



Standard Specification for Polyethylene Plastics Molding and Extrusion Materials from Recycled Post-Consumer (HDPE) Sources¹

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INTRODUCTION

This specification provides for the identification of post-consumer recycled high-density polyethylene plastics (HDPE) plastics molding and extrusion materials derived from specified sources. It provides for the identification of resin characteristics and certification so that the user and the supplier can agree on the acceptability of shipments of the plastic materials. This specification provides that the source of the materials be listed as an aid in identifying the material. The tests described in this specification are intended to provide additional information for identifying these materials.

1. Scope*

1.1 This specification provides for the identification of recycled post-consumer HDPE molding and extrusion materials, from specified sources, in pellet or chip form so that the supplier and the user can agree on the acceptability of lots or shipments. This specification covers post-consumer HDPE materials from the following: (1) blow molded household chemical containers, (2) blow molded milk, juice, and water containers, (3) materials from the spunbonded process, (4) thermoformed packaged food containers and personal care packages, (5) injection molded packaged food containers and beverage bottle base cups, and (6) injection molded housewares and industrial articles such as pails, crates, totes, and pallets. Other post-consumer HDPE materials may be added to this specification when such material streams are characterized.

1.1.1 The tests described in this specification are intended to provide information for identifying these materials. The separation by sources improves the usefulness of the materials.

1.1.2 It is not the function of this specification to provide specific data for design purposes.

1.2 This specification provides a procedure to certify that the materials are from post-consumer sources.

1.3 The values stated in SI units are to be regarded as the standard. The inch-pound units given in parentheses are for information only.

1.4 The following precautionary caveat pertains only to the test method portion, Section 10, 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.*

NOTE 1—There are no ISO standards covering the primary subject matter of this specification.

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
- D883 Terminology Relating to Plastics
- D1238 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
- D1505 Test Method for Density of Plastics by the Density-Gradient Technique
- D3892 Practice for Packaging/Packing of Plastics
- D4703 Practice for Compression Molding Thermoplastic Materials into Test Specimens, Plaques, or Sheets
- D4883 Test Method for Density of Polyethylene by the Ultrasound Technique
- D5033 Guide for Development of ASTM Standards Relating

¹ This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials.

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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.

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

TABLE 1 Specification Values

Property	Specification Value				
	Source A ^A	Source B ^A	Source C ^A	Source D ^A	Source E ^A
Melt Index ^B g/10 min	0.1 to 0.6	0.4 to 1.0	0.4 to 0.9	>20	4 to 20
Density (unpigmented) ^C g/cm ³	≤0.959	>0.958	≥0.955	0.956 to 0.962	0.956 to 0.962
Added antioxidant ^D or other stabilizer	Specify level	Specify level	Specify level	Specify level	Specify level
Tensile stress at yield ^E MPa (psi)	14 (2030) min	20 (2900) min	20 (2900) min	17 (2500) min	17 (2500) min
Secant modulus ^F MPa (psi)	620 (90 000) min	670 (97 000) min	670 (97 000) min	620 (90 000) min	550 (80 000) min

^A See 5.3.

^B Melt index measured at condition 190/2.16 (see Test Method D1238).

^C The apparent density of the pigmented resin may be different (usually higher) than the density of the unpigmented resin. Only the unpigmented density is listed in Table 1. Test Method D4883 may be useful as a measure of the base resin density of pigmented recycled HDPE material.

^D The seller must specify the amount of antioxidant or other stabilizer added, if any, to repelletized material.

^E Type IV tensile bars tested at 50.8 mm/min (2 in./min) (see Test Method D638).

^F Secant modulus at approximately 2 % strain using Method 1, Procedure B with 50.8-mm (2-in.) span on 3.2 by 12.7-mm (0.125 by 0.5-in.) specimens. (See Test Method D790.)

to Recycling and Use of Recycled Plastics (Withdrawn 2007)³

D5577 Guide for Techniques to Separate and Identify Contaminants in Recycled Plastics

D7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

3. Terminology

3.1 *Definitions*—The definitions of terms used in this specification are in accordance with Terminology D883 and Guides D5033 and D7209.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *nominal density*—the density of the unpigmented high-density polyethylene resin, which may differ from the apparent density of the material due to the addition of fillers or pigments to the resin.

3.2.2 *source*—the original end use of the HDPE materials described in this specification.

3.2.3 *spunbonded*—a method of fabrication wherein a material is bonded to form a sheet-like structure during the spinning process.

4. Ordering Information

4.1 The purchase order or inquiry for these materials shall state the specification number, date of issue and desired values for the items listed in Table 1.

4.2 Further definition as may be required for the items listed in Table 1 shall be on agreement between the user and the supplier.

4.3 It is recognized that some contaminants may result in an odor being present in the recycled material. The acceptability of the type and level of odor shall be as agreed upon by the user and supplier. Methods to evaluate odors in recycled materials are being developed elsewhere in the plastics industry.

5. General Requirements

5.1 The material shall be in the form of pellets or chips.

5.2 The material shall be as free of contamination as can be achieved by good manufacturing practice. If necessary, the level of contamination may be agreed upon between the user and the supplier.

5.2.1 Guidance for the separation and identification of contaminants may be found in Guide D5577.

5.3 The materials described in this specification are limited to high-density polyethylene from the sources indicated. Different end uses can be categorized as from the same source provided the physical properties of the HDPE meet the requirements specified in Table 1.

5.3.1 *Source A*—Post-consumer blow molded or thermoformed HDPE containers, usually from household chemicals, packaged food, or personal care packages.

5.3.2 *Source B*—Post-consumer blow molded HDPE containers usually from milk, juice, and water containers.

5.3.3 *Source C*—Post-consumer HDPE items that have been fabricated from spunbonded materials.

5.3.4 *Source D*—Post-consumer injection molded articles, usually from packaged food containers and beverage base cups.

5.3.5 *Source E*—Post-consumer injection molded articles, usually from housewares and industrial articles such as pails, crates, totes, and pallets.

6. Physical Properties

6.1 Test specimens of the materials shall conform to the requirements prescribed in Section 8 and tested as described in Section 10.

6.2 Observed or calculated values obtained from analysis, measurement or test, shall be rounded as specified in Practice E29. Round to the nearest unit in the last right-hand place of figures used in expressing the specified limiting value. The value obtained is compared directly with the specified limiting value. Conformance or nonconformance with the specification is based on this comparison.

³ The last approved version of this historical standard is referenced on www.astm.org.

7. Sampling

7.1 The materials shall be sampled using adequate statistical sampling techniques. Adequate statistical sampling shall be considered as an acceptable alternative. Procedures to ensure sample homogeneity should be part of the sampling plan. A batch or lot of resin shall be considered as a unit of manufacture as prepared for shipment and may consist of a blend of two or more production runs of material.

8. Specimen Preparation

8.1 Test specimens shall be molded in accordance with Procedure C of Annex A1 of Practice **D4703**. If the material is known to be homogenous or has been melt blended, milling, prior to compression molding, is not required except in reference situations.

8.2 The molded sheet thickness shall be 1.9 ± 0.2 mm (0.075 ± 0.008 in.) for tensile testing or 3.2 ± 0.3 mm (0.125 ± 0.012 in.) for flexural modulus testing.

8.3 The mechanical test specimen shall be prepared in accordance with requirements in Test Methods **D638** and **D790**.

9. Conditioning

9.1 *Conditioning*—Once specimens are molded, they shall be moved to a standard laboratory atmosphere or a controlled laboratory atmosphere. For natural unfilled polyethylene plastics the controlled laboratory atmosphere shall be $23 \pm 2^\circ\text{C}$. Test specimens shall be conditioned for a minimum of 40 h immediately prior to testing. For filled and reinforced polyethylene plastics or polyethylene plastic blends, which contain a hydrophilic co-monomer, pigment, or modifier the specimens shall be conditioned in a standard laboratory atmosphere of $23 \pm 2^\circ\text{C}$ and $50 \pm 5\%$ relative humidity (see Practice **D618**, Procedure A). For all materials to be conditioned for electrical testing, conditioning shall comply with the requirements of the standard test methods for electrical testing. In all cases the laboratory shall report both the temperature and humidity conditions during the conditioning period.

9.2 *Test Conditions*—Conduct all tests following the same criteria for temperature and humidity as specified for conditioning in **9.1**.

10. Test Methods

10.1 Determine the properties enumerated in this specification in accordance with the ASTM test methods as they apply, unless otherwise stated herein.

10.1.1 *Melt Index*—Use Test Method **D1238**, Condition 190/2.16. Make duplicate determinations on the material.

NOTE 2—Although the flow rate of polyethylene plastics can be measured under any of the conditions listed for it in **Table 1** of Test Method **D1238**, only Condition 190/2.16 is identified as “melt index.”

10.1.2 *Nominal Density*—Test Method **D1505** or alternative test methods as referenced in **2.1** providing equivalent accu-

racy. Make duplicate determinations using two separate portions of the same or two different moldings.

10.1.3 *Tensile Strength*—Use Test Method **D638**, except that the speed-of-grip separation shall be 50.8 mm (2 in.)/min. Specimens shall conform to dimensions given for Type IV in Test Method **D638**. Their thicknesses shall be 1.9 ± 0.2 mm (0.075 ± 0.008 in.). Specimens shall be either die cut or machined to the specified dimensions. Gage-length shall be 25.40 ± 0.38 mm (1.000 ± 0.015 in.) and initial-grip-separation shall be 62.5 ± 5 mm (2.5 ± 0.2 in.).

NOTE 3—If of interest, tensile stress, strain, or nominal strain at break can also be determined. Test results for specimens that break outside the gauge marks need not be discarded unless the break occurs between the contact surfaces of a grip.

10.1.4 *Secant Modulus of Elasticity in Bending*—Use Test Method **D790**, Method I Procedure B with a 50.8-mm (2-in.) span, and using a testing speed of 12.7 mm/min. (0.5 in./min.). Test specimens each 3.2 by 12.7 mm (0.125 by 0.5 in.) flatwise and calculate the average value of the secant modulus at 2% strain in the outer fibers.

NOTE 4—The tangent modulus of elasticity in bending approximates the secant modulus of elasticity in bending. Generally, however, the secant modulus is lower. The tangent modulus is considered less reproducible due to the inability to construct consistent tangents to the steepest initial straight-line portions of the stress-strain curves.

11. Inspection and Certification

11.1 Inspection and certification of the material shall be made for conformance to the requirements specified herein.

11.2 The supplier shall provide a written certification with each shipment that the chips or pellets are derived from post-post-consumer sources. The source of these materials, as specified in **5.3**, shall be identified in the certification.

11.3 Certification shall be that the material was processed, sampled, tested, and inspected in accordance with this specification and that the average values meet the requirements at a confidence level of 95%.

11.4 Lot acceptance inspection shall be the basis on which acceptance or rejection of the lot is made. The lot acceptance inspection shall consist of those tests that ensure process control as well as those necessary to ensure certifiability in accordance with **11.3**.

11.5 Periodic check/inspection shall consist of the tests specified for all material requirements under this specification.

12. Packaging and Package Marking

12.1 For packing and packaging, the provisions of Practice **D3892** shall apply.

13. Keywords

13.1 blow-molding; HDPE; injection molding; molding and extrusion materials; polyethylene; post-consumer material; recovered material; recycled; spunbonded; thermoforming

SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D5203 - 02) that may impact the use of this standard. (March 1, 2007)

- (1) Added reference to **D7209**.
- (2) Broadened MI range for Source “A” materials.
- (3) Defined tensile stress at yield in Table 1.
- (4) Deleted reference to test specimens over 7 mm in thickness.
- (5) Deleted 10.1.4.1 and 10.1.4.2.

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