



Designation: D6358 – 11

# Standard Classification System and Basis for Specification for Poly (Phenylene Sulfide) (PPS) Injection Molding and Extrusion Materials Using ISO Methods<sup>1</sup>

This standard is issued under the fixed designation D6358; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This classification system covers unfilled, reinforced and filled materials suitable for injection molding and extrusion using ISO methods. The system allows for the use of poly (phenylene sulfide) (PPS) plastic materials that are recycled, reconstituted recycled-regrind, recovered or reprocessed, or both, provided that the requirements as stated in this specification are met. It is the responsibility of the supplier and the buyer of recycled, reconstituted, recycled-regrind, recovered or reprocessed, or both, poly (phenylene sulfide) plastic materials to ensure compliance (see Guide D7209).

1.2 The properties included in this classification are those required to identify the compositions covered. It is possible that other requirements are necessary to identify particular characteristics important to specialized applications. The use of suffixes as shown in Section 5 is one way of specifying these requirements.

1.3 This classification system and subsequent line callout (specification) are intended to provide a means of calling out plastic materials used in the fabrication of end items or parts. It is not intended for the selection of materials. Material selection needs to be made by those having expertise in the plastic 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 costs involved, and the inherent properties of the material other than those covered by this classification.

1.4 The following precautionary caveat pertains only to the test method 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.*

NOTE 1—This standard and ISO 28078 address the same subject matter,

<sup>1</sup> This classification system is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials (Section D20.15.17).

Current edition approved Dec. 1, 2011. Published January 2012. Originally approved in 1998. Last previous edition approved in 2006 as D6358 - 06. DOI: 10.1520/D6358-11.

but differ in technical content.

NOTE 2—ASTM D4067 for PPS uses ASTM test methods.

## 2. Referenced Documents

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

- D618 Practice for Conditioning Plastics for Testing
- D883 Terminology Relating to Plastics
- D1600 Terminology for Abbreviated Terms Relating to Plastics
- D3641 Practice for Injection Molding Test Specimens of Thermoplastic Molding and Extrusion Materials
- D3892 Practice for Packaging/Packing of Plastics
- D4000 Classification System for Specifying Plastic Materials
- D4067 Classification System for and Basis for Specification for Reinforced and Filled Poly(Phenylene Sulfide) (PPS) Injection Molding and Extrusion Materials Using ASTM Methods
- 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

### 2.2 IEC and ISO Standards:<sup>3</sup>

- IEC 60112 Recommended Methods for Determining the Comparative Tracking Index of Solid Insulation Materials
- IEC 60243 Recommended Methods for Electric Strength of Solid Insulating Materials at Power Frequencies
- ISO 62 Plastics—Determination of Water Absorption
- ISO 178 Plastics—Determination of Flexural Properties of Rigid Plastics
- ISO 180/1A Plastics—Determination of Izod Impact Strength of Rigid Materials
- ISO 294-1 Plastics—Injection Moulding Test Specimens of Thermoplastic Materials
- ISO 527 Plastics—Determination of Tensile Properties
- ISO 604 Plastics—Determination of Compressive Properties

<sup>2</sup> 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.

<sup>3</sup> *ISO and IEC Selected Standards for the Plastics Industry, 2nd Edition*, ASTM, Stock#: ISOPLAS2.

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

ISO 1133 Plastics—Determination of Mass Flow Rate and Melt Volume Flow Rate

ISO 1183 Plastics—Methods for Determining the Density and Relative Density of Noncellular Plastics

ISO 3167 Plastics—Multipurpose Test Specimens

ISO 3451 Plastics—Determination of Ash

ISO 11443 Plastics—Determination of the Fluidity of Plastics Using Capillary and Split Die Rheometers

ISO 28078 Plastics—Poly(phenylene sulfide) (PPS) Moulding and Extrusion Materials—Part 1: Designation System and Basis for Specifications

2.3 *UL Standards:*<sup>4</sup>

UL 94 Test for Flammability of Plastic Materials for Parts in Devices and Appliances

2.4 *NTIS Standards:*<sup>5</sup>

AD297457 Procedures and Analytical Method for Determining Toxic Gases Produced by Synthetic Compounds

2.5 *Military Standards:*<sup>6</sup>

MIL-M-24519

MIL-P-46174

### 3. Terminology

3.1 *Definitions*—The terminology used in this classification system is in accordance with Terminology D883 and Terminology D1600.

### 4. Classification

4.1 Poly(phenylene sulfide) materials are classified according to their composition. These classes are subdivided into grades as shown in the Basic Property Table (Table PPS).

NOTE 3—An example of the use of this classification system for specifying fiberglass reinforced poly(phenylene sulfide) is given as follows: The line callout PPS011G40 (specification) indicates the following:

PPS	=	poly(phenylene sulfide) as found in Terminology D1600.
01	=	general purpose (group),
1	=	glass reinforced (class), and
G40	=	nominal 40 % glass with the requirements given in Table PPS (grade).

4.1.1 To facilitate incorporation of future or special materials the “other” category for group (00), class (0), and grade (0) is shown in Table PPS. The basic properties of these materials are obtained from Table A as they apply.

4.2 Reinforced, filled, and unfilled versions of poly(phenylene sulfide) materials that are not in Table PPS are specified in accordance with Tables PPS, A, and B. Table PPS is first used to identify the group and class of poly(phenylene sulfide). Table A is then used to specify the property requirements after the addition or reinforcements, pigments, fillers, or lubricants at the nominal level indicated (see 4.2.1) or Table B is used to specify the property requirements of unfilled/unreinforced versions of poly(phenylene sulfide).

<sup>4</sup> Available from Underwriters Laboratories (UL), 2600 N.W. Lake Rd., Camas, WA 98607-8542, <http://www.ul.com>.

<sup>5</sup> Available from National Technical Information Service (NTIS), 5301 Shawnee Rd., Alexandria, VA 22312, <http://www.ntis.gov>.

<sup>6</sup> Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://dodssp.daps.dla.mil>.

4.2.1 Reinforced versions of the basic materials are identified by a single letter that indicates the reinforcement used and two digits that indicate the nominal quantity in percent by weight. Thus, a letter designation G for glass-reinforced and 30 for percent of reinforcement, G30, specifies a filled material with a nominal glass level of 30 %. The reinforcement letter designations and associated tolerance levels are shown as follows:

Symbol	Material	Tolerance (Based on Total Mass)
C	carbon and graphite fiber reinforced	±2 percentage points
G	glass-reinforced	±3 percentage points
L	lubricants (such as PTFE, graphite, silicone)	depends upon material and process. to be specified by supplier/user agreement.
M	mineral-reinforced	±3 percentage points
R	combinations of reinforcements or fillers, or both	±3 percentage points

NOTE 4—This part of the classification system uses the percent of reinforcements or additives, or both, in the callout (specification) of the modified basic material. The types and percentages of reinforcements and additives are usually shown on the supplier’s technical data sheet unless they are proprietary in nature. If necessary, additional callout of these reinforcements and additives are to be accompanied by use of the suffix part of the system (see Section 5).

4.2.2 Specific requirements for reinforced, filled, or lubricated poly(phenylene sulfide) materials shall be identified by using a six-character line callout. The specification shall consist of the letter “A” and the five digits comprising the cell number for the property requirements in the order as they appear in Table A.

4.2.2.1 Although the values listed are necessary to include the range of properties available in existing materials, this does not infer that every possible combination of the properties exists or can be obtained.

4.2.3 When the grade of the basic material is not known, or is not important, the use of the “0” grade classification shall be used for the reinforced materials in this system.

NOTE 5—An example of a specification for a reinforced PPS material is given as follows. The specification PPS0110G20A31042 indicates the following material requirements:

PPS0110	=	Glass reinforced poly(phenylene sulfide), from Table PPS,
G20	=	Glass reinforced at 20 % nominal,
A	=	Table A property requirements,
3	=	110 MPa tensile strength, min,
1	=	6000 MPa flexural modulus, min,
0	=	Unspecified Izod strength,
4	=	160 MPa flexural strength, min, and
2	=	$1.5 \times 10^3$ kg/m <sup>3</sup> density, min.

If no properties are specified, the designation would be PPS010G20A00000.

NOTE 6—An example of a specification for an unfilled/unreinforced PPS material is given as follows. The designation PPS0000B32030 indicates the following material requirements:

PPS0000	=	unfilled/unreinforced poly(phenylene sulfide), from Table PPS,
B	=	Table B property requirements,
3	=	60 MPa tensile strength, min,
2	=	2000 MPa flexural modulus, min,
0	=	unspecified Izod strength,
3	=	80 MPa flexural strength min, and
0	=	unspecified.

If no properties are specified, the designation would be PPS0000B00000.

## 5. Suffixes

5.1 When additional requirements are needed that are not covered by the basic requirements or cell-table requirements, they shall be indicated through the use of suffixes.

5.2 A list of suffixes is found in Classification System **D4000** (Table 3) and shall be used for additional requirements as appropriate. Additional suffixes will be added to that standard as test methods and requirements are developed and requested.

## 6. General Requirements

6.1 Basic requirements from the property tables or cell tables are always in effect unless superseded by specific suffix requirements, which always take precedence.

6.2 The plastics composition shall be uniform and shall conform to the requirements specified herein.

## 7. Detail Requirements

7.1 The materials shall conform to the requirements in Table PPS, A, and B, and suffix requirements as they apply.

7.2 For purposes of determining conformance, all specified limits for a specification (line callout) based on this classification system are absolute limits, as defined in Practice **E29**. With the absolute method, an observed value or a calculated value is not rounded, but is to be compared directly with the limiting value. Conformance or nonconformance is based on this comparison.

## 8. Sampling

8.1 Sampling shall be adequate statistically to satisfy the requirements of **12.4**.

8.2 A batch or lot shall be constituted as a unit of manufacture as prepared for shipment and may consist of a blend of two or more “production runs.”

## 9. Specimen Preparation

9.1 Test specimens for relevant test methods shall be based on the injection molded ISO 3167 Type 1A multipurpose test specimen. The following specimens are to be used for the listed relevant test methods (tolerances are found in ISO 3167). All test specimens are to be tested as molded and conditioned. Annealing is not allowed.

Test Piece	Relevant Test Method
ISO 3167 Type 1A bar	Tensile strength
80 by 10 by 4-mm bar cut from the center portion of ISO 3167 Type 1A	Flexural modulus, Izod impact, Flexural strength
Specimen approximately 10 by 10 by 4-mm cut from the center portion of ISO 3167 Type 1A	Density

9.2 The test specimens shall be prepared by an injection molding process as specified in ISO 294-1 and Practice **D3641**. Accurate, reproducible settings of the processing parameters are essential to obtain specimens with comparable properties. Processing conditions are:

Drying	2 h at 135°C
Plastic melt temperature	320°C
Mold temperature	140°C
Average injection velocity	275 ± 75 mm/s

## 10. Conditioning

10.1 Test specimens shall be conditioned for a minimum of 4 h at  $23 \pm 2^\circ\text{C}$  and  $50 \pm 10\%$  relative humidity before performing the required tests.

10.2 Conduct those tests influenced by ambient conditions in the standard laboratory atmosphere of  $23 \pm 2^\circ\text{C}$  and  $50 \pm 10\%$  relative humidity in accordance with Practice **D618** (4/23/50).

## 11. Test Methods

11.1 Determine the properties enumerated in this classification system in accordance with the test methods in **2.1**.

11.1.1 The number of tests shall be consistent with the requirements of Sections **8** and **12.4**.

## 12. Inspection and Certification

12.1 Inspection and certification of the material supplied with reference to a specification based on this classification system shall be for conformance to the requirements specified herein.

12.2 Lot-acceptance inspection shall be the basis on which acceptance or rejection of the lot is made. The lot-acceptance inspection shall consist of apparent shear viscosity (Test Method ISO 11443) or flow rate (Test Method ISO 1133); reinforcement or filler content (reinforced and filled products only) (Test Method ISO 3451); and, tensile strength (reinforced and filled products only) (Test Method ISO 527).

12.3 Periodic check inspection with reference to a specification based upon this classification system shall consist of the tests for all requirements of the material under the specification. Inspection frequency shall be adequate to ensure the material is certifiable in accordance with **12.4**.

12.4 Certification shall be that the material was manufactured by a process in statistical control; sampled, tested, and inspected in accordance with this classification system; and that the average values for the lot meet the requirements of the specification (line callout).

12.5 A report of test results shall be furnished when requested. The report shall consist of results of the lot-acceptance inspection for the shipment and, if requested, shall include the results of the most recent periodic-check inspection. If requested, the report shall also include that recycled, reconstituted, recycled-regrind, recovered or reprocessed, or both, poly(phenylene sulfide) plastic was used and the nominal weight percent.

## 13. Packaging, Packing, and Marking

13.1 The provisions of Practice **D3892** apply to packaging, packing, and marking of containers for plastic materials.

## 14. Keywords

14.1 line callout; plastic materials; poly(phenylene sulfide); recycled