



Standard Classification System and Basis for Specification for Styrene-Maleic Anhydride Molding and Extrusion Materials (S/MA)¹

This standard is issued under the fixed designation D4634; 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 U.S. Department of Defense.

1. Scope*

1.1 This classification system covers styrene-maleic anhydride materials suitable for molding or extrusion. This classification system does not apply to alloys or blends of styrene-maleic anhydride materials with non-elastomeric thermoplastics. Styrene-maleic anhydride materials, being thermoplastic, are reprocessable and recyclable. This classification system allows for the use of those materials provided that all the specific requirements of this classification system are met.

1.2 The properties included in this standard are those required to identify the compositions covered. Other requirements necessary to identify particular characteristics important to specialized applications are to be specified by using the suffixes as given in Section 5.

1.3 This classification system and subsequent line call out (specification) are intended to provide means of calling out properties of plastic materials used in the fabrication of end items or parts. It is not intended for the selection of materials. Materials should be selected 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, costs involved, and the inherent properties of the material other than those covered by this classification system.

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

1.5 The following precautionary caveat pertains only to the test methods portion, Section 11, of this classification system. *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—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 (Withdrawn 2016)³
- D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- D883 Terminology Relating to Plastics
- 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
- D7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products (Withdrawn 2015)³
- E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

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 The last approved version of this historical standard is referenced on www.astm.org.

2.2 *Military Standard*.⁴

MIL-STD-1916 DOD Preferred Methods for Acceptance of Product

2.3 *Underwriters Laboratories Standard*.⁵

UL 94 Standard for Tests for Flammability for Parts in Devices and Appliances

3. Terminology

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

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

⁵ Available from Underwriters Laboratories (UL), 333 Pfingsten Rd., Northbrook, IL 60062-2096, <http://www.ul.com>.

4. Classification

4.1 Styrene-maleic anhydride materials are classified into groups according to their use either for injection molding, or for extrusion. These groups are subdivided into classes and grades, as shown in Table S/MA.

NOTE 2—An example of this classification system is as follows: The designation S/MA 211 would indicate:

- S/MA = Styrene-maleic anhydride,
- 2 = injection-molding resin (group),
- 1 = general purpose (class),
- 1 = requirements given in Table S/MA (grade).

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 S/MA. The basic properties can be obtained from Tables A and B as they apply (see 4.3).

TABLE S/MA Requirements for Natural Color Only

Group	Description	Class	Description	Grade	Description	Tensile Strength ^A (D638) min, MPa	Flexural Modulus ^B (D790) min, MPa	Izod Impact Strength ^C (D256) min, J/m	Vicat Softening Point ^D (D1525) min, °C		
1	Crystal	1	general purpose	1		45	3000	10	120		
				0	other	...	...	...	...
		2	high-heat resistant	1		45	2900	10	130		
2	Impact-modified, molding			0	other	...	...	...	...
		0	other	0	other	...	...	...	...
		1	general purpose	1		40	2200	140	115		
				2		33	2100	170	115		
				3		30	2000	200	115		
				0	other	...	...	...	...
		2	high-impact	1		45	2200	500	115		
				2		34	2200	300	120		
				0	other	...	...	...	...
		3	high-heat resistant	1		35	2500	120	135		
				2		33	2200	210	125		
				3		30	2200	80	125		
				0	other	...	...	...	...
				4	plating	1		30	2000	150	120
				0	other	...	...	...	...
		5	FR	1		28	1900	130	115		
				2		22	1800	70	115		
		0	other	...	...	...	...
3	Impact modified, extrusion			0	other	...	...	...	...
		1	general purpose	1		40	2500	140	115		
				2		35	2300	170	115		
				3		30	2200	200	115		
				0	other	...	...	...	...
		2	high-heat resistant	1		33	2200	210	125		
				2		30	2200	80	125		
				0	other	...	...	...	...
				3	FR	1		28	1900	130	115
				2		22	1800	70	115		
0	Other	0	other	0	other	...	...	...	...
		0	other	0	other	...	...	...	...

^A Tensile strength determined on 3.2-mm thick injection-molded **D638**, Type I specimen, tested at 5 mm/min.

^B Flexural modulus determined on centrally-loaded **D638**, Type I tensile bar, 2-in. span, tangent, Method 1, 1.3 mm/s.

^C Izod impact strength determined on 12.5 by 3.2-mm injection molded specimen. The specimen shall be obtained from the central section of a **D638**, Type I tensile bar.

^D Vicat softening point shall be 1-kg load, Rate B, 12.5 by 3.2-mm injection-molded specimen obtained from the central section of a **D638**, Type I tensile bar.

TABLE A Detail Requirements for Reinforced S/MA Materials

Designation Grade	Property	Cell Limits									
		0	1	2	3	4	5	6	7	8	9
1	Tensile Strength ^A D638, MPa, min	Unspecified	40	50	60	70	80	90	100	120	^B
2	Flexural Modulus ^C D790, MPa, min	Unspecified	3500	4500	5500	6500	7500	8500	10 500	14 000	^B
3	Izod Impact Strength ^D D256, J/m, min	Unspecified	20	50	100	150	200	250	300	350	^B
4	Heat Deflection Temperature ^E D648, °C, min	Unspecified	90	100	110	120	130	150	170	190	^B
5	To be determined	...	...	...	...	...	...	...	...	...	...

^A Tensile strength shall be determined on 3.2-mm thick injection-molded D638, Type I specimen, tested at 5 mm/min.

^B Specific value appears on drawing or contract, or both.

^C Flexural modulus shall be determined on centrally-loaded D638, Type I tensile bar, 2-in. span, tangent, Method 1, 1.3 mm/s.

^D Izod impact strength shall be determined on 12.5 by 3.2-mm injection-molded specimen. The specimen shall be obtained from the central portion of a D638, Type I tensile bar.

^E Heat-deflection temperature: 1.8-MPa load, 12.5 by 3.2-mm injection molded specimen.

TABLE B Detail Requirements for Unreinforced S/MA Materials

Designation Grade	Property	Cell Limits									
		0	1	2	3	4	5	6	7	8	9
1	Tensile Strength ^A D638, MPa, min	Unspecified	20	30	40	50	60	70	80	90	^B
2	Flexural Modulus ^C D790, MPa, min	Unspecified	1800	2000	2200	2400	2600	2800	3000	3200	^B
3	Izod Impact Strength ^D D256, J/m, min	Unspecified	20	50	100	150	200	250	300	350	^B
4	Vicat Softening Temperature ^E D1525, °C, min	Unspecified	90	100	110	120	130	150	170	190	^B
5	To be determined	...	...	...	...	...	...	...	...	...	...

^A Tensile strength determined on 3.2-mm thick injection-molded D638, Type I specimen, tested at 5 mm/min.

^B Specific value appears on drawing or contract, or both.

^C Flexural modulus determined on a centrally-loaded D638, Type I tensile bar, 2-in. span, tangent, Method 1, 1.3 mm/s.

^D Izod impact strength determined on 12.5 by 3.2-mm injection-molded specimen. The specimen shall be obtained from the central portion of a D638, Type I tensile bar.

^E Vicat softening point shall be 1-kg load, Rate B, 12.5 by 3.2-mm injection-molded specimen obtained from the central section of a D638, Type I tensile bar.

4.2 Reinforced versions of the materials are classified in accordance with Table A.

4.2.1 A single letter shall be used for the major reinforcement or combination, or both, along with two numbers which indicate the percentage of addition by mass with the tolerances as tabulated in Table 1:

NOTE 3—This part of the system uses percent of reinforcements or additives, or both, in the control of the modified basic material. The types and percentages of reinforcements and additives should be shown on the supplier’s technical data sheet unless this information is proprietary in nature. If necessary, additional control of these reinforcements and additives can be accomplished by the use of the suffix part of the system, Section 5.

4.2.2 Specific requirements for reinforced, filled, or lubricated materials shall be shown by a six-character designation.

TABLE 1 Reinforcement-Filler^A Symbols^B and Tolerances

Symbol	Material	Tolerance
C	carbon	±2 %
G	glass-reinforced	±2 %
L	lubricants (for example, PTFE) graphite, silicone, and molybdenum disulfide	By agreement between supplier and user
M	mineral-reinforced	±2 %
R	combinations of reinforcements or fillers, or both	±3 % for total reinforcement

^AAsh content of filled, or reinforced material, or both, is determined using either Test Method D5630 or ISO 3451-1 where applicable.

^BAdditional symbols will be added to this table as required.

The designation shall consist of the letter A and the five digits comprising the cell numbers for the property requirements in the order in which 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 use of “0” grade classification shall be used for reinforced materials in this system.

NOTE 4—An example of a reinforced styrene-maleic anhydride of this classification system is as follows: The designation S/MA 210G30A22450 would indicate the following, with the material requirements from Table A:

- S/MA 210 = Styrene-maleic anhydride, molding resin, general-purpose
- G30 = Glass reinforced at 30 % nominal (see 4.2.1),
- A = Table A for Property Requirements,
- 2 = 30 MPa Tensile Strength, min,
- 2 = 2000 MPa Flexural Modulus, min,
- 4 = 150 J/M Izod Impact Strength, min,
- 5 = 130°C Heat-Deflection Temperature, min, and
- 0 = Unspecified.

If no properties are specified, the designation would be S/MA 210G30A00000.

4.3 Table B has been incorporated into this specification to facilitate the classification of special materials where Table S/MA or Table A does not reflect the required properties. Table B shall be used in the same manner as Table A.

NOTE 5—An example of a special material using this classification system is as follows: The designation S/MA310B54220 would indicate

the following, with the material requirements from Table B.

S/MA 310	= Styrene-maleic anhydride, extrusion resin, general-purpose,
B	= Table B Property Requirements,
5	= 60 MPa Tensile Strength, min,
4	= 2400 MPa Flexural Modulus, min,
2	= 50 J/m Izod Impact Strength, min,
2	= 100°C Vicat Softening Point, min, and
0	= Unspecified.

NOTE 6—Mechanical properties of pigmented or colored S/MA materials can differ from the mechanical properties of natural S/MA 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 and tensile elongation values. If specific properties of pigmented S/MA materials are necessary, prior testing between the materials supplier and end user should be initiated. Once these agreements are reached, a classification using Table B should be employed to ensure proper property compliance.

5. Suffixes

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 classification system as test methods and requirements are developed and requested.

6. Basic Requirements

6.1 Basic requirements from property or cell tables, 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 in Tables S/MA, A, B, and suffix requirements as they apply. The color and form of the material shall be as specified in the purchase order or contract. Specification changes due to the effects of colorants shall be noted by both parties and, where necessary, covered by suffixes.

8. Detail Requirements

8.1 Test specimens and testing parameters for the various materials shall conform to the requirements prescribed in Tables S/MA, A, and B, and suffix requirements as they apply.

8.2 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 E29.

8.3 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.

9. Sampling

9.1 Sampling shall be statistically adequate to satisfy the requirements of 12.4.

9.2 A batch or lot construed as a unit of manufacture as prepared for shipment and can consist of a blend of two or more “production runs.”

10. Specimen Preparation

10.1 Physical property requirements in Table S/MA are based on injection molded specimens 3.2 mm thick. Test specimens shall be molded in accordance with Practice D3641.

10.2 Group 3 (extrusion) materials are allowed to be compression molded or machined from extruded sheet.

11. Test Methods

11.1 The following specimen conditioning and test methods are required:

11.2 Condition test specimens in standard laboratory atmosphere in accordance with Procedure A (40/23/50) of Practice D618 before performing the required tests. Specimens will not be annealed.

11.3 Perform all tests in the standard laboratory atmosphere (23/50) in accordance with Practice D618.

11.4 *Tensile Strength (Maximum Stress)*—Test Method D638, Type 1, 3.2 mm, at 5-mm/min crosshead speed.

11.5 *Flexural Modulus (Tangent Method)*—Test Methods D790 using a centrally-loaded D638, Type I tensile bar on a 2-in. span and tested at 1.3-mm/s crosshead speed.

11.6 *Izod Impact*—Test Methods D256 with a 12.5 by 3.2-mm injection molded specimen obtained from the central portion of a D638, Type I tensile bar.

11.7 *Vicat Softening Point*—Test Method D1525 with 1-kg load at Rate B. Obtain specimens from the central portion of a D638, Type I tensile bar.

11.8 *Heat Deflection Temperature (DTUL)*—Test Method D648, 1.8-MPa load on 12.5 by 3.2 by 125-mm injection molded bar. Specimens shall not be annealed.

12. Inspection and Certification

12.1 Inspection and certification of S/MA material supplied with reference to this specification based on this classification system shall be for conformance to the requirements specified herein.

12.2 *Lot-Acceptance Inspection*—Lot acceptance inspection shall be the basis on which acceptance or rejection of the lot is made.

12.3 Periodic check inspection with reference to this specification based on this classification system shall consist of the tests for all the requirements of the material under this specification. Inspection frequency shall be adequate to ensure that the material is certifiable in accordance with 12.4.

12.4 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 this classification system (line call out).

NOTE 7—The ASTM publication *Manual on Presentation of Data and Control Chart Analysis, 8th Edition*⁶, provides detailed information about statistical process control.

⁶ Available from ASTM International, stock number: MNL7–8TH-EB.

12.5 A report of test results shall be furnished when requested. The report shall consist of results of the lot acceptance inspection for the shipment, the percent by weight of recycled plastic, as defined in 3.1.47 of Guide **D7209**, if requested, and the results of the most recent periodic-check inspection.

13. Packaging, Packing, and Marking

13.1 The provisions of Practice **D3892** apply to the packaging, packing, and marking of containers for plastic materials.

14. Keywords

14.1 extrusion; high-heat resistant; molding; styrene copolymers; styrene-maleic anhydride

SUPPLEMENTARY REQUIREMENTS

QUALITY ASSURANCE PROVISION FOR GOVERNMENT/MILITARY PROCUREMENT

S1. MIL-STD-1916 DOD describes the choices to be made. Selection of verification level (VL) and of sample size code letter (CL) shall be made with consideration of the specific use requirements. In the absence of contrary requirements, the

following values shall apply:

Testing (polymer unfabricated): Use verification level I (VL-I) and sample size code letter A (CL-A).

SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D4634 - 11a) that may impact the use of this standard. (April 1, 2016)

- (1) Added **Note 7**.
- (2) Removed permissive language in **10.2**.
- (3) Revised **5.1**, **7.1**, and Section **9** to conform with language in Guide D5740.
- (4) Added **Table 1** title and footnotes.
- (5) Modified **12.5** to include percent recycled plastic.

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