Designation: D6339 – 11

Standard Classification System for and Basis for Specifications for Syndiotactic Polystyrene Molding and Extrusion (SPS)[1]

This standard is issued under the fixed designation D6339; 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 classification system covers syndiotactic polystyrene materials including homopolymer, copolymers, blends, and impact modified, suitable for molding and extrusion. Recycled product will be addressed in a separate standard.

1.2 This classification system and subsequent line callout (specification) are intended to provide a means of calling out plastic materials used in fabrication of end use items or parts. It is not intended for the selection of matierials. 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 inherent properties of the material other than those covered by this classification system, and the economics.

1.3 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 called out using the suffixes given in Section 5.

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

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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
D1238 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
D1525 Test Method for Vicat Softening Temperature of 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
D5630 Test Method for Ash Content in Plastics
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

2.2 *Military Standard:*[3]

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

2.3 *ISO Standards:*[4]

ISO 75–1 and 2 Plastics: Determination of Temperature of Deflection Under Load
ISO 179–1 Determination of Charpy Impact Strength—Part 1: Non-Instrumented Impact Test
ISO 306 Plastics: Thermoplastic Materials-Determination of Vicat Softening Temperature (VST)
ISO 527–2 Plastics: Determination of Tensile Properties-Part 2: Test Conditions for Moulding and Extrusion Plastics
ISO 1133 Plastics—Determination of the Melt Mass-Flow Rate (MFR) and the Melt Volume-Flow Rate (MVR) of Thermoplastics
ISO 1183-1 Plastics: Methods for Determining the Density of Non-Cellular Plastics—Part 1: Immersion Method,

[1] 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.

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[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 Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://dodssp.daps.dla.mil.

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

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

Liquid Pyknometer Method and Titration Method
ISO 3451-1 Plastics: Determination of Ash-Part 1 General Methods

3. Terminology

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

4. Classification

4.1 Syndiotactic polystyrene materials are classified into groups according to their composition. These groups are subdivided into classes and grades as shown in the basic properties table, Table SPS. Injection molded properties are the preferred standard and are used for the basis of call out examples. Call outs are allowed to be made in either ASTM or ISO properties where both are given using the same line callout.

NOTE 2—An example of this classification system for SPS is as follows: For SPS0111, the designation SPS would indicate SPS = syndiotactic polystyrene, 01= homopolymer, 1 = general purpose, and 1 (grade) = minimum grade requirements as found in Table SPS.

4.1.1 To facilitate the incorporation of future or special materials the "Other/Unspecified" category (0) for group, class, and grade is shown in Table SPS. The basic properties can be obtained from Tables A or B as they apply (see 4.3).

4.2 Reinforced and filled syndiotactic polystyrene materials are classified in accordance with Table SPS as noted or with Table A.

4.2.1 *Reinforced and Additive Materials*—A single letter will be used for the major reinforcement or combination, or both, along with two digits that indicate the percentage of addition by mass with the tolerances as shown in Table 1.

NOTE 3—This part of the system uses the type and percentages of additive to designate the modification of the basic material. Percentage of additives can be shown on the supplier's Technical Data Sheet unless it is proprietary. If necessary, additional requirements shall be indicated by the use of the suffix part of the system, as given in Section 5.

NOTE 4—Determine ash content of filled or reinforced materials using Test Method D5630 or ISO 3451–1 where applicable.

4.2.2 *Table A, Detail Requirements*—An identifying number is made up of the letter A and five digits comprising the cell numbers for the new requirements in the designated 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, not every possible combination of the properties exists or can be obtained.

NOTE 5—Using Table SPS and Table A, an example of a reinforced syndiotactic polystyrene of this classification system is as follows: The designation would indicate material requirements from Table A as:

SPS0110G15A12332

where:

0110 = Homopolymer, Table SPS,
G15 = Glass-reinforced at 15 % nominal (see 4.2.1),
A = Table A for property requirements,
1 = Tensile strength 50 MPa,
2 = Flexural modulus or tensile modulus (ISO), 4000 MPa/min,
3 = Izod impact 70 J/m or 7 kJ/m^2 (Charpy ISO), minimum,
3 = Deflection temperature, 180°C, minimum, and
2 = Specific gravity, 1.2, minimum.

If no properties are specified, the designation would be SPS0110G15A00000.

4.3 Table B has been incorporated into this classification system to facilitate the classification of special materials where neither Table SPS nor Table A reflect the required properties. Table B shall be used in the same manner as Table A.

NOTE 6—An example of a special material using this classification system is as follows: The following designation would indicate material requirements from Table B as:

SPS0110B76013

where:

0110 = homopolymer from Table SPS,
B = Cell Table B for properties requirements,
7 = Tensile strength, 70 MPa, minimum,
6 = Tensile Modulus, 3500 MPa, minimum,
0 = Unspecified Izod impact/ISO Charpy impact,
1 = Vicat softening temperature, 80°C, minimum, and
3 = Flow rate, 3.0, minimum.

5. Suffix Requirements

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 can be found in Classification System D4000 (Table 3) and are to be used for additional requirements as appropriate. Additional suffixes will be added to that standard as test methods and requirments are developed and requested.

NOTE 7—Properties of pigmented or colored SPS materials can differ from the properties of natural or unpigmented SPS material, depending on the choice of colorants and the concentration. The main property affected is ductility, as illustrated by a reduction in Izod impact strength. If specific properties of pigmented SPS materials are necessary, prior testing between the materials supplier and end user should be initiated.

6. Basic Requirements

6.1 Basic requirements from Table SPS, as they apply, 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. General Requirements

7.1 The material composition shall conform to the requirements in Tables SPS. A, B, and suffix requirements as they apply.

8. Detail Requirements

8.1 Test specimens for the various materials shall conform to the requirements prescribed in Tables SPS, A, and B, and suffix requirements as they apply.

8.2 For the purpose of determining conformance, all specified limits for a specification (line callout) based on this classification system are absolute limits, as defined by Practice E29.

9. Sampling

9.1 Sampling shall be statistically adequate to satisfy the requirements of 13.4.

9.2 A batch or lot is construed as a unit of manufacture as prepared for shipment, and is allowed to consist of two or more production runs or batches.

10. Sample Preparation—Injection

10.1 The test specimens shall be molded by an injection molding process in accordance with Practice D3641 as follows:

10.1.1 Pre-drying of pellets is only required for blends of SPS. Four hours of drying at 200°C in a dryer with a dew point of –30°C is recommended for SPS/PA blends.

10.1.2 For injection-molded samples 290 ± 10°C shall be the melt temperature, and 100 ± 10°C or 160 ± 10°C for filled or reinforced materials, shall be the mold temperature.

10.1.2.1 Average injection velocity shall be 200 ± 100 mm/s, and can be calculated using the following equation:

$$AIV = \frac{\pi d^2\ Va}{4ns} \quad (1)$$

where:

d = screw diameter, mm
Va = screw advance speed, mm/s
n = number of mold cavities, and
s = cross-sectional area of test specimen, mm^2.

11. Conditioning

11.1 Test specimens shall be conditioned in the standard laboratory atmosphere in accordance with Procedure A of Practice D618 before performing the required tests. Blends shall be tested dry as molded.

11.2 Conduct tests in the standard laboratory atmosphere of 23 ± 2°C and 50 ± 10 % relative humidity in accordance with Practice D618.

12. Test Methods

12.1 Unless otherwise stated herein, determine the properties enumerated in this classification system by means of the following Test Methods as applicable: D256 or ISO 179; D638 or ISO 527; D648 or ISO 75; D790; D792 or ISO 1183; D1238 or ISO 1133; D1525 or ISO 306.

13. Inspection and Certification

13.1 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.

13.2 Lot-acceptance inspection shall be the basis on which acceptance or rejection of the lot is made. The lot-acceptance inspection shall consist of the following:

13.2.1 Tensile strength, and

13.2.2 Ash (filled products only).

13.3 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 this classification system. Inspection frequency shall be adequate to ensure material is certifiable in accordance with 13.4.

13.4 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).

13.5 A report of the test results shall be furnished when requested. The report shall consist of results of the lot-acceptance inspection for the shipment and results of the most recent periodic-check inspection.

14. Packaging and Package Marking

14.1 For packing, packaging, and marking, the provisions of Practice D3892 apply.

15. Keywords

15.1 plastics; syndiotactic polystyrene

TABLE SPS Materials, Detail Requirement, Natural Color Only

Group	Description	Class	Description	Grade	MFR[A]	Tensile Strength,[B] MPa		Flexural Modulus,[C] MPa	Tensile Modulus,[D] MPa	DTUL, °C, 1.8 MPa[E]		Specific Gravity[F]	Izod[G]	Charpy[H]
						ASTM	ISO	ASTM	ISO	ASTM	ISO		ASTM J/m	ISO kJ/m^2
01	Homopolymer	1	General purpose	1	7	40	40	3900	3300	105		1.05	15	2
				2	3	40	40	3900	3500	105		1.05	15	2
				0										
				G30	...	95	100	9200	9000	210	220	1.25	70	9
				G40	...	110	110	11 400	11 000	225	240	1.32	100	10
		0	Other	00	...									
		2	Impact modified	1	5	30	30	2600	2400	90	80	1.02	120	10
				G20	...	80	85	6800	6800	180	200	1.16	60	6
				G30	...	95	105	8000	8000	210	220	1.21	100	10
		0	Other	00	...									
02	Copolymer	1	General purpose	1	4	60	65	3500	3400	70	80	1.04	30	3
		0	Other	00										
03	Flame retardant	1	General purpose											
		0	Other	00	...									
		2	Impact modified	G10	...	50	60	5500	4800	100	110	1.29	55	4.5
				G20	...	80	85	6500	6500	190	200	1.32	70	7.5
				G30	...	110	125	9200	8500	215	220	1.39	80	8
				G40	...	110	125	11 500	11 000	230	240	1.50	140	12
		0	Other	00	...									
04	Blends	1	General Purpose	G10	20	...	90	...	4000	...	140	...	...	3
				G20	6	...	135	...	6500	...	230	...	...	6
				G30	13	...	135	...	9000	...	230	...	...	8
		0	Other	00										
		2	Impact Modified	G10	6	...	75	...	3400	...	130	...	...	8
		0	Other	00										
00	Other	0	Other	00										

[A]Test Methods D1238, 300/1.2 condition; ISO 1133, 300/1.2 condition.
[B]Test Methods D638, Type I specimen; ISO 527-2, Type 1A specimen.
[C]Test Methods D790, 3.2 by 12.7 mm specimen, 50 mm span, 1.3 mm/min cross-head rate, tangent.
[D]ISO 527–2, Type 1A specimen, 1.0 mm/min cross-head rate, chord—all dimensions within allowed.
[E]Test Methods D648, 1.82 MPa stress, 3.2 by 12.7 mm specimen, 100 mm support, edgewise; ISO 75-1 and 2, 1.8 MPa stress, 4 by 10 mm specimen, flat, 64 mm support - all dimensions within allowed tolerances in standards.
[F]Test Methods D792; ISO 1183.
[G]Test Methods D256, 3.2 by 12.7 mm specimen;
[H]ISO 179, 4 by 10 mm specimen—all dimensions within allowed tolerances in standards.

TABLE A Reinforced Materials—Detail Requirements

Designation Order Number	Injection Molded Properties	0	1	2	3	4	5	6	7	8	9
1	Tensile Strength,[A] min, MPa	unspecified	50	70	90	100	125	150	175	200	specify
2	Flexural Modulus,[B] min, or Tensile Modulus,[C] min, MPa	unspecified	3500	4000	4800	6000	7000	8000	10 000	13 000	specify
3	Izod Impact,[D] min, J/m	unspecified	40	60	70	80	90	100	120	150	specify
	Charpy Impact,[E] kJ/m^2	unspecified	3.5	6	7	8	9	10	12	15	
4	DTUL,[F] MPa, min °C	unspecified	100	130	180	210	225	245	260	280	specify
5	Specific Gravity,[G] min	unspecified	1.1	1.2	1.4	1.6	1.8	2.0	2.2	2.4	specify

[A]Test Method D638, Type I specimens.
[B]Test Methods D790, 3.2 by 12.7 mm (within allowed tolerances) specimen, 50 mm span, 1.3 mm/min cross-head rate, tangent modulus.
[C]Test Method ISO 527-2, Type 1A specimen, 1.0 mm/min cross-head rate, chord modulus.
[D]Test Methods D256, 3.2 by 12.7 mm (within allowed tolerances) specimen.
[E]ISO 179, 4 by 10 mm (within allowed tolerances) specimen.
[F]Test Method D648, deflection temperature under load, 1.82 MPa, 3.2 by 12.7 mm specimen (within allowed tolerances), 100 mm nominal support, edgewise orientation; ISO 75-1 and 2, 1.8 MPa, 64 mm support, flat orientation, 4 by 10 mm specimen (within allowed tolerances).
[G]Test Methods D792; ISO 1183.

TABLE B Unreinforced Materials—Detail Requirements

Designation Order Number	Injection Molded Properties	0	1	2	3	4	5	6	7	8	9
1	Tensile Strength,[A] min, MPa	unspecified	10	20	30	40	50	60	70	80	specify
2	Tensile Modulus,[A] min, MPa	unspecified	2300	2800	3200	3300	3400	3500	3600	3800	specify
3	Izod Impact,[B] min, J/m	unspecified	15	30	50	90	120	150	200	220	specify
	Charpy Impact,[C] kJ/m^2	unspecified	2	3	4	7	10	12	18	20	
4	Vicat Softening Point,[D] min, °C	unspecified	80	100	120	140	160	180	200	220	specify
5	Melt Flow Rate,[E] g/10 min	unspecified	0.5	1.0	3.0	5.0	7.0	9.0	12.0	15.0	specify

[A]Test Method D638, Type I specimen, tangent modulus; ISO 527-2, Type 1A specimen, chord modulus at 1.0 mm/min cross-head rate.
[B]Test Method D256, 3.2 by 12.7 mm (within allowed tolerances) specimen.
[C]ISO 179, 4 by 10 mm (within allowed tolerances) specimen.
[D]Test Methods D1525, rate B; ISO 306, rate B120.
[E]Test Methods D1238, 300/1.2 condition; ISO 1133, 300/1.2 condition.

TABLE 1 Reinforced and Additive Materials

Symbol	Material	Tolerance (Based on Total Mass)
C	Carbon and graphite fiber-reinforced	± 2 %
G	Glass	± 2 %
M	Mineral reinforced	± 2 %
L	Lubricants	depends upon material and process to be specified
R	Combination of reinforcement or fillers, or both	± 2 %

SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue, D6339 - 05, that may impact the use of this standard. (February 1, 2011)

(1) Revised title and scope to state classification system.
(2) Updated ISO equivalency statement.
(3) Removed permissive language in mandatory sections.
(4) Added references to D1600 and E29 in reference section and Sections 3 and 8, respectively.
(5) Clarified Section 5 on suffixes.