



Designation: D 6394 – 02

## Standard Specification for Sulfone Plastics (SP)<sup>1</sup>

This standard is issued under the fixed designation D 6394; 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 specification covers the classification of sulfone plastics suitable for injection molding and extrusion.

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 will be specified by using the suffixes in Section 5.

1.3 This specification is intended to be a means of calling out sulfone plastics used in the fabrication of end items or parts. 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, and the inherent properties of the material other than those covered by this specification.

1.4 Sulfone polymers, being thermoplastic, are reprocessable and recyclable. This specification allows for the use of those sulfone polymer materials, provided that any specific requirements are met.

1.5 The following safety hazards caveat pertains only to the test method portion, Section 11, of this standard: *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—Reference Guide D 5033 for information and definitions related to recycled plastics.

NOTE 2—There is no equivalent or similar ISO standard.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

D 256 Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics<sup>2</sup>

D 618 Practice for Conditioning Plastics for Testing<sup>2</sup>

D 638 Test Method for Tensile Properties of Plastics<sup>2</sup>

D 648 Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position<sup>2</sup>

D 789 Test Methods for Determination of Relative Viscosity and Moisture Content of Polyamide (PA)<sup>2</sup>

D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials<sup>2</sup>

D 792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement<sup>2</sup>

D 883 Terminology Relating to Plastics<sup>2</sup>

D 1238 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer<sup>2</sup>

D 1600 Terminology for Abbreviated Terms Relating to Plastics<sup>2</sup>

D 3641 Practice for Injection Molding Test Specimens of Thermoplastic Molding and Extrusion Materials<sup>3</sup>

D 3892 Practice for Packaging/Packing of Plastics<sup>3</sup>

D 4000 Classification System for Specifying Plastic Materials<sup>3</sup>

D 4019 Test Method for Moisture in Plastics by Coulometric Regeneration of Phosphorus Pentoxide<sup>3</sup>

D 5033 Guide for Development of ASTM Standards Relating Recycling and Use of Recycled Plastics<sup>4</sup>

D 5630 Test Method for Ash Content in Thermoplastics<sup>4</sup>

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications<sup>5</sup>

#### 2.2 ISO Standards:<sup>6</sup>

ISO 1628-1 Determination of the Viscosity of Polymers in Dilute Solution Using Capillary Viscometer—Part 1: General Principles

ISO 1628-5 Determination of the Viscosity of Polymers in Dilute Solution Using Capillary Viscometers

### 3. Terminology

3.1 Except for terms defined below, the terminology used in this specification is in accordance with Terminologies D 883 and D 1600.

<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.

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<sup>2</sup> Annual Book of ASTM Standards, Vol 08.01.

<sup>3</sup> Annual Book of ASTM Standards, Vol 08.02.

<sup>4</sup> Annual Book of ASTM Standards, Vol 08.03.

<sup>5</sup> Annual Book of ASTM Standards, Vol 14.02.

<sup>6</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

**3.2 Definitions of Terms Specific to This Standard:**

3.2.1 *sulfone plastics, n*—plastics based on any of various aromatic polymers which contain diphenyl sulfone in the backbone of the repeating unit of the molecule.

3.2.1.1 *Discussion*—All of the sulfone polymers which are under this specification contain ether oxygen which is a necessary component of the polymers as in the diphenyl sulfone moiety. Examples of moieties which can be part of the backbone of the repeating unit, in addition to diphenyl sulfone, are diphenyl isopropylidene, and biphenyl. Blends of these polymers can exist as well as co- and ter-polymers. Commercial polymers that are members of this class of thermoplastics include polysulfone (PSU), polyether sulfone (PES), and polyphenylsulfone (PPSU) (see Fig. 1).

**4. Classification**

4.1 Unreinforced sulfone plastics are classified into groups according to their composition. These groups are subdivided into classes and grades as shown in Table SP.

NOTE 3—An example of this designation system is given below. The designation SP0213 indicates the following:

- SP = sulfone plastics as defined in Section 3,
- 02 (Group) = polyether sulfone, as defined in Terminology D 1600,
- 1 (Class) = high temperature, and
- 3 (Grade) = minimum requirements given in Table SP.

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 SP. The basic properties of these materials can be obtained from Table A as they apply.

4.2 Reinforced, filled, and lubricated versions of sulfone plastics that are in Table SP are classified in accordance with Tables SP and A. Table SP is used to specify the group of sulfone plastics and Table A is used to specify the property requirements after the addition of reinforcements, pigments, fillers, or lubricants at the nominal level indicated (see 4.2.1).

4.2.1 *Reinforcements and Additive Materials*—A symbol (single-letter) is used for the major reinforcement or combination, or both, along with two numbers which indicate the percentage of addition by mass with the tolerances tabulated as follows:

Symbol	Material	Tolerance
C	Carbon and graphite fiber reinforced	± 3 %
G	Glass fiber reinforced	± 3 %
L	Lubricants	Depends upon the material and process—to be specified
M	Mineral reinforced	± 3 %
R	Combination of reinforcements or fillers, or both	± 3 %

NOTE 4—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 should be shown on the supplier’s technical data sheet unless they are proprietary in nature. If necessary, additional callout of these reinforcement and additives can be accomplished by use of the suffix part of the system (see Section 5).

4.2.2 Specific requirements for reinforcement, filled, or lubricated sulfone plastics shall be shown by a six-character designation. The designation will consist of the letter “A” and the five digits comprising the cell numbers for 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, users should 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 “0” grade shall be used for the reinforced materials in this system.

NOTE 5—An example of this classification for a reinforced sulfone plastics material is given as follows. The designation SP0213G30A43460 would have the following material requirements:

- SP0213 = poly(ether sulfone) with minimum requirements given in Table SP,
- G30 = glass reinforced at the 30 % nominal level,
- A = Table A property requirements,
- 4 = tensile strength, 95 MPa a minimum,
- 3 = flexural modulus, 4.5 GPa minimum,
- 4 = Izod impact, 50 J/m minimum,
- 6 = deflection temperature, 200°C minimum, and
- 0 = unspecified.

If no properties are specified, the designation would be SP0213G30A00000.

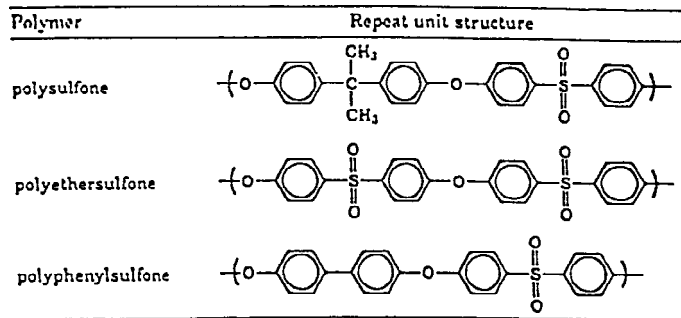
**5. Suffixes**

5.1 Suffixes that may be used are listed in Table 3 of Classification D 4000.

5.2 If the requirements for the poly(ether sulfone) material in 4.2.3 also included flammability requirements, the following example indicates the call-out:

SP0213G30A43460FL310

- SP0213G30A43460 = same as in 4.2.3.
- From Table 3 in Classification D 4000 the following is obtained:
- F = flammability requirements,
- L = UL94 recognition required,
- 3 = 0.8 mm minimum thickness,
- 1 = vertical burn test, and
- 0 = V-0 rating.



**FIG. 1 Repeat Unit Structure**