



Designation: F2763/F2763M – 16 (Reapproved 2021)^{e1}

Standard Specification for 12 to 60 in. [300 to 1500 mm] Dual and Triple Profile-Wall Polyethylene (PE) Pipe and Fittings for Sanitary Sewer Applications¹

This standard is issued under the fixed designation F2763/F2763M; 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.

^{e1} NOTE—Designation editorially changed to match the units statement, 1.4 in July 2021.

1. Scope

1.1 This specification covers requirements and test methods for dual and triple profile wall polyethylene pipe and fittings. The nominal inside diameters covered are 12 in. to 60 in. [300 mm to 1500 mm].

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 essentially smooth interior wall and either an annular corrugation (dual wall) or an essentially smooth and exterior wall using an annular corrugated profile middle wall (triple wall) (Fig. 1).

1.4 *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 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, 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 Recom-*

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

2. Referenced Documents

2.1 ASTM Standards:²

- D578/D578M Specification for Glass Fiber Strands
- 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 Practice for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
- D3212 Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- D3350 Specification for Polyethylene Plastics Pipe and Fittings Materials
- D4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
- 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

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.

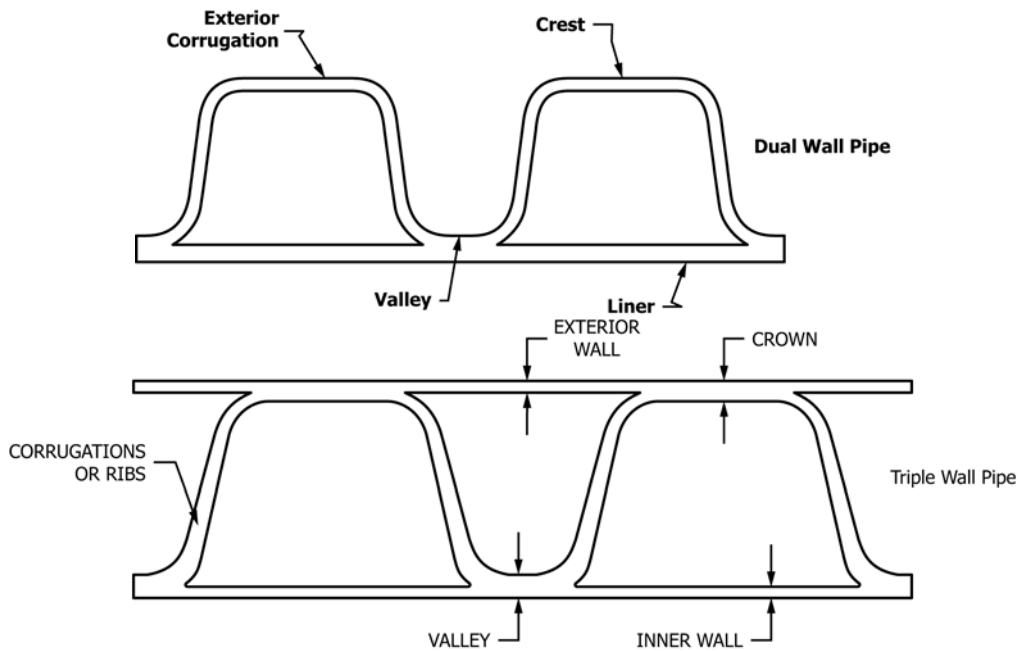


FIG. 1 Typical Dual and Triple Wall Pipe Profile

2.2 AASHTO Standard:³

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

2.3 Federal Standards:⁴

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)
MIL-STD-129 Marking for Shipment and Storage

2.4 NCHRP (National Cooperative Highway Research Program) Report:⁴

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

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 annular corrugation—corrugation formed in a circumferential pattern around the pipe as opposed to a helical corrugation, which is formed in a spiral pattern around the pipe.

3.2.2 dual 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. The corrugation wall is exposed to the soil side of the pipe and is its exterior wall.

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

3.2.3 triple wall, n—in this case, the profile pipe wall construction provides an interior wall in the waterway, an exterior wall to the soil, and includes ribs, corrugations, or other shapes, which can be either solid or hollow, that helps brace the pipe against diametrical deformation. The corrugation wall is completely encapsulated by the interior and exterior walls.

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 (F2763) 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 material meeting the requirements of Specification D3350 with a minimum cell classification of 435400C, except that carbon black content shall equal to or greater than 2.0 % but not exceed 3.0 % when tested in accordance with D4218. Materials 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 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, 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 outside diameters 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.

6.2.2 *Minimum Inside Diameter*—The minimum inside diameter shall be as shown in **Table 1**, when measured in accordance with **7.3.1**.

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

6.2.4 *Minimum Wall, Crown, Valley and Liner Thickness*—The minimum thickness of the pipe wall, crown, valley and liners 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 2—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 conditioned in accordance with **7.2** and tested in accordance with **7.5**.

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 **7.6** and examined under normal light and the unaided eye.

6.6 Fittings and Joining Systems:

6.6.1 Fittings shall be fabricated by the pipe manufacturer from pipe made in accordance with this standard. Fittings fabricated from dual-wall pipe shall be used with dual-wall pipe. Fittings fabricated from triple-wall pipe shall be used with triple-wall pipe. Fitting material shall comply with **5.1** and **5.2**.

NOTE 3—The fittings may be fabricated from the pipe by a variety of processes including hot plate welding, spin welding or other processes.

6.6.1.1 Fittings shall be parallel-plate load tested. Fittings shall be tested in an installation orientation, shall be uniformly supported (body and outlet(s)) by the lower plate, and uniformly loaded (body and outlet(s)) by the upper plate. Fittings shall meet or exceed a vertical load equivalent to the 5% deflection stiffness in accordance with **Table 1** for pipe to which the fitting is to be joined. The equivalent maximum load shall be the 5 % deflection stiffness in accordance with **Table 1** unit load (psi/in or kPa /mm) multiplied by the length of the fitting (run plus branch(es) as applicable) that is loaded by the upper plate. Testing shall be for equivalent load, not deflection. Acceptance criteria shall be in accordance with **6.4**.

NOTE 4—Installation orientation means that the fitting testing orientation is as though it were installed in a pipeline, for example, an elbow or tee with the directional outlet(s) to the side. In accordance with an

TABLE 1 Pipe Stiffness and Pipe Dimensions

| Pipe Inside Diameter ^A | Minimum Inside Diameter ^B | | Inside Diameter Tolerances | | Minimum Pipe Stiffness at 5 % Deflection | | Minimum Inner Liner Thickness | | Minimum Outer Liner Thickness | | Minimum Valley Thickness | | Minimum Crown Thickness | | |
|-----------------------------------|--------------------------------------|-------|----------------------------|--------------|--|-------|-------------------------------|-------|-------------------------------|-------|--------------------------|-------|-------------------------|-------|-------|
| | in. | [mm] | in. | [mm] | lb/in. /in. | [kPa] | in. | [mm] | in. | [mm] | in. | [mm] | in. | [mm] | |
| 12 | [300] | 11.90 | [302] | +0.11/-0.11 | +3.0/-3.0 | 46 | [317] | 0.043 | [1.1] | ... | ... | 0.048 | [1.2] | 0.072 | [1.8] |
| 15 | [375] | 14.85 | [377] | +0.11/-0.11 | +3.0/-3.0 | 46 | [317] | 0.052 | [1.3] | ... | ... | 0.065 | [1.7] | 0.103 | [2.6] |
| 18 | [450] | 17.93 | [455] | +0.14/-0.14 | +4.0/-4.0 | 46 | [317] | 0.060 | [1.5] | ... | ... | 0.072 | [1.8] | 0.105 | [2.7] |
| 21 | [525] | 20.75 | [527] | +0.15/-0.15 | +4.0/-4.0 | 46 | [317] | 0.062 | [1.6] | ... | ... | 0.079 | [2.0] | 0.116 | [2.9] |
| 24 | [600] | 23.90 | [607] | +0.16/-0.16 | +4.0/-4.0 | 46 | [317] | 0.064 | [1.6] | ... | ... | 0.086 | [2.2] | 0.127 | [3.2] |
| 27 | [675] | 26.75 | [679] | +0.17/-0.17 | +4.0/-4.0 | 46 | [317] | 0.073 | [1.9] | ... | ... | 0.088 | [2.2] | 0.130 | [3.3] |
| 30 | [750] | 29.79 | [757] | +0.18/-0.18 | +5.0/-5.0 | 46 | [317] | 0.086 | [2.2] | ... | ... | 0.093 | [2.4] | 0.132 | [3.4] |
| 30 | [750] | 29.62 | [752] | +0.18/- 0.18 | +4.6/-4.6 | 46 | [317] | 0.070 | [1.8] | 0.070 | [1.8] | 0.089 | [2.3] | 0.127 | [3.2] |
| 36 | [900] | 35.40 | [899] | +0.21/- 0.21 | +5.3/-5.3 | 46 | [317] | 0.095 | [2.4] | 0.095 | [2.4] | 0.120 | [3.0] | 0.182 | [4.6] |
| 42 | [1050] | 41.31 | [1049] | +0.22/- 0.22 | +5.6/-5.6 | 46 | [317] | 0.105 | [2.7] | 0.105 | [2.7] | 0.133 | [3.4] | 0.182 | [4.6] |
| 48 | [1200] | 47.31 | [1201] | +0.27/- 0.27 | +6.9/-6.9 | 46 | [317] | 0.105 | [2.7] | 0.105 | [2.7] | 0.139 | [3.5] | 0.187 | [4.8] |
| 54 | [1350] | 53.32 | [1354] | +0.27/- 0.27 | +6.9/-6.9 | 46 | [317] | 0.100 | [2.8] | 0.110 | [2.8] | 0.144 | [3.7] | 0.187 | [4.8] |
| 60 | [1500] | 59.30 | [1506] | +0.31/- 0.31 | +7.9/-7.9 | 46 | [317] | 0.115 | [2.9] | 0.115 | [2.9] | 0.151 | [3.8] | 0.231 | [5.9] |

^AThe triple wall profile wall pipe are only available in sizes 30 in. [750 mm] to 60 in. [1500 mm]. Dual wall profile pipe are available in sizes 12 in. [300 mm] to 30 in. [750 mm]. At 30 in. [750 mm] diameter, where the dimensions for the outer liner thickness are defined, all the associated dimensions shall only pertain to the triple wall profile pipe.

^B The manufacturer's stated inside diameter is the diameter plus or minus the inside diameter tolerance. In no case shall the manufacturer's minimum diameter with the tolerance be less than the minimum as shown in **Table 1**.

established quality program, fittings should be tested to only qualify the overall design and integrity of the unit. As unique structures, testing of every angle orientation is not necessary.

6.6.1.2 The fitting body in an installation orientation shall be impact tested in accordance with 7.6. Acceptance criteria shall be in accordance with 6.5.

6.6.2 The joining system(s) between pipe and between pipe and fittings shall be of a design that preserves pipeline slope and 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. Note that special provisions must be taken in order to join field cut pipe that meets the requirements of Test Method D3212. Any component used in the joining material shall be resistant to effluents being carried in the pipe.

6.6.4 *Lubricant*—The lubricant used for assembly of gasketed joints shall have no detrimental effect on the gasket or on the pipe.

6.6.5 *Optional Bell Retaining Bands or External Wraps*—Bell retaining bands or external stiffening wraps shall be made of corrosive resistant materials such as fiberglass (Specification D578/D578M) or stainless steel (Specification A666). All metallic mechanical devices, including castings and bolt assemblies used to mechanically restrain the bell shall be constructed of corrosion resistant materials meeting the physical properties and chemical composition requirements of Specification A666, Type 302 through Type 316.

6.6.5.1 The Specification D578/D578M fiberglass roving chopped strand shall be an E or S type glass, free of any alkali, dirt or other impurities. The band shall consist of overlapping continuous or chopped, filament fiber strand and not a fabric.

6.6.6 A joint proof-of-design analysis shall be conducted on the pipe joints using the 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 analysis or test. This test is a one-time validation test for the specific pipe diameter, profile geometry, gasket and joint configuration supplied by the manufacturer.

6.7 *Pipe Flattening*—There shall be no evidence of splitting, cracking, breaking, separation of seams, separation of either the outer or inner wall, or combinations thereof, when tested in accordance with 7.5. Additionally, at or below the deflection limit defined in Eq 1 and Eq 2 for dual wall and triple wall profiles, respectively, the specimen shall be considered as failing this test when the load does not increase continuously with increasing deflection.

Buckling Deflection Limit:

Dual wall:

$$\Delta = 0.012 \cdot \left(\frac{D}{0.5(D_o - D_i)} \right) \quad (1)$$

Triple Wall:

$$\Delta = 0.0144 \cdot \left(\frac{D}{0.5(D_o - D_i)} \right) \quad (2)$$

where:

- Δ = minimum buckling deflection limit (in/in [mm/mm])
- D = mean diameter (centroid) of pipe (in [mm])
- $0.5 (D_o - D_i)$ = height of the corrugation (outside diameter minus inside diameter)

NOTE 5—Eq 1 and Eq 2 are based on the results from NCHRP Report 631 and is defined as being derived from the standard parallel plate test equation.

6.8 *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 7.6.

6.9 *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 average failure time of the five test specimens shall exceed 30 h with no single test specimen's failure time less than 21 h. For smaller pipe sizes where the NCLS test cannot be conducted on the pipe due to size limitations on the longitudinal coupon, the NCLS test shall be conducted on molded plaques, and the average failure time of the five test specimens shall exceed 41 h.

6.10 *Structural Design:*

6.10.1 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 LRFD, Section 12. The design engineer shall verify that the data provided by the manufacturer satisfy the product requirements.

6.10.2 The minimum long-term (50-year) design values for modulus of elasticity and tensile strength for the PE compounds shall be 22 000 psi [152 MPa] and 900 psi [6.2 MPa], respectively.

6.10.3 The maximum allowable long-term (50-year) tensile strain limit for design shall be 5%.

7. Test Methods

7.1 *Conditioning:*—

7.1.1 *Referee Testing*—When conditioning is required for referee tests, condition the specimens in accordance with Procedure A of Practice D618 at 73.4 °F ± 3.6 °F [23 °C ± 2 °C] for not less than 40 h prior to test. Conduct tests under the same conditions of temperature. The selection of the sample or samples of the pipe and fittings shall be as agreed upon between the owner and the seller. In case of no prior agreement, any sample selected by the testing laboratory shall be deemed permitted.

7.1.2 *Quality Control Testing*—Condition specimens for a minimum of 4 h prior to test in air or 1 h in water at 73.4 °F ± 3.6 °F [23 °C ± 2 °C] without regard to relative humidity.

7.2 *Test Conditions*—Conduct tests other than those for routine quality control purposes in the standard laboratory atmosphere of 73.4 °F ± 3.6 °F [23 °C ± 2 °C], in the referenced test method or in this specification.

7.3 *Dimensions:*