Designation: D4203 – 07

StandardSpecification for Styrene-Acrylonitrile (SAN) Injection and Extrusion Materials[1]

This standard is issued under the fixed designation D4203; 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 Department of Defense.

1. Scope*

1.1 This specification covers unfilled, filled, and reinforced styrene acrylonitrile (SAN) materials suitable for injection molding and extrusion.

1.2 This specification is not intended for the selection of materials, but only as a means of calling out materials to be used in the manufacture of parts. Materials are to be selected by personnel with expertise in the plastics field where the economics, the environment to be encountered, the inherent properties of the materials, the part design, the part performance required, and the manufacturing process to be employed all enter into the selection.

1.3 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 agreed upon between the user and the supplier, by using the suffixes specified in Section 7.

1.4 The values stated in SI units are to be regarded as the standard. The values in parentheses are given for information only (see IEEE/ASTM SI-10.)

1.5 The following precautionary caveat pertains only to the test methods portion, Section 15, 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—Although this specification and ISO 4894/1 differ in approach or detail, data obtained using either are technically equivalent.

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
D2584 Test Method for Ignition Loss of Cured Reinforced Resins
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
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E105 Practice for Probability Sampling of Materials
IEEE/ASTM SI-10 Standard for Use of the International System of Units (SI): The Modern Metric System

[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.15.03).

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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.

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

2.2 *ISO Standards:*[3]

ISO 75 Plastics and Ebonite—Determination of Temperature of Deflection Under Load

ISO 178 Plastics—Determination of Flexural Properties of Rigid Plastics

ISO 180/1A Plastics—Determination of Izod Impact Strength of Rigid Materials

ISO 294 Plastics—Injection Moulding Test Specimens of Thermoplastic Materials

ISO 306 Plastics—Determination of Vicat Softening Temperature of Thermoplastics

ISO 527 Plastics—Determination of Tensile Properties

ISO 1133 Plastics—Determination of the Melt Flow Rate of Thermoplastics

ISO 1183 Plastics—Methods for Determining the Density and Relative Density of Non-Cellular Plastics

ISO 4894/1 Plastics—Styrene/Acrylonitrile (SAN) Copolymer Molding and 4894/2 Extrusion Materials Part 1: Designation, Part 2: Determination of Properties

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology D883 and abbreviations are in accordance with Terminology D1600, unless otherwise indicated. The abbreviation for styrene-acrylonitrile plastics is SAN.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *lot*—a unit of manufacture; may consist of a blend of two or more production runs or batches of material.

4. Classification

4.1 SAN compounds are typically general-purpose materials used in either molding or extrusion processes and applications. There is currently no group, class, or grade distinctions and no basic property table given.

NOTE 2—Where no basic property table exists, the generic family designation will be followed by three zeros, for example: SAN000.

4.1.1 They are usually grouped as reinforced or unreinforced. Therefore, SAN materials are classified by Table A for reinforced materials and Table B for unreinforced materials. Specialty products such as antistatic, barrier, etc. would also utilize the suffix system described in Section 7.

4.1.2 Each compound is given a five-digit cell classification representing the physical properties in the order in which they are listed in the cell table.

4.2 Reinforced and lubricated versions of the SAN materials are classified in accordance with Table A, which specifies the properties after the addition of reinforcements or lubricants at the nominal level indicated (see 4.2.1).

4.2.1 A single letter shall be used for the major reinforcement or combination, or both, along with two digits that indicate the percentage of addition by mass, with the tolerance as tabulated below:

Symbol	Material	Tolerance
C	Carbon- and graphite-fiber reinforced	±2 %
G	Glass-reinforced	±2 %
L	Lubricants (PTFE, for example) graphite, silicone and molybdenum disulfide	by agreement between the supplier and the user
M	Mineral-reinforced	±2 %
R	Combinations of reinforcements or filler, or both	±3 % for the total reinforcement

NOTE 3—This part of the system uses 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 this information is proprietary in nature. If necessary, additional callout of these reinforcements and additives can be accomplished by the use of the suffix part of the system, as described in Section 7.

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

NOTE 4—An example of this classification for a reinforced SAN is as follows:

The designation SAN000G30A34421:

SAN000	= Styrene acrylonitrile material,
G30	= Glass reinforced at 30 % nominal level,
A	= Table A for property requirements,
3	= % AN, 30 %, min,
4	= Deflection temperature under load, 105°C, min,
4	= Specific gravity, 1.6, min,
2	= Tensile strength, 80 MPa, min, and
1	= Flexural modulus, 3000 MPa, min,

If no properties are specified, the designation would be SAN000G30A00000.

4.3 Table B classifies all unreinforced SAN materials. Table B shall be used in the same manner as Table A.

NOTE 5—An example of this classification for an unreinforced SAN is as follows:

The designation SAN000B22320 indicates:

SAN000	= Styrene acrylonitrile material,
B	= Cell Table B, property requirements,
2	= % AN, 20 %, min,
2	= Vicat softening temperature, 100°C, min,
3	= Flow rate, 10 g/10 min, min
2	= Tensile strength, 60 MPa, min, and
0	= Flexural modulus, unspecified,

4.3.1 Mechanical properties of pigmented or colored SAN materials can differ from the mechanical properties of natural SAN material, depending on the choice and concentration of colorants. The main property affected is ductility, as illustrated by a reduction in Izod impact strength and tensile-elongation values. If specific properties of pigmented SAN materials are necessary, prior testing between the materials supplier and end user should be initiated. Once these agreements are reached, a classification using Cell Table B should be employed to ensure proper property compliance.

4.4 ISO test methods and correlated cell values have been included for informational purposes. They have been provided for those international users wishing to determine the corresponding ISO test values for a particular SAN callout.

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

NOTE 6—Using the example ASTM callout in Note 5, (ISO) SAN000B22320 would indicate:

(ISO)	= ISO line-property requirements,
SAN000	= Styrene acrylonitrile material,
B	= Table B,
2	= % AN, 20%, min,
2	= Vicat softening point, 95°C, min,
3	= Flow rate, 25 g/10 min, min,
2	= Tensile strength, 60 MPa, min,
0	= Flexural modulus, unspecified.

NOTE 7—Internationally, ANSI has been working with ISO to harmonize specification and designation documents in three specific areas, including SAN. A correlation was carried out and has been appended for information purposes. This study provided the basis for the correlated ISO values found in the cell tables and the novel approach of being able to determine a specified product's property requirements by either ASTM or ISO test methods.

TABLE A SAN Compounds (Reinforced)

Designation Order Number	Property	Cell Limits						
		0	1	2	3	4	5	9
1	AN Content, % AN, min	Unspecified	10	20	30	40	50	[A]
	(ISO, % AN, min)	(Unspecified)	(10)	(20)	(30)	(40)	(50)	[A]
2	Deflection temperature under load, ASTM D648, °C, min[B]	Unspecified	90	95	100	105	110	[A]
	(ISO 75, °C, min)	(Unspecified)	(90)	(95)	(100)	(105)	(110)	[A]
3	Specific gravity, ASTM D792, min	Unspecified	1.1	1.2	1.4	1.6	1.8	[A]
	(ISO 1183, min)	(Unspecified)	(1.1)	(1.2)	(1.4)	(1.6)	(1.8)	[A]
4	Tensile strength, ASTM D638, MPa, min[B]	Unspecified	60	80	100	120	140	[A]
	(ISO 527, MPa, min)	(Unspecified)	(60)	(80)	(100)	(120)	(140)	[A]
5	Flexural tangent modulus, ASTM D790 MPa, min[B]	Unspecified	3000	4500	6000	7500	9000	[A]
	(ISO 178, MPa, min)	(Unspecified)	(2800)	(4200)	(5600)	(7000)	(8500)	[A]

[A] If specific value is required, it must appear on drawing or contract, or both.
[B] MPa × 145 = psi.

TABLE B SAN Compounds (Unreinforced)

Designation Order Number	Property	Cell Limits						
		0	1	2	3	4	5	9
1	AN Content,% AN, min	Unspecified	10	20	30	40	50	[A]
	(ISO, % AN, min)	(Unspecified)	(10)	(20)	(30)	(40)	(50)	[A]
2	Vicat softening point, ASTM D1525, °C, min	Unspecified	90	100	105	110	120	[A]
	(ISO 306, °C, min)	(Unspecified)	(85)	(95)	(100)	(105)	(110)	[A]
3	Flow rate, ASTM D1238, g/10 minutes, min	Unspecified	2	5	10	15	20	[A]
	(ISO 1133, g/10 minutes, min)	(Unspecified)	(5)	(15)	(25)	(40)	(50)	[A]
4	Tensile strength, ASTM D638, MPa, min[B]	Unspecified	50	60	70	80	95	[A]
	(ISO 527, MPa, min)	(Unspecified)	(50)	(60)	(70)	(80)	(95)	[A]
5	Flexural tangent modulus, ASTM D790, MPa, min[B]	Unspecified	2600	3000	3400	3800	4200	[A]
	(ISO 178, MPa, min)	(Unspecified)	(2400)	(2800)	(3200)	(3600)	(3900)	[A]

[A] If specific value is required, it must appear on drawing or contract, or both.
[B] MPa × 145 = psi.

5. Ordering Information

5.1 The SAN compound shall be as agreed upon between the purchaser and seller, and the following information should be included in the purchase order:

5.1.1 Quantity and packaging;

5.1.2 Cell classification, as described in Table A or Table B;

5.1.3 Color reference should be made to color chip number, if available;

5.1.4 Form, for example, pellets, granules, or powder; and

5.1.5 This ASTM designation, "D4203," and the year of issue.

6. Materials and Manufacture

6.1 The SAN compounds are produced by the polymerization of the monomers acrylonitrile and styrene.

6.2 The SAN compound shall be uniform in composition, as defined by the cell classification, and shall be of size, shape, and color, as specified by the product specification, or purchase order or contract.

6.3 Colorants may be added in concentrate form to the SAN compounds. Additives necessary for compounding may also be present.

7. Suffix Requirements

7.1 When requirements are needed that supersede or supplement the cell-table requirements, they shall be specified through the use of suffixes. In general, the first suffix letter indicates the special requirement 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 the Suffix Symbols and Requirements Table 3 of Classification System D4000.

8. Basic Requirements

8.1 Basic requirements from the cell tables, as they apply, are always in effect unless these requirements are superseded by specific suffix requirements, which always take precedence.

9. General Requirements

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

changes due to the effects of colorants shall be noted by the materials supplier and the end user and, where necessary, shall be covered by suffixes.

10. Detail Requirements

10.1 Test specimens and testing parameters for the materials shall conform to the requirements prescribed in Cell Table A, and Table B, and suffix requirements as they apply.

10.2 Observed or calculated values obtained from analysis, measurement, or test shall be rounded off to the nearest unit in the last right-hand place of figures used in expressing the specified limiting value in accordance with the rounding method of Practice E29.

11. Sampling

11.1 Sample the materials in accordance with the sampling procedure prescribed in Practice E105. Statistical sampling shall be considered as an acceptable alternative.

12. Number of Tests

12.1 One set of specimens, as prescribed in the test methods, shall be considered sufficient for each lot. The average result for the specimens tested shall meet the requirements of the applicable Table when tested in accordance with the test methods listed in Section 15.

13. Specimen Preparation

13.1 The test specimens shall be injection molded in accordance with Practice D3641. Molding conditions shall be 240 ± 5°C melt temperature and 60 ± 5°C mold temperature for all grades. Test specimens shall be molded in one piece and shall not be a composite of thinner sections. If ISO requirements are necessary, sample preparation shall be in accordance with ISO 294 and ISO 4894/2.

14. Conditioning

14.1 Test specimens shall be conditioned in the standard laboratory atmosphere in accordance with Procedure A of Practice D618 before performing the required tests. The minimum conditioning time shall be 24 h.

14.2 Conduct tests in the standard laboratory atmosphere of 23 ± 2°C and 50 ± 5 % relative humidity in accordance with Practice D618, unless otherwise specified.

15. Test Methods

15.1 *ASTM Methods:*

15.1.1 The melt-flow rate shall be determined at 230°C and 3.8 kg load.

15.1.2 The Vicat softening point shall be determined for a 1-kg load, 12.5 by 3.2-mm (½ by ⅛-in.) injection-molded, unannealed specimen, Rate B (2°C/min).

15.1.3 The heat-deflection temperature shall be determined for a 1.82-MPa load, 12.5 by 3.2-mm (½ by ⅛-in.) injection-molded, unannealed, specimen.

15.1.4 The tensile strength at yield shall be determined on a 3.2-mm (⅛-in.) thick injection-molded Type I specimen, tested at 5 mm/min (0.2 in./min).

15.1.5 The flexural modulus shall be determined on a 12.5 by 3.2-mm (½ by ⅛-in.) injection-molded specimen, (50.8-mm) 2-in. span, tangent, Method I, at 1.3 mm/min (0.05 in./min).

15.1.6 The glass content of glass-reinforced materials shall be determined in accordance with Test Method D2584.

15.2 *ISO Methods:*

15.2.1 The melt-flow rate shall be determined by Condition No. 19; 220°C and 10.0 kg load.

15.2.2 The Vicat softening point shall be determined for a 5.0 kg load, 10.0 by 4.0-mm injection-molded, unannealed specimen, Method B, Rate 50°C/h.

15.2.3 The heat-deflection temperature shall be determined for a 1.8-MPa load, 10.0 by 4.0-mm injection-molded, unannealed specimen, Method A, Rate 2°C/min.

15.2.4 The tensile strength at yield shall be determined on a 4.0-mm thick injection-molded Type 1A or 1B (or the identical ISO 3167 Type A or B) specimen, tested at 5 mm/min.

15.2.5 The flexural modulus shall be determined on a 4.0-mm thick injection-molded specimen, 60.0-mm span, tangent, 1.0 mm/min.

15.3 Reinforcement (other than glass) and Additive Concentration-Method to be agreed upon between the supplier and user.

16. Certification and Inspection

16.1 Inspection and certification of the material supplied with reference to a specification based on this specification shall be in accordance with the requirements specified herein.

16.2 Lot-acceptance inspection shall be the basis on which acceptance or rejection of the lot is made. The lot-acceptance inspection shall consist of those tests that ensure process control during manufacture as well as those necessary to ensure certifiability in accordance with 16.4.

16.3 Periodic-check inspection shall consist of the tests specified for all requirements of the material under this specification. Inspection frequency shall be adequate to ensure that the material is certifiable in accordance with 16.4.

16.4 Certification shall be that the material was manufactured, sampled, tested, and inspected in accordance with this specification and that the average values meet the requirements at a confidence level of 95 %.

16.5 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.

17. Rejection and Rehearing

17.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the tests, the producer or supplier may make claim for a rehearing.

17.2 In case of a dispute of test results, ASTM methods and cell values shall apply.