Designation: D4203 – 17

Standard Specification for and Basis for Specifications 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 U.S. 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 classification system and subsequent line callout (specification) are intended to provide a means of calling out plastic materials used in the fabrication of end items or parts. It is not intended for the selection of materials. Material selection can be made by those having expertise in the plastic 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 costs involved, and the inherent properties of the material other than those covered by this standard.

1.3 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 using the suffixes specified in Section 5.

1.4 The values stated in SI units are to be regarded as the standard. The values in parentheses are given for information only.

1.5 The following precautionary caveat pertains only to the test methods 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—This standard and ISO 19064-1 and ISO 4894-2 address the same subject matter, but differ in technical content. Although this standard and ISO 19064-1 and ISO 4894-2 differ in approach or detail, data obtained using either are technically equivalent.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

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

[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**

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

2.2 *ISO Standards:*[3]

ISO 75 Plastics—Determination of Temperature of Deflection Under Load
ISO 178 Plastics—Determination of Flexural Properties
ISO 180/1A Plastics—Determination of Izod Impact Strength
ISO 294 Plastics—Injection Moulding Test Specimens of Thermoplastic Materials
ISO 306 Plastics—Thermoplastic materials—Determination of Vicat Softening Temperature (VST)
ISO 527 Plastics—Determination of Tensile Properties
ISO 1133 Plastics—Determination of the Melt Mass-Flow Rate (MFR) and Melt Volume-Flow Rate (MVR) of Thermoplastics
ISO 1183 Plastics—Methods for Determining the Density of Non-Cellular Plastics
ISO 4894-2 Plastics—Styrene/Acrylonitrile (SAN) Moulding and Extrusion Materials—Part 2: Preparation of Test Specimens and Determination of Properties
ISO 19064-1 Plastics—Styrene/Acrylonitrile (SAN) Moulding and Extrusion Materials—Part 1: Designation System and Basis for Specifications

3. Terminology

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

4. Classification

4.1 SAN materials 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 5.

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, filled, 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 nominal quantity in percent by weight. (See Table 1.)

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 are sometimes shown on the supplier's technical data sheet. 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 5.

TABLE 1 Reinforcement-Filler[A] Symbols and Tolerances[B]

Symbol	Material	Tolerance
C	Carbon- and graphite-fiber reinforced	±2 %
G	Glass-reinforced	±2 %
L	Lubricants (PTFE, for example) graphite, silicone and molybdenum disulfide	Depends upon material and process—to be specified.
M	Mineral-reinforced	±2 %
R	Combinations of reinforcements or filler, or both	±3 % for the total reinforcement

[A]Ash content or filled and/or reinforced materials is determined using either Test Method D5630 or ISO 3451-1 where applicable.
[B]Additional symbols will be added to this table as required.

NOTE 4—Materials containing reinforcements or fillers, or both, at nominal levels not in multiples of five are included in the nearest grade designation. For example, a material with a nominal glass fiber level of 33 % is included with a Grade G35.

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 5—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 6—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, a classification using Cell Table B is employed.

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

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.

NOTE 7—Using the example ASTM callout in Note 6, (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 8—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 4894-2, % 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 4894-2, % 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. Suffix Requirements

5.1 When additional requirements are needed that are not covered by the 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 requirements are developed and requested.

6. Basic Requirements

6.1 Basic requirements from the cell tables, 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. Detail Requirements

7.1 The materials shall conform to the requirements in Tables SAN, A, and B, and suffix requirements 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 E29.

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 is construed as a unit of manufacture as prepared for shipment and can consist of a blend of two or more "production runs".

9. Specimen Preparation

9.1 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.

10. Conditioning

10.1 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.

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

11. Test Methods

11.1 *ASTM Methods:*

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

11.1.2 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).

11.1.3 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.

11.1.4 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).

11.1.5 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).

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

11.2 *ISO Methods:*

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

11.2.2 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.

11.2.3 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.

11.2.4 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.

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

11.3 Reinforcement (other than glass) and Additive Concentration-Method to be specified.

12. Certification and Inspection

12.1 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.

12.2 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 12.4.

12.3 Periodic-check inspection with reference to a specification based upon this classification system shall consist of the tests specified for all requirements of the material under the specification. Inspection frequency shall be adequate to ensure 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 the specification (line callout).

NOTE 9—The ASTM publication *Manual on Presentation of Data and Control Chart Analysis, 8th Edition*, provides detailed information about statistical process control.

12.5 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.

13. Packaging and Package Marking

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

14. Keywords

14.1 call-out; SAN; styrene/acrylonitrile

APPENDIX

(Nonmandatory Information)

X1. SAN COPOLYMERS

X1.1 *Introduction*—This study was initiated with the goal being to develop a correlation between ASTM and ISO cell designations for SAN copolymers. Contained within this report is the data necessary to harmonize those cell limits set by ASTM and ISO. The four candidates, the injection-molding parameters followed in order to produce test specimens, and each test method will be addressed individually. A summary data table can be found at the end of the report.

X1.2 *SAN Candidates*—The four SAN candidates chosen for this cell-harmonization study were picked on the basis of their percent acrylonitrile content and their melt-flow indices. The reason for this choice is to create a range beginning with a soft-melt-flow material, continuing with two medium-flow materials and concluding with a stiff-flow material. Three major SAN producers participated in this study by supplying SAN pellet material in the soft-, medium-, and stiff-melt-flow categories, respectively.

Material	% AN[A]
SAN 1	24
SAN 2	29
SAN 3	33
SAN 4	33

[A] % AN values were obtained through CHN analysis.

Their melt-flow indices, along with the test methods used, will be presented under their own title in the Testing Methods and Results section.

X1.3 *Injection Molding of Physical-Testing Specimens*—Prior to molding, all four of the materials in their pellet form were dried for 18 h at a temperature of 85°C. After this drying period, the four pellet samples were placed in heat-sealed polyethylene bags until molding began.

X1.3.1 The injection molding of all test specimens was executed on the same molding machine using the same parameters. The injection-molding conditions are listed in Table X1.1.

X1.3.2 The mold design was such that both the ASTM and the ISO test specimens could be molded simultaneously. In a single cycle, the following test specimens were molded: one ASTM tensile bar, one ½ by ⅛ by 5 in. bar, one ½ by ½ by 5 in. bar, two ISO tensile bars, one 80 by 10 by 4-mm bar, and one 110 by 10 by 4-mm bar. All of the ASTM specimens were side-gated while all of the ISO specimens were end-gated. A sufficient number of each type of specimen was molded in order to carry out the necessary testing.

X1.4 *Testing Procedures*—All tests were performed using the recommended procedures outlined by both ASTM and ISO. The tests chosen give a broad view of the properties inherent in each of the materials and will form the basis on which a comparison can be made. The test method and its ASTM and ISO designations are listed in Table X1.2. In the following section, Testing Methods and Results, a summary containing key aspects of the method, as well as the results obtained by that method will be revealed.

TABLE X1.1 Injection-Molding Parameters

Barrel Temperatures	(°F)
nozzle	400
zone 1	390
zone 2	380
zone 3	380
Mold Temperature	(°F)
	110
Pressures	(psi)
hold	1000
plasticate	150
injection profile	20 % FLAT
hold profile	50 % FLAT
Times	(s)
injection	2.55
hold	20
cooling	40
Screw speed	(r/min)
	150
Shot Size	(oz)
	2.5

TABLE X1.2 Testing Methods with Their Designations

SAN Specifications	ASTM	ISO
	D4203	4894-2
Testing procedures:		
Melt-Flow Rate	D1238	1133
Tensile Strength	D638	527
Flexural Modulus	D790	178
Izod Impact Strength	D256	180
Vicat Softening Temperature	D1525	306
DTUL	D648	75

X1.5 *Testing Methods and Results:*

X1.5.1 *Melt Flow Rate*—Test Method D1238 (procedure A) and ISO 1133 outline the melt-flow rate procedure. The apparatus used was a plastometer having dimensions which met both ASTM and ISO standards. Refer to Table X1.3 for dimension values.

X1.5.1.1 The materials used for testing were in the form of pellets. These samples were oven dried for approximately 17.5 h at a temperature of 80°C prior to testing. The testing temperatures and applied loads were 230°C/3.8 kg for ASTM and 220°C/10.0 kg for ISO standards. The test results are displayed in Table X1.4.

TABLE X1.3 Dimensions of the Plastometer

	Diameter	Length
Test bore	9.55 ± 0.001 mm	162 mm
Die	2.095 ± 0.005 mm	8.0 ± 0.025 mm
Test plunger	9.48 ± 0.1 mm	

TABLE X1.4 Melt Flow Rate Results

	ASTM	ISO
SAN 1	7.6 gms/10min	20.4gms/10min
SAN 2	3.7	9.3
SAN 3	14.32	34.4
SAN 4	8.4	21.0

X1.5.2 *Tensile Strength*—Test Method D638 and ISO 527 outline the procedures used for determining tensile properties. The testing machine accommodated both methods of testing. Prior to testing, both the ASTM and ISO specimens were conditioned at 40/23/61. The atmospheric conditions during testing were also 23°C and 61 % relative humidity. ASTM requires a constant crosshead speed of 5 mm/min (0.2 in./min). This speed is in agreement with ISO standards as well. Five test specimens per material per method were tested. The type of test specimen, its principal dimensions and the test results can be found in Table X1.5.

X1.5.3 *Flexural Modulus*—Test Methods D790 and ISO 178 describe procedures for determining flexural properties. Table X1.6 lists particulars concerning the testing apparatus set-up.

X1.5.3.1 The conditioning of the test specimens (both ASTM and ISO) was at >40/23/50 as is recommended by both organizations. The ASTM method and procedure classification for this test is Method I and Procedure A. The test-specimen dimensions and the calculated flexural modulus are compiled in Table X1.7.

X1.5.4 *Izod Impact Strength*—Test Method D256 and ISO 180/1A outline the procedures used to determine Izod impact strength. In accordance with the guidelines contained within the ASTM procedure Method C was chosen. Method C was chosen due to historical SAN Izod values of 0.35 to 0.4 ft lb_f /in. which lie below the minimum value of 0.5 ft lb_f /in. for Method A. The milling machine used to notch the test specimens created a notch with an included angle of 45 ± 1° and a radius of curvature at the apex of 0.25 ± 0.05 mm. The depth of the notch was adjusted to meet the 0.1 ± 0.02 in. specification set by ASTM and the required depth of 0.079 in. set by ISO. Conditioning of all the test specimens at 40/23/50 was executed. A total of six test specimens per material per method were examined and averaged to yield the data presented in Table X1.8.

X1.5.5 *Vicat Softening Temperature*—Test Method D1525 (Rate B) and ISO 306 (Method B) provide guidelines for determining vicat softening temperatures (VST). The apparatus used met both organizations' specifications. The required minimum thickness of 0.12 in. was ensured by placing two layers of the grip end of a molded tensile bar on the testing surface. ASTM Rate B denotes an immersion-bath heating rate of 120°C/h and an applied load of 1 kg. ISO Method B indicates an applied load equivalent to 5 kg and a heating rate of 50°C/h. Dow Corning 200 silicone oil served as the immersion-bath medium. The vicat softening temperature for each of the materials is shown in Table X1.9.

X1.5.6 *DTUL*—Test Method D648 and ISO 75 (Method A) describe the procedure necessary to determine the deflection temperature under load. The apparatus used met the specifications set by both ASTM and ISO. All of the test specimens were conditioned at 40/23/61 + ≥4/23/desiccator prior to testing. The immersion medium, Dow Corning 200 silicone fluid,

TABLE X1.5 Tensile Strength Results

	Method	Type	Width (in.)	Thickness (in.)	Tensile Strength @ Break/Std. Dev. (psi)
SAN 1	ASTM	I	0.508	0.128	9 999/304
SAN 2	ASTM	I	0.509	0.129	10 740/203
SAN 3	ASTM	I	0.508	0.128	10 910/279
SAN 4	ASTM	I	0.508	0.126	11 396/62
SAN 1	ISO	I	0.395	0.155	9 808/198
SAN 2	ISO	I	0.395	0.155	10 790/80
SAN 3	ISO	I	0.395	0.155	11 061/87
SAN 4	ISO	I	0.396	0.155	10 943/56

TABLE X1.6 Particulars of Flexural Apparatus

	ASTM	ISO
Span length	2.0 in.	2.36 in.
Radii of supports and loading nose	0.125	(same)
Rate of crosshead motion	0.05 in./min	0.04 in./min

TABLE X1.7 Flexural Test Specimen Dimensions and Tangent Modulus

	Method	Width (in.)	Depth (in.)	Tangent Modulus (psi)/Std. Dev.
SAN 1	ASTM	0.498	0.130	533 000/0.03
SAN 2	ASTM	0.499	0.129	548 000/0.02
SAN 3	ASTM	0.499	0.130	564 000/0.05
SAN 4	ASTM	0.499	0.130	558 000/0.03
SAN 1	ISO	0.387	0.156	499 000/0.01
SAN 2	ISO	0.387	0.156	500 000/0.03
SAN 3	ISO	0.387	0.155	535 000/0.05
SAN 4	ISO	0.386	0.155	533 000/0.06

TABLE X1.8 Izod-Impact Results

	Method	End	Width (in.)	Izod Impact/Std. Dev. (ft lbf/in.)	Average Izod Impact (ft lbf/in.)
SAN 1	ASTM	gate	0.129	0.2570/0.06	0.2613
		dead	0.130	0.2656/0.03	
SAN 2	ASTM	gate	0.130	0.2590/0.04	0.2544
		dead	0.130	0.2498/0.14	
SAN 3	ASTM	gate	0.129	0.2729/0.01	0.2813
		dead	0.131	0.2896/0.04	
SAN 4	ASTM	gate	0.129	0.2663/0.06	0.2584
		dead	0.131	0.2505/0.03	
SAN 1	ISO	N/A	0.156	0.2679/0.07	0.2679
SAN 2	ISO	N/A	0.156	0.3005/0.09	0.3005
SAN 3	ISO	N/A	0.156	0.3417/0.10	0.3417
SAN 4	ISO	N/A	0.156	0.3212/0.14	0.3212

TABLE X1.9 Vicat Results

	ASTM (°C)	ISO (°C)
SAN 1	105.0	98.2
SAN 2	106.6	97.1
SAN 3	103.4	96.8
SAN 4	104.9	97.1

was heated at a rate of 2°C/min. Included in Table X1.10 are the specimen dimensions, maximum fiber stress and deflection temperature.

TABLE X1.10 DTUL Results

	Method	Dimensions (in.)	Maximum Fiber Stress	Deflection Temp. (°C)
SAN 1	ASTM	0.130 × 0.498 × 5	264 psi	78.4
SAN 2	ASTM	0.130 × 0.499 × 5	264 psi	77.3
SAN 3	ASTM	0.130 × 0.498 × 5	264 psi	76.8
SAN 4	ASTM	0.130 × 0.498 × 5	264 psi	77.2
SAN 1	ISO	0.156 × 0.393 × 4.331	1.8 N/mm^2	79.1
SAN 2	ISO	0.156 × 0.393 × 4.331	1.8 N/mm^2	80.8
SAN 3	ISO	0.156 × 0.393 × 4.331	1.8 N/mm^2	79.5
SAN 4	ISO	0.156 × 0.393 × 4.331	1.8 N/mm^2	78.7

TABLE X1.11 Summary Data Table for the SAN Candidates

	SAN 1	SAN 2	SAN 3	SAN 4	
ASTM:					
Tensile Strength	9 999	10 740	10 910	11 396	psi
Flex. Modulus	533 000	548 000	564 000	558 000	psi
Izod Impact Strength	0.26	0.25	0.28	0.26	ft lbf/in.
Vicat Softening Temp.	105.0	106.6	103.4	104.9	°C
DTUL	78.4	77.3	76.8	77.2	°C
Melt Flow	7.6	3.7	14.3	8.4	g/10 min
ISO:					
Tensile Strength	9 808	10 790	11 061	10 943	psi
Flex. Modulus	499 000	500 000	535 000	533 000	psi
Izod Impact Strength	0.27	0.30	0.34	0.32	ft lbf/in.
Vicat Softening Temp.	98.2	97.1	96.8	97.1	°C
DTUL	79.1	80.8	79.5	78.7	°C
Melt Flow	20.4	9.3	34.4	21.0	g/10 min
% AN	24	29	33	33	

TABLE X1.12 Summary Factor Table for ASTM vs. ISO[A]

Tensile Strength	0.98	1.03	1.01	0.96	0.995 avg
Flex. Modulus	0.93	0.91	0.95	0.96	0.94 avg
Izod Impact Strength	1.03	1.18	1.21	1.24	1.17 avg
Vicat Softening Temp.	0.94	0.91	0.94	0.93	0.93 avg
DTUL	1.01	1.05	1.04	1.02	1.03 avg
Melt Flow	2.68	2.51	2.40	2.50	2.52 avg

[A] ISO/ASTM

SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D4203 - 12) that may impact the use of this standard. (August 1, 2017)

(1) Updated ISO equivalency statement to reflect current ISO material method for SAN of ISO 19064-1 and remove prior referenced method of ISO 4894-1.
(2) Added footnotes to Table 1.
(3) Added ISO 4894-2 method number for determining AN content to Tables A and B.
(4) Added NOTE 9—The ASTM publication Manual on Presentation of Data and Control Chart Analysis, 8th Edition.