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Standard Specification for Sulfone Plastics (SP)[1]

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 (ε) 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~~ Other requirements necessary to identify particular characteristics important to specialized ~~applications. These will~~applications are to be specified by using the suffixes in Section 5. See Guide D 5740.

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~~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 cost involved, 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 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.*

NOTE ~~1—Reference Guide D5033~~ 1—Reference Guide D 7209 for information and definitions related to recycled plastics.

NOTE ~~2—There is no equivalent or similar ISO standard.~~ 2—ISO 25137 is similar in subject matter but not equivalent to this specification.

[1] 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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***A Summary of Changes section appears at the end of this standard.**

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D 256 Test Methods for Determining the Izod Pendulum 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 1238 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
D 1600 Terminology for Abbreviated Terms Relating to Plastics
D 3641 Practice for Injection Molding Test Specimens of Thermoplastic Molding and Extrusion Materials
D 3801 Test Method for Measuring the Comparative Burning Characteristics of Solid Plastics in a Vertical Position
D 3892 Practice for Packaging/Packing of Plastics
D 4000 Classification System for Specifying Plastic Materials ~~D5033Guide for Development of ASTM Standards Relating to Recycling and Use of Recycled Plastics~~
D 5630 Test Method for Ash Content in Plastics
D 5740 Guide for Writing Material Standards in the Classification D 4000 Format
D 6869 Test Method for Coulometric and Volumetric Determination of Moisture in Plastics Using the Karl Fischer Reaction (the Reaction of Iodine with Water)
D 7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products
E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
~~2.2~~
2.2 *Unwriters' Laboratories Standards:*
UL94 Standard for Tests for Flammability of Plastic Materials[3]
2.3 *ISO Standards:*
~~ISO 1628-1Determination of the Viscosity of Polymers in Dilute Solution Using Capillary Viscometer—Part 1: General Principles~~ [4]
ISO 25137-1 Sulfone Polymer moulding and Extrusion Materials—Part 1: Designation System and Basis for Specification
~~ISO 1628-5Determination of the Viscosity of Polymers in Dilute Solution Using Capillary Viscometers~~ ISO 25137-2 Sulfone Polymer Moulding and Extrusion Materials—Part 2: Preperation of Test Specimens and Determination of Properties

3. Terminology

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

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 (PESU), and polyphenylsulfone (PPSU) (see Fig. 1).

4. Classification

4.1 Unreinforced sulfone plastics are classified into groups in accordance with 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:

[2] 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.
~~[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.~~
[3] Available from Underwriters Laboratories (UL), 333 Pfingsten Rd., Northbrook, IL 60062-2096, http://www.ul.com.
[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

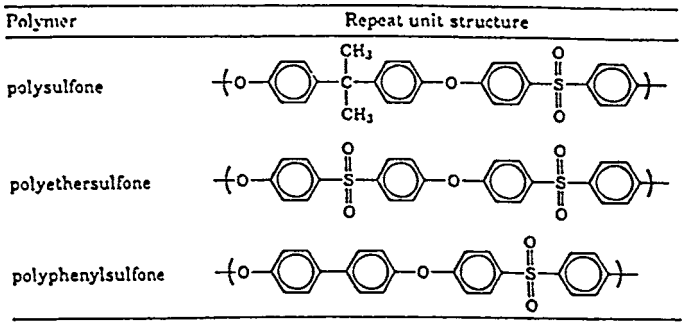

FIG. 1 Repeat Unit Structure

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~~	~~LubricantsDepends upon the material and process to be specified~~	~~Depends upon the material~~
L	Lubricants	Depends upon the material and process to be specified
M	Mineral reinforced	±3 %
R~~Combination of reinforcements or fillers, or both~~		Combination of reinforcements
	or fillers, or both	

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~~this does not ~~infer~~imply 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 SP0213<u>0</u>G30A43460 would have the following material requirements:

~~SP0213 = poly(ether sulfone) with minimum requirements given in Table SP,~~
SP0210 = poly(ether sulfone) from Table SP,
G30 = glass reinforced at the 30 % nominal level,
A = Table A property requirements,
4 = tensile strength, 95 MPa min,
3 = flexural modulus, 4.5 GPa min,
4 = Izod impact, 50 J/m min,
6 = deflection temperature, 200°C min, and
0 = unspecified.

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

5. Suffixes

~~5.1Suffixes that may be used are listed in Table 3 of Classification D4000.~~

~~5.2If the requirements for the poly(ether sulfone) material in~~

5.1 When additional requirements are needed for the materials covered in this specification that are not covered in Tables SP or A, then those requirements shall be designated through the use of suffixes.

5.1.1 A list of suitable suffixes are found in Table 3 of Classification D 4000.

5.2 Flammability callouts were changed in 2007. Therefore, callouts written before 2007 are different from those written in 2007 and later.

5.2.1 If the requirements for the poly(ether sulfone) material in 4.2.3 ~~also included flammability requirements, the following example indicates the callout:~~

also included flammability requirements, the following example indicates the callout based on D 4000 - 04:

~~SP0213G30A43460FL310~~
SP0210G30A43460FL310

~~SP0213G30A43460 = same as in 4.2.3.~~
SP0210G30A43460 = same as in 4.2.3.
~~From Table 3 in Classification D 4000 the following is obtained:~~
From Table 3 in Classification D 4000 - 04 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.

5.2.2 The following example illustrates the callout based on D 4000 - 07:

SP0210G30A43460FF003

SP0210G30A43460 = same as in 4.2.3.
From Table 3 in Classification D 4000 - 07 the following is obtained:
F = flammability requirements,
F= Vertical burn rate by D 3801 or UL94V,
0 = Rating of designation V-0,
03 = 0.8 mm minimum specimen thickness.

6. General Requirements

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

6.1 Basic requirements from the property table (Table SP) or cell table (Table A) are always in effect unless superseded by specific suffix requirements, which always take precedence. Properties in Table A supersede properties in Table SP.

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 respective requirements of Tables SP, A, and ~~suffix requirements~~the suffix 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 E 29.

7.2.1 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 statistically adequate to satisfy the requirements of 12.4.

8.2 A batch or lot shall be defined as a unit of manufacture as prepared for shipment and ~~may~~is permitted to consist of a blend of two or more production runs.

9. Specimen Preparation

9.1 The test specimens shall be prepared by injection molding process in accordance with Practice D 3641. Recommended processing conditions are shown in Table 1.

9.2 Before molding, the material shall be dried to a moisture level of no more than 0.05 % as determined by test methods described in ~~either~~ Test Method D 6869.

10. Conditioning

10.1 Test specimens shall be conditioned in the standard laboratory atmosphere in accordance with Procedure A of Practice D 618 for a minimum of ~~24~~4 h before performing the required tests.

10.2 Conduct those tests influenced by ambient conditions in the standard laboratory atmosphere of 23 ± 2°C and 50 ± ~~5%~~10 % relative humidity.