



Standard Specification for Physical Properties of Polyethylene Corrugated Gravity Flow (non-pressure) Pipe and Fittings with Recycled Content¹

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1. Scope

1.1 This specification covers the identification of minimum physical properties of polyethylene corrugated pipe and fittings products both with recycled polyethylene content (post-consumer or post-industrial) and without recycled content. It is not the function of this specification to provide specific engineering data for design purposes, to specify manufacturing tolerances, or to determine suitability for use for a specific application.

1.2 Polyethylene corrugated pipe and fittings, being thermoplastic, are re-processable and recyclable (Note 2). This specification allows for the manufacture of these products with recycled polyethylene content, provided the minimum performance requirements of this specification are met.

1.3 The polyethylene corrugated gravity flow (non-pressure) pipe and fittings products to which this standard is to be applied are only fully formulated during the extrusion or molding process. It is in this process where the recycled polyethylene materials are used either alone or blended with virgin (unpigmented) polyethylene materials and combined with color concentrates/masterbatches or other additives. The requirements presented in this document apply to the final formulated/manufactured pipe and fittings products.

NOTE 1—The notes in this specification are for information only and shall not be considered part of this specification.

NOTE 2—See Guide ISO 15270 for information and definitions related to recycled plastics.

1.4 Quality-control measures are to be taken by manufacturers. See Annex A1 for general requirements on quality control.

NOTE 3—There is no known ISO equivalent to this standard.

1.5 The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to inch-pound units and are given for informational purposes only.

¹ This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.26 on Olefin Based Pipe.

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

2. Referenced Documents

2.1 ASTM Standards:²

- D618 Practice for Conditioning Plastics for Testing
- D638 Test Method for Tensile Properties of Plastics
- D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- D1505 Test Method for Density of Plastics by the Density-Gradient Technique
- D4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
- D4703 Practice for Compression Molding Thermoplastic Materials into Test Specimens, Plaques, or Sheets
- D4883 Test Method for Density of Polyethylene by the Ultrasound Technique
- F412 Terminology Relating to Plastic Piping Systems
- 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

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.

Post- Consumer Recycled HDPE

2.2 ISO Standards:³

ISO 15270 Plastics– Guidelines for the recovery and recycling of plastics waste.

3. Terminology

3.1 Definitions:

3.1.1 Terms used in this specification are in accordance with Terminology **F412**. The abbreviation for polyethylene is PE.

4. Product Requirements

4.1 Performance properties of polyethylene corrugated pipe and fittings products are to be determined in accordance with the appropriate ASTM test methods for density, carbon black content, tensile strength at yield, tensile elongation at break, flexural modulus, and slow crack growth resistance. Minimum values and ASTM test methods are shown in **Table 1**.

NOTE 4—The values for NCLS and UCLS are also determined by the associated ASTM product standards for their specific applications and requirements.

NOTE 5—Transportation Research Board (TRB) research established the minimum required elongation at break value listed.

5. Physical Properties

5.1 *General*—Test values for specimens of the PE drainage pipe and fitting products prepared as specified and tested in accordance with Section 8 shall conform to the minimum values shown in **Table 1**.

5.1.1 *Density*—Test Method **D792**, **D1505**, or **D4883** shall be used to determine the density value. The density value reported shall be the density of the final PE pipe formulation as produced.

5.1.2 *Carbon Black Content*—Test Method **D4218** shall be used to determine the Carbon Black Content.

5.1.3 *Tensile Strength at Yield*—Test Method **D638** shall be used to determine the Tensile Strength at Yield value.

5.1.4 *Tensile Elongation at Break*—Test Method **D638** shall be used to determine the Tensile Elongation at Break value.

5.1.5 *Flexural Modulus*—Test Method **D790** shall be used to determine the Flexural Modulus value.

5.1.6 *Slow Crack Growth Resistance*—Test Method **F2136** or **F3181** or a combination of both Test Method **F2136** and **F3181** shall be used to determine the Slow Crack Growth Resistance.

³ Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <https://www.iso.org>.

6. Number of Tests

6.1 The requirements identified by the product designation and otherwise specified in the purchase order shall be verified by testing in accordance with the specific product standard and this standard. For routine inspection, only those tests necessary to identify the product to the satisfaction of the purchaser shall be required.

7. Specimen Preparation

7.1 Unless otherwise specified in Section 8, the test specimens shall be molded in accordance with Procedure C of Annex A1 of Practice **D4703**.

8. Test Method

8.1 The properties enumerated in this specification shall be determined in accordance with the following test methods:

8.1.1 *Conditioning*—Unless otherwise specified in the test methods or in this specification, for those tests where conditioning is required, condition the molded test specimens in accordance with Procedure A of Practice **D618**.

8.1.2 *Test Conditions*—Unless otherwise specified in the test methods or in this specification, conduct tests at the standard laboratory temperature of 23 °C ± 2 °C (73 °F ± 4 °F).

8.1.3 *Density*—Test Method **D792**, **D1505** or **D4883**. Make duplicate determinations using two separate portions of the same pipe or molding or from two pipes or moldings. The prepared specimen thickness portions shall be 1.9 mm ± 0.2 mm (0.075 in. ± 0.008 in.). Calculate the average value.

8.1.4 *Carbon Black Content*—Test Method **D4218** shall be used. Make duplicate determinations from a sample in the form of specimens cut from the pipe or fitting.

8.1.5 *Tensile Strength at Yield*—The tensile strength at yield shall be determined in accordance with Test Method **D638**. The speed of testing shall be 500 mm/min (20 in./min for materials in the density range from 0.910 g/cm³ to 0.925 g/cm³) and 50 mm/min (2 in./min for all others). Specimens shall conform to the dimensions given for Type IV in Test Method **D638** with a thickness of 1.9 mm ± 0.2 mm (0.075 in. ± 0.008 in.). Specimen shall be either die cut or machined.

8.1.6 *Tensile Elongation at Break*—The tensile elongation at break shall be determined in accordance with Test Method **D638**. The speed of testing shall be 500 mm/min (20 in./min for materials in the density range from 0.910 g/cm³ to 0.925 g/cm³) and 50 mm/min (2 in./min for all others). Specimens shall conform to the dimensions given for Type IV in Test Method **D638** with a thickness of 1.9 mm ± 0.2 mm (0.075 in. ± 0.008 in.). Specimen shall be either die cut or machined.

TABLE 1 Minimum Performance Requirements for PE Pipe and Fittings

Property	Units	Test Method	Minimum Value
Density	g/cm ³	D792 , D1505 , D4883	0.940
Carbon Black Content	wt. %	D4218	2.0
Tensile Strength at Yield	mPa (psi)	D638	21 (3000)
Tensile Elongation at Break	%	D638	150
Flexural Modulus	mPa (psi)	D790	552 (80 000)
Slow Crack Growth Resistance			
Notched Constant Ligament Stress (NCLS)	hours	F2136	12
Un-notched Constant Tensile Load (UCLS)	hours	F3181	34