



Designation: D5336 – 15a

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

This standard is issued under the fixed designation D5336; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

### 1. Scope\*

1.1 This classification system covers polyphthalamide materials suitable for injection molding.

1.2 The properties included in this classification system 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.

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

1.4 This classification system 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 classification system.

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 11, of this classification system: *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 11.7.1.

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

<sup>1</sup> This standard 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).

Current edition approved Oct. 1, 2015. Published October 2015. Originally approved in 1992. Last previous edition approved in 2015 as D5336 - 15. DOI: 10.1520/D5336-15A.

### 2. Referenced Documents

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

- 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
- D6869 Test Method for Coulometric and Volumetric Determination of Moisture in Plastics Using the Karl Fischer Reaction (the Reaction of Iodine with Water)

<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.

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

**D7209** Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products (Withdrawn 2015)<sup>3</sup>

**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 Materials<sup>4</sup>

2.3 *ISO Standards:*<sup>5</sup>

**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 classification system is in accordance with Terminologies **D883** and **D1600**.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

<sup>4</sup> Available from Underwriters Laboratories (UL), 333 Pfingsten Rd., Northbrook, IL 60062-2096, <http://www.ul.com>.

<sup>5</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

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 are 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 <b>D1600</b>
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**).

NOTE 3—This part of the classification system uses the percent of reinforcements or additives, or both, in the callout of the modified basic material. The types and percentages of reinforcements and additives is sometimes shown on the supplier’s technical data sheet. If necessary additional callout of these reinforcements and additives can be accomplished by use of the suffix of the system (see Section 5).

NOTE 4—Materials containing reinforcements or fillers, or both, at nominal levels not in multiples of five are included in the nearest grade designation. For example, a material with a nominal glass fiber level of 33 % is included with Grade G35.

**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> , T <sub>g</sub> , °C
01	semicrystalline	1	high-temperature molding	1		0.80-1.06	305-320	115-130
				2		0.70-1.00	315-330	115-130
	PPA	2	low-temperature molding	0	Other			
				1		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	Other	0	Other					
00	Other	0	Other	0	Other			

<sup>A</sup>Practice **D2857** or Test Method **D5225** with conditions as specified in **11.7** of this classification system.

<sup>B</sup>Test 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, <sup>A</sup> Test Method <b>D2857</b> , 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 <b>D638</b> <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 <b>D790</b> <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 <b>D256</b> <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 <b>D648</b> <sup>I</sup> , °C, min	<sup>B</sup>	100	125	160	185	210	235	260	285	<sup>C</sup>

<sup>A</sup>See **11.7** of this classification system for specific conditions.

<sup>B</sup>Unspecified requirement.

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

<sup>D</sup>Test Method **D638**, Type I tensile bar. The speed of testing shall be as described in **11.2** of this classification system.

<sup>E</sup>MPa × 145 = psi.

<sup>F</sup>Test Method **D790** with a 1-mm (0.05-in.)/min testing speed.

<sup>G</sup>Test Methods **D256**, Test Method A.

<sup>H</sup>J/m × 0.01873 = ft-lb/in.

<sup>I</sup>Test Method **D648**, using 1820-kPa (264-psi) stress.

**TABLE B Detail Requirements of Special Reinforced PPAs Using ISO 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
Tensile strength, ISO 527 MPa min <sup>A</sup>	<sup>B</sup>	45	75	90	100	135	200	230	255	<sup>C</sup>
Tensile modulus, ISO 527 GPA min <sup>D</sup>	<sup>B</sup>	1.5	3.5	5.5	7.5	9.5	12.0	14.0	18.0	<sup>C</sup>
Charpy, ISO 179-1, J/m <sup>2</sup> , min <sup>E</sup>	<sup>B</sup>	2.0	4.0	5.5	7.5	9.0	11.0	13.0	15.0	<sup>C</sup>
Deflection Temperature Under Load, ISO 75-2 method Af, °C, min <sup>F</sup>	<sup>B</sup>	100	125	160	185	210	235	260	285	<sup>C</sup>
To be determined	<sup>B</sup>									

<sup>A</sup>ISO 527, Type 1A tensile bar. The speed of testing shall be as described in 12.2 of this classification system.

<sup>B</sup>Unspecified requirement.

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

<sup>D</sup>ISO 527, Type 1A tensile bar. The Speed of testing shall be 1 mm/min.

<sup>E</sup>ISO 179-1, Test specimen shall be taken from the center portion of multipurpose tensile bar.

<sup>F</sup>ISO 75-2, The test specimen shall be taken from the center portion of the multipurpose tensile bar, 4 mm thick, and tested in the flatwise position.