



Designation: D 4067 – 96

Standard Specification for Reinforced and Filled Polyphenylene Sulfide (PPS) Injection Molding and Extrusion Materials¹

This standard is issued under the fixed designation D 4067; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers reinforced and filled polyphenylene sulfide materials suitable for injection molding and extrusion.

1.2 This specification is not intended for the selection of materials, but only as a means to call out plastic materials to be used for the manufacture of parts. The selection of these materials is to be made by personnel with expertise in the plastics field where the environment, inherent properties of the materials, performance of the parts, part design, manufacturing process, and economics are considered.

1.3 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 specific applications. These will be agreed upon between the user and the supplier by using the suffixes as given in Section 5.

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

1.5 This precautionary statement pertains only to the test method portion of this specification, section 13. *This standard does not purport to address all of the safety concerns 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.*

2. Referenced Documents

2.1 ASTM Standards:

D 149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies²

D 150 Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials²

D 256 Test Methods for Impact Resistance of Plastics and Electrical Insulating Materials³

D 257 Test Methods for DC Resistance or Conductance of Insulating Materials²

D 495 Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation²

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing³

D 638 Test Method for Tensile Properties of Plastics³

D 648 Test Method for Deflection Temperature of Plastics Under Flexural Load³

D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials³

D 792 Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement³

D 883 Terminology Relating to Plastics³

D 1600 Terminology for Abbreviated Terms Relating to Plastics³

D 1897 Practice for Injection Molding Test Specimens of Thermoplastic Molding and Extrusion Materials³

D 1898 Practice for Sampling of Plastics³

D 3418 Test Method for Transition Temperatures of Polymers by Thermal Analysis⁴

D 3892 Practice for Packaging/Packing of Plastics⁴

D 4000 Classification System for Specifying Plastic Materials⁴

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specification⁵

E 595 Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment⁶

E 662 Test Method for Specific Optical Density of Smoke Generated by Solid Materials⁷

F 814 Test Method for Specific Optical Density of Smoke Generated by Solid Materials for Aerospace Applications⁶

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 (Section D20.15.17).

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² *Annual Book of ASTM Standards*, Vol 10.01.

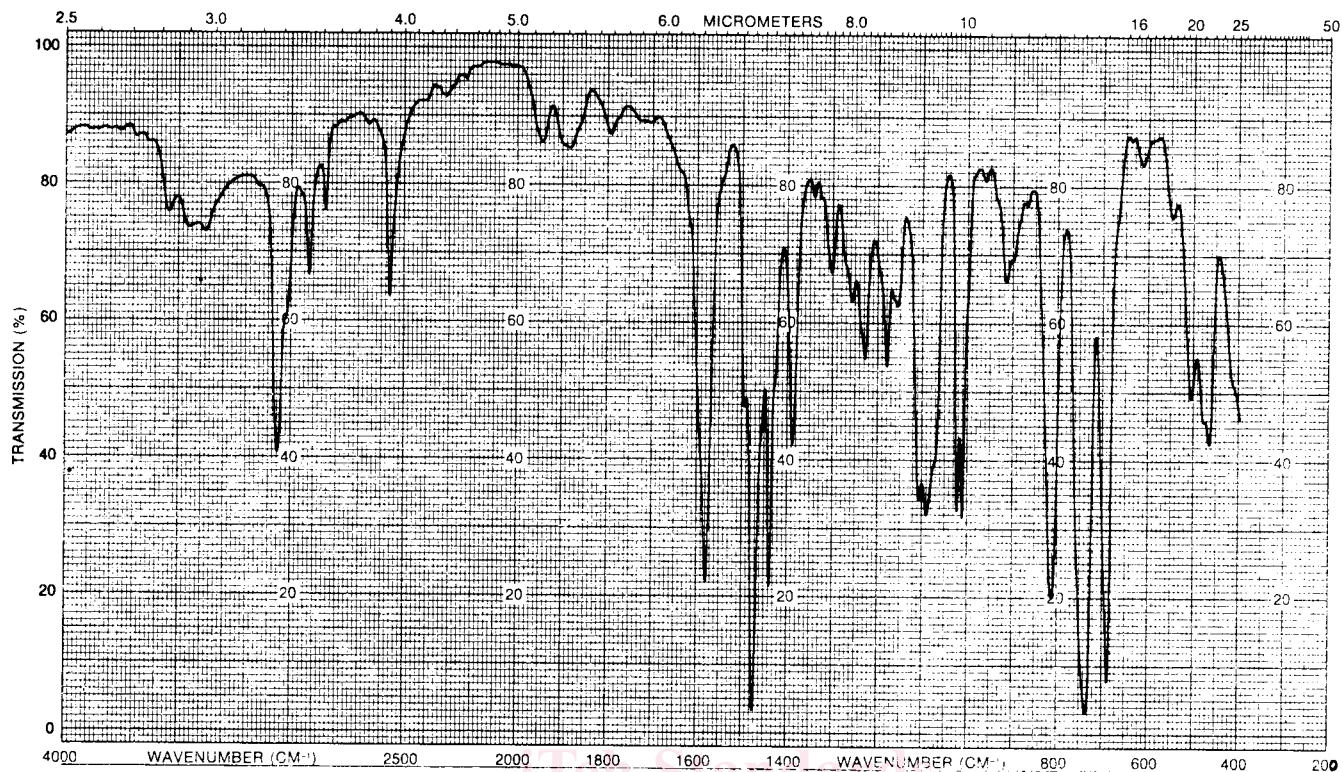
³ *Annual Book of ASTM Standards*, Vol 08.01.

⁴ *Annual Book of ASTM Standards*, Vol 08.02.

⁵ *Annual Book of ASTM Standards*, Vol 14.02.

⁶ *Annual Book of ASTM Standards*, Vol 15.03.

⁷ *Annual Book of ASTM Standards*, Vol 04.07.



Phase—Liquid
 Cell thickness—0.025 mm
 Sample—Pyrolyzate
 Prism—NaCl

FIG. 1 Infrared Spectrum of Polyphenylene Sulfide Pyrolyzate

TABLE 1 Detail Requirements

Property	Condition ^A	Units	A	B	C	D	E	F	G	H	I
Dielectric constant ^B max	E-48/50 + D24/23										
1 KHz	E-48/50 + D24/23		4.0	4.0	4.2	4.5	4.8	5.3	6.8	5.8	9.0
1 MHz	E-48/50 + D24/23		4.0	4.0	4.1	4.4	4.5	4.8	6.3	6.3	9.0
Dissipation factor ^B max	E-48/50 + D24/23										
1 KHz	E-48/50 + D24/23		0.002	0.002	0.004	0.008	0.02	0.08	0.10	0.10	0.10
1 MHz	E-48/50 + D24/23		0.007	0.007	0.007	0.010	0.02	0.01	0.03	0.03	0.10
Volume resistivity ^C , min	C-24/23/50	ohm-cm	1×10^{16}	1×10^{14}	1×10^{16}	1×10^{14}	1×10^{15}	1×10^{15}	1×10^{15}	1×10^{15}	1×10^{14}
Dielectric strength ^D , min	E-48/50 + 96/23/50	KV/mm (Y/mil)	14.6 (375)	14.6 (375)	13.6 (350)	11.7 (300)	11.7 (300)	11.7 (300)	11.7 (300)	11.7 (300)	11.7 (300)
Arc resistance ^E , min		second	30	10	30	0	150	150	150	180	150
Comparative tracking index ^A		Y	130	130	130	130	200	200	150	230	200
^F min											

^A In accordance with Methods D 618.

^B ASTM Test Method D 150.

^C ASTM Test Method D 257.

^D ASTM Test Method D 149.

^E ASTM Test Method D 495.

^F UL Method 746A.

2.2 Military Standards:⁸

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes

MIL-P-46174 (MR) Plastic Molding Material, Polyphenylene Sulfide, Glass Fiber Reinforced

MIL-M-24519 Molding Plastics, Electrical, Thermoplastic

2.3 Underwriters Laboratories:⁹

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

UL Standard 746A Polymeric Materials—Short-Term Property Evaluation

⁸ Available from Standardization Documents, Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

⁹ Available from Underwriters Laboratories, Inc. Publications Stock, 333 Pfingsten Road, Northbrook, IL 60062.



TABLE A Physical Property Requirements

Designation Order	Property/ASTM Test Method	Units	0	1	2	3	4	5	6	7	8	9
1	Tensile strength, min D 638 ^A	MPa ^B	C	60	80	110	120	130	160	180	200	D
2	Flexural modulus, min D 790 ^E	MPa ^B	C	7 000	10 000	12 000	14 000	17 000	20 000	23 000	26 000	D
3	Izod impact strength, min D 256 ^F	J/m ^G	C	28	40	52	70	80	90	100	110	D
4	Flexural strength, min D 790 ^E	MPa ^B	C	85	105	135	165	195	225	255	285	D
5	Density, min D 792	g/cm ³	C	1.40	1.50	1.60	1.70	1.80	1.90	2.0	2.10	D

^A Type I or type IV specimens, 3.18 mm thickness, crosshead speed of 5 mm/min. Values in Table A were generated using type IV specimens.
^B MPa × 145 = psi.
^C Unspecified.
^D Specific value (must be shown).
^E Test specimens are 3.18 by 12.7 mm and tested by Method I, Procedure A (Tangent) with crosshead speed of 1.3 mm/min ± 50 % with a span to depth ratio of 16/1.
^F Test specimens are 3.18 mm thick with a notch radius of 0.25 mm and tested by Method A.
^G J/m × 18.73 × 10⁻³ = ft-lbf/in.

3. Terminology

3.1 Definitions:

3.1.1 The definitions used in this specification are in accordance with Terminology D 883 and Terminology D 1600.

4. Classification

4.1 There is currently no group, class, or grade distinction and no basic property table is given.

NOTE 1—Where no basic property table exists, the generic family designation will be followed by three zeros, for example: PPS 000.

4.1.1 Table A shall be used to specify the physical property requirements which shall be shown by a six-character designation. The designation shall consist of the letter A and the five digits comprising the cell numbers for the property requirements in the order as they appear in Table A.

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

4.2 A single letter shall be used to indicate the major category of the reinforcement, along with two numbers that indicate the percentage of additive(s) by mass, with the tolerances as tabulated below:

Category	Material	Tolerance (Based on the total mass)
C	Carbon and graphite fiber-reinforced	±2 percentage points
G	Glass-reinforced ≤15 % glass content	±2 percentage points ±3 percentage points
L	Lubricants (such as PTFE, graphite, silicone, and molybdenum disulfide)	By agreement between the supplier and the user.
M	Mineral-reinforced	±2 percentage points
R	Reinforced-combination/mixtures of reinforcements or other fillers/reinforcements.	±3 percentage points based on the total reinforcement.

NOTE 2—This part of the system uses the type and percentage of additive to designate the modification of the basic material. To facilitate this designation, the type and percentage of additive can be shown on the suppliers technical data sheet unless it is proprietary in nature. If necessary, additional requirements shall be indicated by the use of the suffix part of the system, as given in Section 5. Special agreements on tolerances may be needed below 5 % levels.

NOTE 3—An example of this classification system for a polyphenylene sulfide material is as follows: The designation PPS000G40A42043 would indicate the following material requirements from Table A:

- PPS000 = polyphenylene sulfide material,
- G40 = glass-reinforced at 40 % nominal level,
- A = Table A physical property requirements,
- 4 = tensile strength, min 120 MPa,

- 2 = flexural modulus, min 10 000 MPa,
- 0 = unspecified,
- 4 = flexural strength, min 165 MPa, and
- 3 = density, min 1.60 g/cm³.

If no properties are specified, the designation would be PPS000G40A00000.

5. Suffixes

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

E = Electrical requirements as designated by the following digits:

First Digit

0 = Specimen to be specified by user

Second Digit

- 0 = To be specified by user
- 1 = Meets Requirements, Table 1, Column A
- 2 = Meets Requirements, Table 1, Column B
- 3 = Meets Requirements, Table 1, Column C
- 4 = Meets Requirements, Table 1, Column D
- 5 = Meets Requirements, Table 1, Column E
- 6 = Meets Requirements, Table 1, Column F
- 7 = Meets Requirements, Table 1, Column G
- 8 = Meets Requirements, Table 1, Column H
- 9 = Meets Requirements, Table 1, Column I
- F = Flammability requirements as designated by the following digits:

First Digit

- 0 = to be specified by user
- 1 = product is tested according to UL 94 at 3.05 mm minimum thickness
- 2 = product is tested according to UL 94 at 1.47 mm minimum thickness
- 3 = product is tested according to UL 94 at 0.71 mm minimum thickness

Second Digit

- 0 = to be specified by user
- 1 = UL 94V-0 flammability class
- 2 = UL 94V-1 flammability class
- 3 = UL 94V-2 flammability class
- 4 = UL 94-5V flammability class

NOTE 4—**Precaution:** By publication of this specification and its use of flammability ratings, ASTM does not intend that their use in any way reflects hazards presented under actual fire conditions.

Y = Heat deflection temperature as designated by the following digits:

First Digit

1 = Test Method D 648, 1820 kPa

Second Digit

1 = minimum of 260°C—High heat deflection temperatures may be