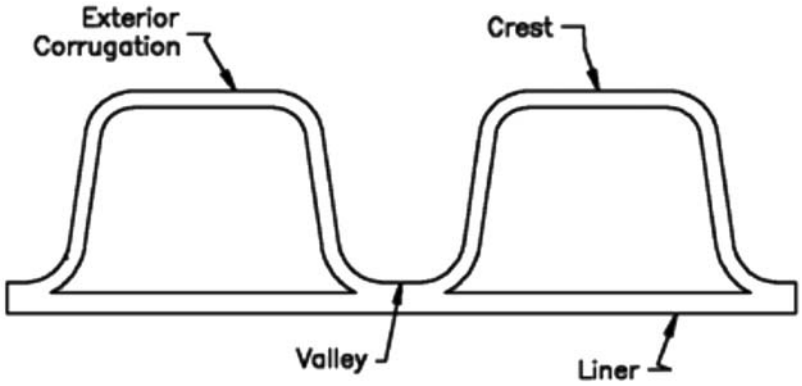

FIG. 1 Typical Annular Corrugated Pipe Profile

F2136 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:*[3]

LRFD, Section 12 AASHTO LRFD Bridge Design Specifications Section 12–Buried Structures and Tunnel Liners

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 is PE.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *profile wall, n*—in this case, the profile pipe wall construction provides an interior liner in the waterway and 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 Diameters,

4.1.3 Total footage of each pipe diameter involved,

4.1.4 Pipe laying length,

4.1.5 Fitting type(s):

4.1.5.1 Size and type of fittings, including mainline and branch diameters, and

4.1.5.2 Number of fittings per diameter.

5. Materials and Manufacture

5.1 *Pipe and Fabricated Fittings*—The pipe and fabricated fittings shall be made of virgin PE compound meeting the requirements of Specification D3350 with a minimum cell classification of 435400C. The carbon black content in the pipe shall be equal to or greater than 2.0 wt % and shall not exceed 3.0 wt %. For quality assurance purposes, the cell classification shall be performed on compression molded plaque, made according to Test Method D4703 and cooled at 15°C/min. The pipe density shall be corrected for percentage carbon black according to Specification D3350. Compounds that have a higher cell classification in one or more performance properties shall be permitted provided all other product requirements are met.

5.2 *Rework*—Clean rework generated from the manufacturer's own pipe and fittings production of this product shall be permitted to be used by the same manufacturer. Rework shall be the same cell classification as new PE compound with which it is blended and the pipe produced shall 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 through valleys.

6.1.1 Visible defects, cracks, creases, splits, and delaminations 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.

NOTE 1—The actual inside diameter of a pipe depends on the material distribution, construction and stiffness. It may be considerably higher than the minimums specified in this table. For more information, see the manufacturer's documentation.

6.2.2 *Mean Inside Diameter*—The manufacturer's stated mean inside diameter shall be as shown in Table 1, when measured in accordance with 7.3.1.

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

6.2.3 *Laying Length*—The pipe shall be supplied in any laying length agreeable to both the owner and the manufacturer. Laying length shall not be less than 99 % of stated quantity when measured in accordance with 7.3.2.

[3] Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, http://www.transportation.org.

TABLE 1 Pipe Stiffness and Pipe Dimensions

Nominal Diameter		Mean Inside Diameter		Minimum Pipe Stiffness Stiffness @ 5% Deflection		Minimum Liner Thickness	
mm	[in.]	mm	[in.]	kPa	[lb/in./in.]	mm	[in.]
150	6	145	5.91	441	64	1.0	0.039
200	8	195	7.87	414	60	1.1	0.043
225	9	220	8.86	407	59	1.2	0.047
250	10	245	9.84	400	58	1.3	0.051
300	12	294	11.57	372	54	1.4	0.055
375	15	369	14.51	310	45	1.7	0.067
400	16	392	15.43	303	44	1.8	0.071
450	18	450	17.72	297	43	1.9	0.074
500	20	490	19.29	276	40	2.0	0.079
600	24	588	23.15	262	38	2.2	0.087
750	30	751	29.56	228	33	2.4	0.094
800	32	785	30.91	200	29	2.6	0.102
900	36	902	35.49	179	26	2.7	0.106
1000	40	985	38.79	179	26	2.9	0.114
1050	42	1051	41.39	172	25	3.2	0.126
1200	48	1185	46.65	152	22	3.5	0.138
1500	60	1501	59.10	138	20	4.0	0.157

6.2.4 *Liner Thickness*—The minimum liner thickness of the pipe shall meet the requirements given in Table 1 when measured in accordance with 7.3.3.

6.3 *Pipe Stiffness*—Minimum pipe stiffness at 5 % deflection shall meet the requirements given in Table 1 when tested in accordance with 7.4.

NOTE 3—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 corrugation seams, separation of the valley and liner, or combinations thereof, when tested in accordance with 7.5.

6.5 *Pipe Impact Strength*—There shall be no evidence of splitting, cracking, breaking, separation of corrugation seams, separation of the valley and liner, or combinations thereof, on any specimen when tested in accordance with 7.6.

6.6 *Fittings and Joining Systems:*

6.6.1 Only fittings fabricated from pipe meeting this specification and supplied or recommended by the pipe manufacturer shall be used. Fabricated 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.

6.6.3 Pipe and fittings shall have a watertight bell/spigot joint that complies with the laboratory tests defined and described in Test Method D3212 and utilizes a gasket that complies with the requirements of Specification F477. All joints shall show no signs of leakage when tested in accordance with Specification D3212. Note that special provisions must be taken in order that joints made to field cut pipe meet the requirements of Specification D3212. Any component used in the joining material shall be resistant to effluents being carried in the pipe.

6.6.4 *Optional Bell Restraining Bands*—Bell restraining bands, when used, shall be made of corrosion resistant materials such as fiberglass (Specification D4389) or stainless steel (Specification A666).

6.6.5 *Joint Proof-of-Design*—To assess the effects of long-term properties of the pipe and gasket material under a joint assembly, a joint proof-of-design test shall be conducted on the pipe joints using the test method outlined in 7.8. Each joint proof of design pressure test shall be conducted by an independent third party, which provides written certification for each test. This test is a one-time validation test for the specific pipe diameter, profile geometry, gasket and joint configuration supplied by the manufacturer. This proof-of-design test shall be conducted on at least one pipe diameter within the prescribed diameter range and shall be conducted on each diameter that differs in joint design. If the joint design does not change within the prescribed range, the largest diameter shall be tested. If the diameter range includes more than 5 different pipe diameters, then two sizes shall be tested; the largest and smallest diameters.

6.7 *Slow Crack Growth Resistance–Pipe*—For slow crack-growth resistance, the pipe shall be evaluated using the notched constant ligament stress (NCLS) test according to the procedure described in 7.7. The NCLS test shall be conducted on molded plaques, and the average failure time of the five test specimens shall exceed 41 h with no single test specimen's failure time less than 29 h.

6.8 *Structural Design:*

6.8.1 The manufacturer shall supply appropriate data necessary to satisfy the requirements of deflection, thrust, buckling, bending stress and long-term strain in accordance with the design criteria of the AASHTO LRFD Bridge Design Specification (LRFD, Section 12). The design engineer shall verify that the data provided by the manufacturer satisfy the product requirements.

6.8.2 The minimum long-term (50-year) design values for modulus of elasticity and tensile strength for the PE compounds shall be 152 MPa (22,000 psi) and 6.2 MPa (900 psi), respectively. The maximum allowable long-term (50-year) tensile strain limit for design shall be 5 %.

6.8.2.1 *Creep Rupture Strength*—Specimens fabricated in the same manner and composed of the same materials as the finished pipe shall have a 50-year creep rupture tensile strength