



Designation: D 6339 – 98

Standard Specification for Syndiotactic Polystyrene Molding and Extrusion (SPS)¹

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1. Scope

1.1 This specification covers syndiotactic polystyrene materials including homopolymer, copolymers and impact modified, suitable for molding and extrusion. Recycled product will be addressed in a separate standard.

1.2 This specification is intended to be a means of calling out plastic materials used in fabrication of end use 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, the inherent properties of the material other than those covered by this specification, and the economics.

1.3 The properties included in this specification are those required to identify the compositions covered. Other requirements necessary to identify particular characteristics important to specialized applications can be called out using the suffixes given in Section 5.

NOTE 1—There is no ISO equivalent.

2. Referenced Documents

2.1 ASTM Standards:

- D 256 Test Methods for Impact Resistance of Plastics and Electrical Insulating Materials²
- D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing²
- D 638 Test Method for Tensile Properties of Plastics²
- D 648 Test Method for Deflection Temperature of Plastics under Flexural Load²
- D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials²
- D 792 Test Methods for Specific Gravity (Relative Density) of Plastic by Displacement²
- D 883 Terminology Relating to Plastics²

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.

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² Annual Book of ASTM Standards, Vol 08.01.

D 1238 Test Methods for Flow Rate of Thermoplastics by Extrusion Plastometer²

D 1525 Test Method for Vicat Softening Temperature of Plastics²

D 1898 Practice for Sampling of Plastics²

D 3641 Practice for Injection Molding Test Specimens of Thermoplastic Molding and Extrusion Materials³

D 3892 Practice for Packaging/Packing of Plastic³

D 4000 Classification System for Specifying Plastic Materials³

D 5630 Test Method for Ash Content in Thermoplastics⁴

2.2 Military Standard:⁵

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

3. Terminology

3.1 *Definitions*—For definitions of technical terms pertaining to plastics used in this specification, see Terminology D 883.

4. Classification

4.1 Syndiotactic polystyrene materials are classified into groups according to classes and grades 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.

NOTE 2—An example of this classification system for SPS is as follows: For SPS0111, the designation SPS would indicate SPS = syndiotactic polystyrene = homopolymer = 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.

³ Annual Book of ASTM Standards, Vol 08.02.

⁴ Annual Book of ASTM Standards, Vol 08.03.

⁵ Available from Standardization Documents Order Desk, Bldg. 4 Section D, Philadelphia, PA, 199111-5094, Attn: PODS.

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—Ash content of filled or reinforced materials may be determined using Test Method D 5630 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, users should not infer that 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, 4000 MPa/min,
- 3 = Izod impact 80 J/m, minimum,
- 3 = Deflection temperature, 150°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 specification 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, 3600 MPa, minimum,
- 0 = Unspecified izod impact,
- 1 = Vicat softening temperature, 80°C, minimum, and
- 3 = Flow rate, 3.0, minimum.

5. Suffix Requirements

5.1 When requirements are needed that supersede or supplement the property table or cell table requirements they shall be specified through the use of suffixes. In general, the first suffix letter indicates the special requirements needed and the second letter indicates the condition or test method, or both, with a three-digit number indicating the specific requirement. The suffixes that may be used are listed in Table 3 of Classification D 4000.

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 these requirements are superseded by specific suffix requirements, which always take precedence.

7. General Requirements

7.1 The material composition shall be uniform and shall conform to the requirements specified herein.

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.

9. Sampling

9.1 Sampling shall be in accordance with the sampling procedure prescribed in Practice D 1898 or statistically adequate to satisfy the requirements of 13.4. A lot of material shall be considered as a unit of manufacture as prepared for shipment, and may 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 D 3641 as follows:

10.1.1 For injection-molded samples $290 \pm 10^\circ\text{C}$ is the melt temperature, and $100 \pm 10^\circ\text{C}$ or $160 \pm 10^\circ\text{C}$ when high crystallinity required, is the mold temperature.

10.1.1.1 Average injection velocity is 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,
- Va = screw advance speed,
- n = number of mold cavities, and
- s = cross-sectional area of test specimen.

11. Conditioning

11.1 Test specimens shall be conditioned in the standard laboratory atmosphere in accordance with Procedure A of Practice D 618 before performing the required tests.

11.2 Conduct tests in the standard laboratory atmosphere of $23 \pm 2^\circ\text{C}$ and $50 \pm 5\%$ relative humidity in accordance with Practice D 618.

12. Test Methods

12.1 Unless otherwise stated herein, determine the properties enumerated in this specification by means of the following

Test Methods as applicable: D 256; D 638; D 648; D 790; D 792; D 1238; D 1525.

13. Inspection and Certification

13.1 Inspection and certification of the material supplied under this standard specification 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 specification. 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 line callout specified.

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 D 3892 apply.

15. Keywords

15.1 plastics; syndiotactic polystyrene

TABLE SPS Materials, Detail Requirement, Natural Color Only

Group	Description	Class	Description	Grade	MFR ^A HL1	Tensile Strength, ^B MPa	Flexural Modulus, ^C MPa	DTUL, °C, 1.8 MPa ^D	Specific Gravity ^E	Izod, ^F J/m		
01	Homopolymer	1	General purpose	1	7	55	3900	105	1.05	15		
				2	3	60	3800	105	1.05	25		
		0	other	G10	---	70	5500	175	1.12	42		
				G20	---	90	6500	200	1.18	60		
				G30	---	120	9500	250	1.25	95		
				G40	---	130	10500	260	1.32	110		
				00	---							
				2	Impact modified	1	5	40	3000	90	1.02	80
						G10	---	60	4500	150	1.11	50
						G20	---	80	5500	200	1.16	85
		G30	---			100	7000	240	1.21	115		
		0	other	G40	---	115	9500	250	1.29	115		
				00	---							
		02	Copolymer	1	General purpose	1	4	60	3500	90	1.04	30
0	other			00								
03	Flame retardant	1	General purpose	G10	---	70	5700	170	1.15	30		
				G20	---	80	6700	190	1.26	35		
				G30	---	90	9500	240	1.32	40		
				G40	---	105	11000	250	1.42	50		
		0	other	00	---							
		2	Impact modified	G10	---	65	5500	170	1.18	55		
				G20	---	75	6500	190	1.26	60		
				G30	---	85	9200	245	1.32	65		
				G40	---	105	11500	250	1.40	75		
		0	other	00	---							
00	Other	0	other	00								

^ATest Methods D 1238, 300/1.2 condition.

^BTest Methods D 790, 3.2 by 12.7 mm specimen, 50 mm span, 1.3 mm/min cross-head rate.

^CTest Methods D 648, 1.82 MPa stress, 3.2 by 12.7 mm specimen.

^DTest Methods D 792.

^ETest Methods D 256, 3.2 by 12.7 mm specimen.

^FTest Methods D 638, Type I specimen.

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, MPa	unspecified	3500	4000	5000	6000	7,000	8,000	10,000	13,000	specify
3	Izod Impact, ^C min, J/m	unspecified	40	60	80	100	150	200	400	600	specify
4	DTUL, ^D MPa, min °C	unspecified	100	125	150	175	200	220	240	260	specify
5	Specific Gravity, ^E min	unspecified	1.1	1.2	1.4	1.6	1.8	2.0	2.2	2.4	specify

^ATest Method D 638, Type I specimens.

^BTest Methods D 790, 3.2 by 12.7 mm (within allowed tolerances) specimen, 50 mm span, 1.3 mm/min cross-head rate, tangent modulus.

^CTest Methods D 256, 3.2 by 12.7 mm (within allowed tolerances) specimen.

^DTest Method D 648, deflection temperature under load, 1.82 MPa.

^ETest Methods D 792.

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	2100	2400	2700	3000	3300	3600	3900	4200	specify
3	Izod Impact, ^B min, J/m	unspecified	10	25	50	100	150	200	250	300	specify
4	Vicat Softening Point, ^C min, °C	unspecified	80	100	120	140	160	180	200	220	specify
5	Melt Flow Rate, ^D g/10 min	unspecified	0.5	1.0	3.0	5.0	7.0	9.0	12.0	15.0	specify

^ATest Method D 638, Type I specimen.

^BTest Method D 256, 3.2 by 12.7 mm (within allowed tolerances).

^CTest Methods D 1525, rate B.

^DTest Methods D 1238, 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 %

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