



Designation: F2947/F2947M – 21a

Standard Specification for 150 to 1500 mm [6 to 60 in.] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Sanitary Sewer Applications¹

This standard is issued under the fixed designation F2947/F2947M; 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 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 The products manufactured under this specification use either virgin or recycled (post-industrial or post-consumer) materials in accordance with the requirements specified for each.

1.5 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.6 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *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 Recom-*

mendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 ASTM Standards:²

- A666 Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
- D638 Test Method for Tensile Properties of Plastics
- D618 Practice for Conditioning Plastics for Testing
- 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
- 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 Practice for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
- D2565 Practice for Xenon-Arc Exposure of Plastics Intended for Outdoor Applications
- 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
- D3895 Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
- D4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
- D4389 Specification for Finished Glass Fabrics Woven From Rovings

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 Nov. 1, 2021. Published December 2021. Originally approved in 2012. Last previous edition approved in 2021 as F2947/F2947M–21. DOI: 10.1520/F2947_F2947M-21A

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.

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



Documents

Document Sharing Hub

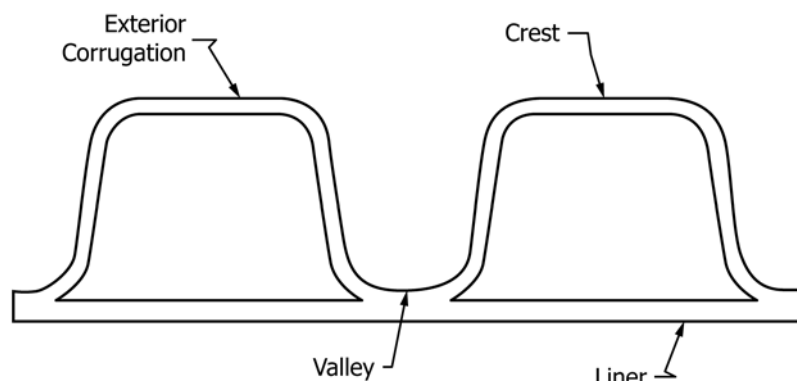


FIG. 1 Typical Annular Corrugated Pipe Profile

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

D4883 Test Method for Density of Polyethylene by the Ultrasound Technique

D5630 Test Method for Ash Content in Plastics

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

D7399 Test Method for Determination of the Amount of Polypropylene in Polypropylene/Low Density Polyethylene Mixtures Using Infrared Spectrophotometry

F412 Terminology Relating to Plastic Piping Systems

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

F2136 Test Method for Notched, Constant Ligament-Stress (NCLS) Test to Determine Slow-Crack-Growth Resistance of HDPE Resins or HDPE Corrugated Pipe

F3181 Test Method for The Un-notched, Constant Ligament Stress Crack Test (UCLS) for HDPE Materials Containing Post-Consumer Recycled HDPE

F3308 Practice for Sampling and Testing Frequency for Recycled Materials in Polyethylene (PE) Pipe for Non-Pressure Applications

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 AASHTO Standard:³

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

2.3 NCHRP (National Cooperative Highway Research Program) Reports⁴

NCHRP Report 631 – Updated Test and Design Methods for Thermoplastic Drainage Pipe

NCHRP Report 870 – Performance of Corrugated Pipe Manufactured with Recycled Content

2.4 ISO Standard:⁵

ISO 15270 Guidelines for the Recovery and Recycling of Plastic Waste

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.

3.2.2 *service temperature, n*—the average ambient temperature of the in situ conditions at which the pipe will be operating for the life of the project.

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 Virgin or recycled materials,

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 *Virgin Resin Pipe and Fabricated Fittings*—The pipe and fabricated fittings shall be made from virgin PE compound meeting the requirements of Specification D3350 with a minimum cell classification of 435400C or 435400E. Black

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>.

⁴ Available from U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Washington, DC 20401-0001, <http://www.access.gpo.gov>.

⁵ Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <http://www.iso.org>.

compound shall have a carbon black content equal to or greater than 2.0 wt % and shall not exceed 3.0 wt % per 6.1.2. Colored compounds shall contain sufficient UV stabilizers to protect against UV degradation. 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 [27 °F/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.

5.1.1 For slow crack growth resistance, extruded pipe shall be evaluated using the notched constant ligament stress (NCLS) test according to the requirements and procedures described in 6.7.

NOTE 1—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, Practice G154 or Practice G155 may be useful for this purpose. Exposure to sunlight during normal construction periods is not harmful. It is good practice to store pipe and fittings under suitable cover prior to installation.

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.

5.3 *Recycled Material Pipe:*

5.3.1 *Recycled Material Pipe*—The pipe containing any post-consumer or post-industrial (pre-consumer) recycled materials shall be made of PE plastic compound recovered and recycled in accordance with Guide ISO 15270 such that the compound is a blend of virgin compound and post-consumer/post-industrial compound that meets the following additional requirements in accordance with Specification D3350:

5.3.1.1 Cell classification 435400C or 435400E in accordance with Specification D3350.

5.3.1.2 The carbon black content in compounds meeting cell classification 435400C shall be equal to or greater than 2 % but not exceed 4 % when tested in accordance with Test Method D4218. Compounds that have a higher cell classification in one or more properties shall be permitted provided the density of the compound shall not exceed 0.955 g/cm³ as tested in accordance with Test Method D4883 and all other product requirements are met.

5.3.1.3 For slow crack growth resistance, extruded pipe shall be evaluated using the notched constant ligament stress (NCLS) test according to the requirements and procedures described in 6.7.

5.3.1.4 Crack initiation shall be tested in accordance with the procedures in 7.10. The average failure time of five test specimens shall exceed the minimum required for the applied tensile stress, service temperature and required service life required for the application.

5.3.1.5 Maximum level of polypropylene present by volume shall not be greater than 5 percent when tested in accordance with the procedures in 7.8.

5.3.1.6 Maximum ash content shall not be more than 2% in accordance with the procedures in 7.9.

5.3.1.7 Samples taken from the extruded pipe supplied to the project shall have a minimum Oxidative-Induction-Time of 25 minutes when tested in accordance with Test Method D3895 and break strain of 150 % when tested in accordance with Test Method D638.

5.3.1.8 Service prediction shall be done in accordance with 7.10.

5.3.1.9 All sampling and testing requirements and frequencies for recycled material pipe shall be conducted in accordance with Practice F3308.

5.3.2 *Recycled Material Fittings*—Fittings made from recycled materials are not permitted under this standard.

NOTE 2—Post-consumer recycled materials contain a wide assortment of polyethylene compounds, which may have a combination of high and low environmental stress crack resistance. Post-industrial recycled materials will have much more consistent quality of compounds, but they will be of the same stress-crack resistance. They may, therefore, have higher or lower environmental stress crack resistance than postconsumer materials. The ASTM F3181 test method will, however, provide predictable and reproducible results for either material.

6. General Requirements

6.1 *Workmanship*—The pipe and fittings shall be black or color; shall be homogeneous throughout; and shall 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.

6.1.2 Carbon black content in this pipe or fitting shall be tested in accordance with Test Method D1603 or Test Method D4218.

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

NOTE 4—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.

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.