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Standard Specification for Polyphthalamide (PPA) Injection Molding Materials¹

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1. Scope*

1.1 This specification covers polyphthalamide materials suitable for injection molding.

1.2 The properties included in this specification are those required to identify the compositions covered. Other requirements necessary to identify particular characteristics important to specialized applications are to be specified by using suffixes as given in Section 5. See Guide D5740.

1.3 This specification allows for the use of recycled materials provided that all specification requirements are met.

1.4 This specification is intended to be a means of calling out plastics materials used in the fabrication of end items or parts. It is not intended for the selection of materials. Material selection can be made by those having expertise in the plastics field only after careful consideration of the design and the performance required of the part, the environment to which it will be exposed, the fabrication process to be employed, the costs involved, and the inherent properties of the material other than those covered by this specification.

1.5 The values stated in SI units are to be regarded as the standard (see IEEE/ASTM SI-10). The values given in parentheses are for information only.

1.6 The following precautionary caveat pertains only to the test methods portion, Section 12, 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.* Specific precautionary statements are given in Note 6.

NOTE 1—There is no known ISO equivalent to this specification.

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 (Section D20.15.09).

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2. Referenced Documents

2.1 ASTM Standards:²

- D256 Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
- D618 Practice for Conditioning Plastics for Testing
- D638 Test Method for Tensile Properties of Plastics
- D648 Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
- 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
- D883 Terminology Relating to Plastics
- D1600 Terminology for Abbreviated Terms Relating to Plastics
- D2857 Practice for Dilute Solution Viscosity of Polymers
- D3418 Test Method for Transition Temperatures and Enthalpies of Fusion and Crystallization of Polymers by Differential Scanning Calorimetry
- D3641 Practice for Injection Molding Test Specimens of Thermoplastic Molding and Extrusion Materials
- D3801 Test Method for Measuring the Comparative Burning Characteristics of Solid Plastics in a Vertical Position
- D3835 Test Method for Determination of Properties of Polymeric Materials by Means of a Capillary Rheometer
- D3892 Practice for Packaging/Packing of Plastics
- D4000 Classification System for Specifying Plastic Materials
- D5225 Test Method for Measuring Solution Viscosity of Polymers with a Differential Viscometer
- D5630 Test Method for Ash Content in Plastics
- D5740 Guide for Writing Material Standards in the Classification Format
- D6869 Test Method for Coulometric and Volumetric Determination of Moisture in Plastics Using the Karl Fischer

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

Reaction (the Reaction of Iodine with Water)
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
IEEE/ASTM SI-10 Standard for Use of the International System of Units (SI): The Modern Metric System

2.2 *Underwriters Laboratories Standard:*
UL94 Standard for Tests for Flammability of Plastic Materials³
 2.3 *ISO Standards:*⁴
ISO 75-1 Determination of Temperature of Deflection Under Load – Part 1: General Test Methods
ISO 75-2 Determination of Temperature of Deflection Under Load – Part 2: Plastics and Ebonite
ISO 179-1 Determination of Charpy Impact Strength—Part 1: Non-Instrumented Impact Test
ISO 294-1 Injection Moulding of Test Specimens of Thermoplastic Materials—Part 1: General Principles, Multipurpose-Test Specimens and Bars
ISO 527-1 Determination of Tensile Properties—Part 1: General Principles
ISO 527-2 Determination of Tensile Properties—Part 2: Testing Conditions
ISO 3451-1 Determination of Ash General Methods
ISO 3451-4 Determination of Ash, Polyamides
ISO 15512 Determination of Water Content

3. Terminology

3.1 *Definitions*—The terminology used in this specification is in accordance with Terminologies **D883** and **D1600**.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *polyphthalamide, PPA, n*—a polyamide in which residues of terephthalic acid or isophthalic acid or a combination

of the two comprise at least 55 molar percentage of the dicarboxylic acid portion of the repeating structural units in the polymer chain.

4. Classification

4.1 The polyphthalamide materials will be designated “PPA,” as specified in Terminology **D1600**.

4.2 Unreinforced polyphthalamide materials are classified into groups according to crystallinity. These groups are subdivided into classes and grades as shown in Table PPA.

NOTE 2—An example of this classification system is as follows: The designation PPA0121 would indicate from Table PPA:

- PPA = Polyphthalamide as found in Terminology **D1600**
- 01 (Group) = Semicrystalline PPA
- 2 (Class) = Low-temperature molding material
- 1 (Grade) = With the corresponding requirements shown in Table PPA

4.2.1 To facilitate the incorporation of future or special materials, the “other/unspecified” category (00) for group, (0) for class, and (0) for grade is shown. The basic properties of the material can be obtained from Table A as they apply.

4.3 Reinforced and lubricated versions of the polyphthalamide materials are classified in accordance with Tables PPA and A, where Table PPA specifies the unreinforced material and Table A the properties after the addition of reinforcements or lubricants at the nominal level indicated (see 4.3.1).

4.3.1 A single letter shall be used to indicate the major reinforcement, or filler, or combinations of reinforcements or fillers, or both, along with two digits that indicate the percentage of additive(s) by total mass, with tolerances as tabulated as follows:

Symbol	Material	Tolerance (Based on the Total Mass)
C	Carbon or graphite fiber	±3 %
G	Glass reinforced	±3 %
L	Lubricants	by agreement between the supplier and the user
M	Mineral	±3 %
R	Combinations of reinforcements or fillers, or both	±3 % for the total reinforcement or filler, or both

TABLE PPA Requirements for Unreinforced Polyphthalamide Resins

Group	Description	Class	Description	Grade	Description	Inherent Viscosity ^A , dL/g	Melting Temperature, ^B °C	Glass Transition ^B , Tg, °C	
01	semicrystalline PPA	1	high-temperature molding	1		0.80-1.06	305-320	115-130	
				2		0.70-1.00	315-330	115-130	
		2	low-temperature molding	1	Other	0	0.80-1.05	320-335	90-105
				2		0.85-0.95	290-305	85-95	
				3		0.85-1.05	300-315	85-95	
				0					
00	Other	0	Other	0					
				0					

^APractice **D2857** or Test Method **D5225** with conditions as specified in 12.7 of this specification.

^BTest Method **D3418** using a heating rate of 10°C/min.

TABLE A Detail Requirements of Special Reinforced PPAs Using ASTM Methods

NOTE—All mechanical properties are determined on dry-as-molded injection molded specimens.

Property	0	1	2	3	4	5	6	7	8	9
Inherent viscosity, ^A Test Method D2857 , ^B dL/g, min		0.60	0.7	0.75	0.8	0.85	0.9	0.95	1	^C
Tensile strength, Test Method D638 ^D , ^B MPa ^E (psi), min		45 (6500)	75 (10 900)	90 (13 000)	100 (14 500)	135 (19 600)	200 (29 000)	230 (33 400)	255 (37 000)	^C