

Sponge and Expanded Cellular Rubber Products¹

1. Scope

- 1.1 **Rationale**—The SAE Committee on Automotive Rubber Specifications has concluded, that in light of the fact that SAE J18 is a mirror image of ASTM D 1056 (Vol. 8.01), SAE J18 will be eliminated in the year 2005.
- 1.2 This SAE Recommended Practice covers flexible cellular rubber products known as sponge rubber and expanded rubber, but does not apply to latex foam rubber or ebonite cellular rubber. The base material for an open/closed cellular product may be made of synthetic, natural, reclaimed rubber, or a mixture, and may contain other polymers or chemicals, or both, which may be modified by organic or inorganic additives. These elastomeric materials have properties similar to those of vulcanized rubber, namely (a) the ability to be converted from a thermoplastic to a thermosetting state by crosslinking (vulcanization) and or (b) substantial recovery of their original shapes when strained or elongated, or both.
- 1.3 Extruded or molded shapes of sizes too small for cutting standard test specimens are difficult to classify or test by these methods and will usually require special testing procedures.
- 1.4 In case of conflict between the provisions of this general specification and those of detailed specifications or test methods for a particular product, the latter shall take precedence. Reference to the test methods in this document should specifically state the particular test or tests desired.
- 1.5 The values stated in SI units are to be regarded as the standard. English units are included for reference only.
- 1.6 The following safety hazards caveat pertains only to the test methods portions of this document: *This document 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 document to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

NOTE—ASTM D 1056-98 and ISO 6916-1 are similar to this document.

1. This specification is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.22 on Flexible Cellular Materials.

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2. References

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein.

- 2.1.1 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D 395—Test Methods for Rubber Property—Compression Set²

ASTM D 471—Test Method for Rubber Property—Effect of Liquids²

ASTM D 573—Test Method for Rubber—Deterioration in an Air Oven²

ASTM D 575—Test Methods for Rubber Properties in Compression²

ASTM D 832—Practice for Rubber Conditioning for Low-Temperature Testing²

ASTM D 1056—Specification for Flexible Cellular Materials—Sponge or Expanded Rubber³

ASTM D 1171—Test Method for Rubber Deterioration—Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)²

ASTM D 3182—Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets²

ASTM D 3183—Practice for Rubber—Preparation of Pieces for Test Purposes from Products²

- 2.1.2 ISO PUBLICATION—Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 6916-1—Flexible Cellular Polymeric Materials; Sponge and Expanded Cellular Rubber Products—Specification Part 1 Sheet

3. Definitions—Definitions of Terms Specific to this Document.

- 3.1 **Cellular Material**—A generic term for materials containing many cells (either open, closed, or both) dispersed throughout the mass.

- 3.2 **Closed Cell**—A product whose cells are totally enclosed by its walls and hence not interconnecting with other cells.

- 3.3 **Expanded Rubber**—Cellular rubber having closed cells made from a solid rubber compound.

- 3.4 **Flexible Cellular Material**—A flexible cellular organic polymeric material will not rupture within 60 s when a specimen 200 x 25 x 25 mm (8 x 1 x 1 in) is bent around a 25 mm (1 in) diameter mandrel at a uniform rate of one lap/5 s in the form of a helix at a temperature between 18 and 29 °C (65 and 85 °F).

- 3.5 **Open Cell**—A product whose cells are not totally enclosed by its walls and open to the surface, either directly or by interconnecting with other cells.

- 3.6 **Rubber**—A material that is capable of recovering from large deformations quickly and forcibly, and can be, or already is, modified to a state in which it is essentially insoluble (but can swell) in boiling solvent, such as benzene, methyl ethyl ketone, and ethanol-toluene azeotrope.

- 3.6.1 **DISCUSSION**—A rubber in its modified state, free of diluents, retracts within 1 min to less than 1.5 times its original length after being stretched at room temperature, 20 to 27 °C (68 °F ± 81 °F) to twice its length and held for 1 min before release.

2. Annual book of ASTM Standards, Vol 09.01.

3. Annual Book of ASTM Standards, Vol 08.01.

3.7 Skin—The textured outer surface on the material formed during manufacture by contact with molds, cover plate, air, or other curing medium.

3.7.1 DISCUSSION—Normally, this skin is formed by contact with the mold or cover plates during manufacture. Molded open-cell (sponge) parts usually have a skin on all surfaces, except when cut to length from longer strips. Parts made by cutting from open-cell (sponge) sheets usually have skin on two faces and open cells at the cut edges. Closed-cell (expanded) rubber sheets are frequently split from thicker pieces and consequently do not have the skin faces. On some products, it is desirable to add a solid rubber skin coating. The use to which the cellular rubber product is to be put determines the thickness of added skin required. Products subject to abrasion or open-cell (sponge) rubber that must withstand absorption of water or transmission of gases will ordinarily require an applied skin coating. Closed-cell (expanded) rubber does not usually require an added skin for these reasons.

3.8 Sponge Rubber—Cellular rubber consisting predominantly of open cells made from a solid rubber compound.

4. Classification (Types, Classes, Grades, and Suffix Letters)

4.1 Types—These specifications cover two types of cellular rubber designated by the prefix numbers 1 and 2.

4.1.1 TYPE 1—Open cell rubber.

4.1.2 TYPE 2—Closed cell rubber.

4.2 Classes—Both types are divided into four classes designated by the letters A, B, C, and D added to the number prefix.

4.2.1 CLASS A—Cellular rubber made from synthetic rubber, natural rubber, reclaimed rubber, or rubber-like materials, alone or in combination where specific resistance to the action of petroleum base oils is not required.

4.2.2 CLASS B—Cellular rubber made from synthetic rubber or rubber-like materials alone or in combination, having specific requirements for oil resistance with low mass change.

4.2.3 CLASS C—Cellular rubber made from synthetic rubber or rubber-like materials alone or in combination, having specific requirements for oil resistance with medium mass change.

4.2.4 CLASS D—Cellular rubbers made from synthetic rubber or rubber-like materials alone or in combination having specific requirements for extreme temperature resistance ranging from -75 to 175 °C (-103 to 347 °F); but specific resistance to the action of petroleum-base oils is not required.

NOTE—ASTM Oil No. 3 is no longer available (as of December 1993). It has been replaced by IRM 903⁴, which does not necessarily produce the same degree of swelling as ASTM #3 Oil. Comparison of the effect of IRM 903 versus ASTM Oil No. 3, on most elastomers tested, produces a close correlation.

4. Available from R. E. Carroll, P. O. Box 139, Trenton, NJ 08801

4.3 Grades—Each type and class has been divided into a number of different grades. Each grade is based on a specific range of firmness as expressed by compression-deflection (see Section 17). Grades are designated by digit, the softer grades being identified with the lower numbers and the higher grades being identified with the higher numbers.

4.3.1 GRADE 0—For Types 1 and 2 cellular rubber, a compression-deflection range from 0 to 15 kPa (0 to 2 psi).

4.3.2 GRADE 1—For Types 1 and 2 cellular rubber, a compression-deflection range from 15 to 35 kPa (2 to 5 psi).

4.3.3 GRADE 2—For Types 1 and 2 cellular rubber, a compression-deflection range from 35 to 65 kPa (5 to 9 psi).

4.3.4 GRADE 3—For Types 1 and 2 cellular rubber, a compression-deflection range from 65 to 90 kPa (9 to 13 psi).

4.3.5 GRADE 4—For Types 1 and 2 cellular rubber, a compression-deflection range from 90 to 120 kPa (13 to 17 psi).

4.3.6 GRADE 5—For Types 1 and 2 cellular rubber, a compression-deflection range from 120 to 170 kPa (17 to 25 psi).

5. *Materials and Manufacture*

5.1 Sponge Rubber—Sponge rubber is made by incorporating into the compound a blowing agent, such as sodium bicarbonate, that gives off a gas which expands the mass during the vulcanization process. Sponge rubber is manufactured in sheet, strip, molded, or special shapes. Unless otherwise specified, sheet and strip sponge rubber shall have a natural skin on both the top and bottom surfaces. Fabric surface impressions are ordinarily not objectionable. The coarseness of the impressions shall be agreed upon by the parties concerned.

5.2 Expanded Rubber—Closed-cell rubbers are made by incorporating gas-forming ingredients in the rubber compound, or by subjecting the compound to high-pressure gas such as nitrogen. Expanded rubber is manufactured in sheet, strip, molded, tube, cord, and profile shapes by molding or extruding. Unless otherwise specified, the presence of skin on the top or bottom surfaces of sheet and strip expanded rubber shall be optional. Extruded shapes have skin on all surfaces except cut ends.

6. *Physical Properties*

6.1 The various grades of cellular rubber shall conform to the physical property requirements listed in Tables 1 and 2, together with any additional requirements indicated by suffix letters in the grade designations as described in Section 4 and Table 3.

7. *Tolerances on Dimensions*

7.1 Tolerances on dimensions of cellular rubber products shall be as specified in Table 4.

8. *Color*

8.1 Unless otherwise specified, the color of cellular rubber shall be black.

TABLE 1A—PHYSICAL REQUIREMENTS OF CELLULAR RUBBERS, TYPE 1, OPEN-CELL SPONGE—BASIC REQUIREMENTS

Grade Number	Compression Deflection (Limits), kPa (psi) ⁽¹⁾	Compression Deflection after Oven Aging, % Change from Original 168 h at 70 °C (158 °F)	Compression Deflection after Oven Aging, % Change from Original 22 h at 150 °C (302 °F)	Oil-Aged 22 h at 70 °C (158 °F), Change in Volume in IRM 903 (Limits), %	Compression Set, 50% Deflection, max %, 22 h at 70 °C (158 °F)	Compression Set, 50% Deflection, max %, 22 h at 100 °C (212 °F)	Low-Temperature Flex, 5 h at -55 °C (-67 °F)
Class A, Non-Oil Resistant							
1A0	less than 15 (2)	±20 ⁽²⁾	—	—	15	—	—
1A1	15 to 35 (2 to 5)	±20	—	—	15	—	—
1A2	35 to 65 (5 to 9)	±20	—	—	15	—	—
1A3	65 to 90 (9 to 13)	±20	—	—	15	—	—
1A4	90 to 120 (13 to 17)	±20	—	—	15	—	—
1A5	120 to 170 (17 to 25)	±20	—	—	15	—	—
Class B, Oil-Resistant, Low Mass Change ⁽³⁾							
1B0	less than 15 (2)	±20 ⁽²⁾	—	-25 to 10	40	—	—
1B1	15 to 35 (2 to 5)	±20	—	-25 to 10	40	—	—
1B2	35 to 65 (5 to 9)	±20	—	-25 to 10	40	—	—
1B3	65 to 90 (9 to 13)	±20	—	-25 to 10	40	—	—
1B4	90 to 120 (13 to 17)	±20	—	-25 to 10	40	—	—
1B5	120 to 170 (17 to 25)	±20	—	-25 to 10	40	—	—
Class C, Oil-Resistant, Medium Swell ⁽³⁾							
1C0	less than 15 (2)	±20 ⁽²⁾	—	+10 to 60	50	—	—
1C1	15 to 35 (2 to 5)	±20	—	+10 to 60	50	—	—
1C2	35 to 65 (5 to 9)	±20	—	+10 to 60	50	—	—
1C3	65 to 90 (9 to 13)	±20	—	+10 to 60	50	—	—
1C4	90 to 120 (13 to 17)	±20	—	+10 to 60	50	—	—
1C5	120 to 170 (17 to 25)	±20	—	+10 to 60	50	—	—
Class D, High-Temperature-Resistant							
1D0	less than 15 (2)	—	±5	—	—	—	pass
1D1	15 to 35 (2 to 5)	—	±5	—	—	50	pass
1D2	35 to 65 (5 to 9)	—	±5	—	—	30	pass
1D3	65 to 90 (9 to 13)	—	±5	—	—	30	pass
1D4	90 to 120 (13 to 17)	—	±5	—	—	30	pass
1D5	120 to 170 (17 to 25)	—	±5	—	—	30	pass

1. Compression deflection ranges modified to agree with ASTM D 1056-98.
2. If this grade after aging still falls within the compression-deflection requirement of <15 kPa (2 psi), it shall be considered acceptable even though the change from the original is greater than ±20%.
3. Terminology was changed in 1997 from low swell to low mass change to better reflect the data obtained.

**TABLE 1B—PHYSICAL REQUIREMENTS OF CELLULAR RUBBERS, TYPE 1, OPEN-CELL SPONGE—
REQUIREMENTS ADDED BY SUFFIX LETTERS**

Grade Number	Compression Deflection, 25% Deflection (Limits), kPa (psi) ⁽¹⁾	A4 Compression Deflection after Oven Aging, % Change From Original, 22 h at 175 °C (347 °F)	B1 Compression Set, 50% Deflection max %, 22 h at 70 °C (158 °F)	F1 Low-Temperature Flex 5 h at -40 °C (-40 °F)	F2 Low-Temperature Flex 5 h at -55 °C (-67 °F)	F3 Low-Temperature Flex 5 h at -75 °C (-103 °F)
Class A, Non-Oil Resistant						
1A0	less than 15 (2)	—	—	pass	pass	—
1A1	15 to 35 (2 to 5)	—	—	pass	pass	—
1A2	35 to 65 (5 to 9)	—	—	pass	pass	—
1A3	65 to 90 (9 to 13)	—	—	pass	pass	—
1A4	90 to 120 (13 to 17)	—	—	pass	pass	—
1A5	120 to 170 (17 to 35)	—	—	pass	pass	—
Class B, Oil-Resistant, Low Mass Change⁽²⁾						
1B0	less than 15 (2)	—	—	pass	—	—
1B1	15 to 35 (2 to 5)	—	—	pass	—	—
1B2	35 to 65 (5 to 9)	—	—	pass	—	—
1B3	65 to 90 (9 to 13)	—	—	pass	—	—
1B4	90 to 120 (13 to 17)	—	—	pass	—	—
1B5	120 to 170 (17 to 35)	—	—	pass	—	—
Class C, Oil-Resistant, Medium Mass Change⁽²⁾						
1C0	less than 15 (2)	—	25	pass	—	—
1C1	15 to 35 (2 to 5)	—	25	pass	—	—
1C2	35 to 65 (5 to 9)	—	25	pass	—	—
1C3	65 to 90 (9 to 13)	—	25	pass	—	—
1C4	90 to 120 (13 to 17)	—	25	pass	—	—
1C5	120 to 170 (17 to 35)	—	25	pass	—	—
Class D, High-Temperature-Resistant						
1D0	less than 15 (2)	±25	—	pass	—	pass
1D1	15 to 35 (2 to 5)	±25	—	pass	—	pass
1D2	35 to 65 (5 to 9)	±25	—	pass	—	pass
1D3	65 to 90 (9 to 13)	±25	—	pass	—	pass
1D4	90 to 120 (13 to 17)	±25	—	pass	—	pass
1D5	120 to 170 (17 to 35)	±25	—	pass	—	pass

1. Compression deflection ranges modified to agree with ASTM D 1056-98.

2. Terminology was changed in 1997 from low swell to low mass change to better reflect the data obtained.

TABLE 2A—PHYSICAL REQUIREMENTS OF CELLULAR RUBBERS, TYPE 2, CLOSED-CELL EXPANDED—BASIC REQUIREMENTS

Grade Number	Compression Deflection 25% Deflection (Limits) kPa (psi) ⁽¹⁾	Oven-Aged, % Change from Original Compression Deflection Values (Limits), 168 h at 70 °C (158 °F)	Oven-Aged, % Change from Original Compression Deflection Values (Limits), 22 h at 150 °C (302 °F)	Water Absorption, max weight % Density over 160 kg/m ³ (10 lb/ft ³) or less	Fluid Immersion, 7 Days at 23 °C (73.4 °F), max weight % ⁽²⁾ Density over 160 kg/m ³ (10 lb/ft ³)	Fluid Immersion, 7 Days at 23 °C (73.4 °F), max weight % ⁽²⁾ Density 160 kg/m ³ (10 lb/ft ³) or less
Class A, Non-Oil Resistant						
2A0	Less than 15 (2)	±30	—	5	10	—
2A1	15 to 35 (2 to 5)	±30	—	5	10	—
2A2	35 to 65 (5 to 9)	±30	—	5	10	—
2A3	65 to 90 (9 to 13)	±30	—	5	10	—
2A4	90 to 120 (13 to 17)	±30	—	5	10	—
2A5	120 to 170 (17 to 25)	±30	—	5	10	—
Class B, Oil Resistant, Fuel-Resistant, Low Mass Change⁽³⁾						
2B0	Less than 15 (2)	±30	—	5	10	100
2B1	15 to 35 (2 to 5)	±30	—	5	10	100
2B2	35 to 65 (5 to 9)	±30	—	5	10	100
2B3	65 to 90 (9 to 13)	±30	—	5	10	100
2B4	90 to 120 (13 to 17)	±30	—	5	10	100
2B5	120 to 170 (17 to 25)	±30	—	5	10	100
Class C, Fuel-Resistant, Medium Mass Change⁽³⁾						
2C0	Less than 15 (2)	±30	—	5	10	250
2C1	15 to 35 (2 to 5)	±30	—	5	10	250
2C2	35 to 65 (5 to 9)	±30	—	5	10	250
2C3	65 to 90 (9 to 13)	±30	—	5	10	250
2C4	90 to 120 (13 to 17)	±30	—	5	10	250
2C5	120 to 170 (17 to 25)	±30	—	5	10	250
Class D, High-Temperature-Resistant						
2D0	Less than 15 (2)	—	±5	5	10	—
2D1	15 to 35 (2 to 5)	—	±5	5	10	—
2D2	35 to 65 (5 to 9)	—	±5	5	10	—
2D3	65 to 90 (9 to 13)	—	±5	5	10	—
2D4	90 to 120 (13 to 17)	—	±5	5	10	—
2D5	120 to 170 (17 to 25)	—	±5	5	10	—

1. Compression deflection ranges modified to agree with ASTM D 1056-98.

2. This test (see Section 19) of weight change in Reference Fuel B is used in place of the usual oil-resistance test of volume change of IRM 903 oil for the following reason: Oil or solvent immersion of flexible closed cellular materials usually causes loss of gas, by diffusion through the softened cell walls, that results in some shrinkage of the test sample. This shrinkage counteracts the swell that would normally occur, therefore invalidating test data based on volume change. Reference Fuel B is used because it produces a wider and more consistent differentiation among the A, B, and C classes than does IRM 903 oil.

3. Standard oil resistance test methods give inconsistent results on closed cellular materials. This test gives a general indication of oil resistance but more reliable information should be obtained by testing in actual or simulated service conditions.

The values of 150% maximum Class C and 50% maximum Class B apply to cellular materials having densities of more than 160 kg/m³ (10 lb/ft³). For cellular materials with densities of 160 kg/m³ or less, the values of maximum mass change allowed are 250% for Class C and 100% for Class B. Terminology was changed in 1997 from low swell to low mass change to better reflect the data obtained.

**TABLE 2B—PHYSICAL REQUIREMENTS OF CELLULAR RUBBERS, TYPE 2, CLOSED-CELL EXPANDED—
REQUIREMENTS ADDED BY SUFFIX LETTERS**

Grade Number	Compression Deflection 25% Deflection (Limits) kPa (psi)	Compression Set, max %, Under Constant		Compression Set, max %, Under Constant		Low-Temperature Flex, Suffix F1 5 h @ −40 °C (−40 °F)	Low-Temperature Flex, Suffix F2 5 h at −55 °C (−67 °F)
		Deflection of 50% Suffix B1 22 h at 100 °C (212 °F)	Deflection of 50% Suffix B2 ⁽¹⁾ 22 h at 23 °C (73.4 °F) 24 h recovery	Deflection of 50% Suffix B3 22 h at 23 °C (73.4 °F) 24 h recovery			
Class A, Non-Oil Resistant							
2A0	Less than 15 (2)	—	25	35	pass	—	—
2A1	15 to 35 (2 to 5)	—	25	35	pass	—	—
2A2	35 to 65 (5 to 9)	—	25	35	pass	—	—
2A3	65 to 90 (9 to 13)	—	25	35	pass	—	—
2A4	90 to 120 (13 to 17)	—	25	35	pass	—	—
2A5	120 to 170 (17 to 25)	—	25	35	pass	—	—
Class B, Oil Resistant, Fuel-Resistant, Low Mass Change ⁽²⁾							
2B0	Less than 15 (2)	—	25	35	pass	—	—
2B1	15 to 35 (2 to 5)	—	25	35	pass	—	—
2B2	35 to 65 (5 to 9)	—	25	35	pass	—	—
2B3	65 to 90 (9 to 13)	—	25	35	pass	—	—
2B4	90 to 120 (13 to 17)	—	25	35	pass	—	—
2B5	120 to 170 (17 to 25)	—	25	35	pass	—	—
Class C, Fuel-Resistant, Medium Mass Change ⁽²⁾							
2C0	Less than 15 (2)	—	25	35	pass	—	—
2C1	15 to 35 (2 to 5)	—	25	35	pass	—	—
2C2	35 to 65 (5 to 9)	—	25	35	pass	—	—
2C3	65 to 90 (9 to 13)	—	25	35	pass	—	—
2C4	90 to 120 (13 to 17)	—	25	35	pass	—	—
2C5	120 to 170 (17 to 25)	—	25	35	pass	—	—
Class D, High-Temperature-Resistant							
2D0	Less than 15 (2)	80	—	—	—	—	pass
2D1	15 to 35 (2 to 5)	80	—	—	—	—	pass
2D2	35 to 65 (5 to 9)	80	—	—	—	—	pass
2D3	65 to 90 (9 to 13)	80	—	—	—	—	pass
2D4	90 to 120 (13 to 17)	80	—	—	—	—	pass
2D5	120 to 170 (17 to 25)	80	—	—	—	—	pass

1. Previous versions of SAE J18 inadvertently listed the suffix as "B," instead of "B2."
2. Standard oil resistance test methods give inconsistent results on closed cellular materials. This test gives a general indication of oil resistance but more reliable information should be obtained by testing in actual or simulated service conditions.
The values of 150% maximum Class C and 50% maximum Class B apply to cellular materials having densities of more than 160 kg/m³ (10 lb/ft³). For cellular materials with densities of 160 kg/m³ or less, the values of maximum mass change allowed are 250% for Class C and 100% for Class B.
Terminology was changed in 1997 from low swell to low mass change to better reflect the data obtained.