



Designation: D 5336 – 03

# Standard Specification for Polyphthalamide (PPA) Injection Molding Materials<sup>1</sup>

This standard is issued under the fixed designation D 5336; 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.

## 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. There may be other requirements necessary to identify particular characteristics important to specialized applications. These may be specified by using suffixes as given in Section 5.

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 should be made by those having expertise in the plastics field 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 inherent properties of the material other than those covered by this specification, and the economics.

1.5 The values stated in SI units are to be regarded as the standard (see [IEEE/ASTM SI-10](#)).

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 similar or equivalent ISO standard.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

[D 256](#) Test Methods for Determining the Izod Pendulum

<sup>1</sup> 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

### Impact Resistance of Plastics

[D 618](#) Practice for Conditioning Plastics for Testing

[D 638](#) Test Method for Tensile Properties of Plastics

[D 648](#) Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position

[D 790](#) Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

[D 792](#) Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

[D 883](#) Terminology Relating to Plastics

[D 1600](#) Terminology for Abbreviated Terms Relating to Plastics

[D 2857](#) Practice for Dilute Solution Viscosity of Polymers

[D 3418](#) Test Method for Transition Temperatures of Polymers by Differential Scanning Calorimetry

[D 3641](#) Practice for Injection Molding Test Specimens of Thermoplastic Molding and Extrusion Materials

[D 3835](#) Test Method for Determination of Properties of Polymeric Materials by Means of a Capillary Rheometer

[D 3892](#) Practice for Packaging/Packing of Plastics

[D 4000](#) Classification System for Specifying Plastic Materials

[D 4019](#) Test Method for Moisture in Plastics by Coulometric Regeneration of Phosphorus Pentoxide

[D 5225](#) Test Method for Measuring Solution Viscosity of Polymers with a Differential Viscometer

[D 5630](#) Test Method for Ash Content in Thermoplastics

[D 5740](#) Guide for Writing Material Standards in the D 4000 Format

[E 29](#) 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 Materials<sup>3</sup>

## 3. Terminology

3.1 *Definitions*—The terminology used in this specification is in accordance with Terminologies [D 883](#) and [D 1600](#).

<sup>3</sup> Available from Underwriters Laboratories (UL), Corporate Progress, 333 Pfingsten Rd., Northbrook, IL 60062.

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

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 D 1600.

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 D 1600
- 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 <sup>A</sup> , dL/g	Melting Temperature, <sup>B</sup> °C	Glass Transition <sup>B</sup> , Tg, °C
01	semicrystalline PPA	1	high-temperature molding	1		0.80-1.06	305-320	115-130
			low-temperature molding	0	Other			
		2	1		0.85-1.05	320-335	90-105	
			2		0.85-0.95	290-305	85-95	
			3		0.85-1.05	300-315	85-95	
			0	Other				
00	Other	0	Other	0	Other			

<sup>A</sup>Practice D 2857 or Test Method D 5225 with conditions as specified in 12.6 of this specification.

<sup>B</sup>Test Method D 3418 using a heating rate of 10°C/min.

TABLE A Detail Requirements of Special Reinforced PPAs

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, <sup>A</sup> Test Method D 2857, dL/g, min	<sup>B</sup>	0.60	0.7	0.75	0.8	0.85	0.9	0.95	1	<sup>C</sup>
Tensile strength, Test Method D 638 <sup>D</sup> , MPa <sup>E</sup> [psi], min	<sup>B</sup>	45 [6500]	75 [10 900]	90 [13 000]	100 [14 500]	135 [19 600]	200 [29 000]	230 [33 400]	255 [37 000]	<sup>C</sup>
Flexural modulus, Test Method D 790 <sup>F</sup> , GPa [kpsi], min	<sup>B</sup>	1.5 [218]	2.5 [363]	3.0 [435]	5.5 [798]	6.5 [943]	10.0 [1450]	13.5 [1958]	15.0 [2175]	<sup>C</sup>
Izod impact, Test Method D 256 <sup>G</sup> J/m <sup>H</sup> [ft-lb/in], min	<sup>B</sup>	20 [0.38]	40 [0.75]	60 [1.1]	90 [1.6]	100 [1.9]	350 [6.6]	500 [9.4]	650 [12.1]	<sup>C</sup>
Deflection Temperature Test Method D 648 <sup>I</sup> , °C, min	<sup>B</sup>	100	125	160	185	210	235	260	285	<sup>C</sup>

<sup>A</sup>See 12.6 of this specification for specific conditions.

<sup>B</sup>Unspecified requirement.

<sup>C</sup>Specific value must be given in call-out.

<sup>D</sup>Test Method D 638, Type I tensile bar. The speed of testing shall be as described in 12.2 of this specification.

<sup>E</sup>MPa × 145 = psi.

<sup>F</sup>Test Method D 790 with a 1-mm [0.05-in.] testing speed.

<sup>G</sup>Test Methods D 256, Test Method A.

<sup>H</sup>J/m × 0.01873 = ft-lb/in.

<sup>I</sup>Test Method D 648, using 1820-kPa [264-psi] stress.