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Standard Specification for THERMOPLASTIC POLYTEREPHTHALATE MOLDING AND EXTRUSION MATERIALS[1]

This standard is issued under the fixed designation D 3221; 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.

[ε1]NOTE—Section 9.1.2 was editorially revised in August 1982.

1. Scope

1.1 This specification covers thermoplastic polyterephthalate resins suitable for injection molding or extrusion. Requirements for reinforced polyterephthalate resins are described in Specification D 3220.

1.2 This specification provides for the designation, based on selected physical properties, of commercially available polyterephthalate resins. These properties are specific gravity, tensile strength, flexural modulus, deflection temperature, Izod impact strength, and flow rate.

1.3 The values stated in SI units are to be regarded as the standard.

NOTE 1—There may be other requirements necessary to specify materials for specific applications. These can be specified by agreement between the purchaser and the seller.

2. Applicable Documents

2.1 *ASTM Standards*:

D 256 Tests for Impact Resistance of Plastics and Electrical Insulating Materials[2]

D 618 Conditioning Plastics and Electrical Insulating Materials for Testing[2]

D 638 Test for Tensile Properties of Plastics[2]

D 648 Test for Deflection Temperature of Plastics Under Flexural Load[2]

D 790 Test for Flexural Properties of Plastics and Electrical Insulating Materials[2]

D 792 Tests for Specific Gravity and Density of Plastics by Displacement[2]

D 1130 Recommended Practice for Injection Molding Test Specimens of Thermoplastic Materials[2]

D 1238 Test for Flow Rates of Thermoplastics by Extrusion Plastometer[2]

D 1898 Recommended Practice for Sampling of Plastics[2]

D 3220 Specification for Reinforced Polyterephthalate Molding and Extrusion Materials[2]

D 3892 Practice for Packaging/Packing of Plastics[2]

3. Classification

3.1 Polyterephthalate materials are classified according to Table 1. An identifying number is used for each material made up of six digits comprising the cell numbers for the characteristics in the order in which they appear in Table 1.

3.2 Although the values listed are necessary to include the range of properties available in existing materials, they should not be interpreted as implying that every possible combination of the properties exists or can be obtained commercially.

4. General Requirements

4.1 The compositions shall be uniform and shall conform to the requirements prescribed herein. The color and form of the material shall be as agreed upon by the purchaser and the seller.

5. Detail Requirements

5.1 The material shall conform to the specified properties chosen from Table 1.

[1] This specification is under the jurisdiction of ASTM Committee D-20 on Plastics, and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials.

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[2] *Annual Book of ASTM Standards*, Part 35.

5.2 Material supplied in these forms shall be as uniform in composition and size and as free of contamination as can be achieved by good manufacturing practice.

6. Sampling

6.1 Unless otherwise agreed between the purchaser and the seller, the material shall be sampled in accordance with the procedure described in Sections 9 through 12 of Recommended Practice D 1898. Adequate statistical sampling prior to packaging shall be considered an acceptable alternative.

6.2 A batch or lot of molding compound 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.

7. Specimen Preparation

7.1 Test specimens shall be molded using a screw injection molding press in accordance with Recommended Practice D 1130, *under conditions recommended by the supplier.*

8. Conditioning

8.1 *Conditioning*—Condition the test specimen at 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 5 % relative humidity for not less than 40 h prior to test in accordance with Procedure A of Methods D 618 for those tests where conditioning is required. In cases of disagreement, the tolerances shall be ± 1°C (± 1.8°F) and ± 2 % relative humidity.

8.2 *Test Conditions*—Conduct tests in the Standard Laboratory Atmosphere of 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 5 % relative humidity, unless otherwise specified in the test methods or in this specification. In cases of disagreement, the tolerances shall be ± 1°C (± 1.8°F) and ± 2 % relative humidity.

9. Test Methods

9.1 The properties required in this specification are those enumerated in Table 1 and shall be determined as specified below:

9.1.1 *Specific Gravity at 23°C*—Method A-1 of Methods D 792.

9.1.2 *Tensile Strength*—Method D 638, Type I test specimens, 50 mm (2 in.)/min testing speed.

9.1.3 *Flexural Modulus*—Method I of Methods D 790, employing a 3.2 by 12.7-mm (0.125 by 0.50-in.) specimen and a 50.7-mm (2-in.) span with a crosshead speed of 1.3-mm (0.05-in.)/min and calculated by the tangent method.

9.1.4 *Impact Strength*—Method A of Methods D 256, employing a 3.2-mm (0.125-in.) thick specimen. The test specimen shall be one piece and not a composite of thinner sections. The type of failure must be complete; other breaks require a cell number of zero in classifying material.

9.1.5 *Deflection Temperature*—Method D 648, employing a 3.2-mm (0.125-in.) thick specimen and a fiber stress of 1.82 MPa (264 psi).

9.1.6 *Flow Rate*—Condition E of Method D 1238, except the temperature shall be 250 ± 0.2°C. Procedure A or Procedure B may be used.

9.1.6.1 Dry the test sample in a vacuum oven (0.5-mm Hg) for 30 min at 150°C, 4 h at 120°C, or other conditions that will reduce the moisture content to a level that will be equivalent to these alternate drying times. If the dried sample cannot be immediately charged into the plastometer it can be stored for a limited time in an efficient dryer or desiccator.

NOTE 2—Polyterephthalate resins must be extremely dry for flow rate measurements. Care must be taken not to subject polyterephthalates to temperatures high enough to increase the molecular weight of the material. The use of nitrogen to purge the vacuum oven may also be helpful in eliminating molecular weight changes of polymer and reducing the moisture content of the polymer.

9.1.6.2 Flow rate measurements by this technique are not applicable to polyethylene terephthalate (PET). Therefore, flow rate shall be unspecified when classifying PET according to Table 1.

10. Number of Tests

10.1 Routine testing of each batch or lot shall be limited to the specified properties chosen from Table 1 of this specification unless otherwise designated.

10.2 One set of test specimens as prescribed in the methods cited in Section 9 shall be considered sufficient for testing each batch or lot. The average result for the specimens tested shall conform to the requirements prescribed in this specification.

11. Inspection

11.1 Inspection of the material shall be

agreed upon by the purchaser and the seller as part of the purchase contract.

12. Retest and Rejection

12.1 If any failure occurs, the materials may be retested to establish conformity in accordance with agreement between the purchaser and the seller.

13. Packaging and Marking

13.1 *Packaging*—The material shall be packaged in standard commercial containers, so constructed as to ensure acceptance by common or other carriers for safe transportation at the lowest rate to the point of delivery, unless otherwise specified in the contract or order.

13.2 *Marking*—Unless otherwise agreed between the purchaser and the seller, shipping containers shall identify the material and its supplier, the batch or lot number, its type, and the quantity contained.

13.3 All packing, packaging, and marking provisions of Practice D 3892 shall apply to this specification.

QUALITY ASSURANCE PROVISIONS FOR GOVERNMENT/MILITARY PROCUREMENT

These requirements apply *only* to Federal/Military procurement, not domestic sales or transfers.

S1. Sampling for inspection and testing shall be carried out in accordance with the recommendations of Recommended Practice D 1898.

S2. Selection of Acceptable Quality Level (AQL) and of Inspection Level (IL) shall be made, with consideration of the specific use requirements. This is discussed in Sections 7 and 8 of the above document, with reference to Military Standard MIL-STD-105.

S3. In the absence of contrary requirements, the following values shall apply:

	IL	AQL
Defects of appearance and workmanship	II	2.5
Defects of preparation for delivery	S-2	2.5
Testing (products)	S-1	1.5
Testing (polymer, unfabricated)	S-1[A]	—

[A] Samples shall be drawn from the required number of units, and pooled for preparation of molded samples for mechanical properties evaluation.

TABLE 1 Specifications for Unfilled Polyterephthalate Plastic Molding and Extrusion Materials[A]

Property	Units	Cells						
		0	1	2	3	4	5	6
1. Specific gravity, 23°C, min	none	unspecified	1.18	1.25	1.30	1.40		
2. Tensile strength, min	psi	unspecified	6500	7200	8000	9000		
	MPa		45	50	55	62		
3. Flexural modulus, min	10^5 psi	unspecified	2.5	2.7	3.0	3.3	3.6	4.0
	GPa		1.7	1.9	2.1	2.3	2.5	2.8
4. Izod impact strength, min	ft·lbf/in. of notch	unspecified	0.4	0.6	0.8	1.0		
	J/m of notch		21	32	43	53		
5. Deflection temperature 1.82 MPa (264 psi), min	°C	unspecified	54	50	60			
	°F		113	122	140			
6. Flow rate, 250°C		unspecified	<3	3.1–6.0	6.1–10	10.1–20	20.1–35	

[A] An example of this classification system is as follows:

A polyterephthalate 233204 would have the following characteristics:

Specific gravity, min	1.25
Tensile strength, min	55 MPa (8000 psi)
Flexural modulus, min	2.1 GPa (3.0×10^5 psi)
Izod impact strength, min	32 J/m of notch (0.6 ft·lbf/in. of notch)
Deflection temperature, 1.82 MPa (264 psi), min	unspecified
Flow rate, g/10 min at 250°C	10.1–20