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SURFACE VEHICLE RECOMMENDED PRACTICE

An American National Standard

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SPONGE AND EXPANDED CELLULAR RUBBER PRODUCTS[1]

Foreword—See Rationale for changes and also the format has been changed to comply with the SAE Technical Standards Board format.

1. Scope

1.1 This SAE Recommended Practice covers flexible cellular rubber products known as sponge rubbers and expanded rubbers but does not apply to latex foam rubbers. The base material used in their manufacture may be natural rubber, reclaimed rubber, synthetic rubber, or rubber-like materials, alone or in combination. Ebonite cellular rubbers are not included.

1.2 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.

1.3 In case of conflict between the provisions of this general specification and those of detailed specifications of test for a particular product the latter shall take precedence. Reference to these methods for testing cellular rubber products should specifically state the particular test or tests desired.

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

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.

ASTM D 395—Test Methods for Rubber Property—Compression Set
ASTM D 471—Test Method for Rubber Property—Effect of Liquids
ASTM D 573—Test Method for Rubber—Deterioration in an Air Oven
ASTM D 575—Test for Rubber Properties in Compression
ASTM D 832—Practice for Rubber Conditioning for Low-Temperature Testing
ASTM D 1056—Specification for Flexible Cellular Materials—Sponge or Expanded Rubber

1. This specification is under the jurisdiction of ASTM Committee D-11 on Rubber and is the direct responsibility of Subcommittee D11.33 on Flexible Cellular Materials.
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ASTM D 1171—Test Method for Rubber Deterioration—Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D 3182—Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets
ASTM D 3183—Practice for Rubber—Preparation of Pieces for Test Purposes from Products

3. Definitions

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

3.2 Expanded Rubber—Cellular rubber having closed cells made from a solid rubber compound.

3.3 Flexible—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 in 5 s in the form of a helix at a temperature between 18 and 29 °C (65 and 85 °F).

3.4 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.

3.4.1 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) to twice its length and held for 1 min before release.

3.5 Skin—A relatively dense layer at the surface of a cellular material. 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 which 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. In all cases where a skin is applied, there should be good adhesion between it and the cellular rubber.

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

4. Materials and Manufacture

4.1 Sponge Rubbers—Sponge rubbers are made by incorporating into the compound an inflating agent, such as sodium bicarbonate, that gives off a gas which expands the mass during the vulcanization process. Sponge rubbers are 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.

4.2 Expanded Rubbers—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 rubbers are manufactured in sheet, strip molded, and special 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.

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

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

5.1.1 TYPE 1—Open-cell rubber.

5.1.2 TYPE 2—Closed-cell rubber.

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

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

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

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

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

5.3 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 15). Grades are designated by digit, the softer grades being identified with the lower numbers and the higher grades being identified with the higher numbers.

5.3.1 GRADE 0—For Type 1 cellular rubbers only, a compression-deflection range of 3.5 to 14 kPa (0.5 to 2 psi).

5.3.2 GRADE 1—For Types 1 and 2 cellular rubbers, a compression-deflection range of 14 to 35 kPa (2 to 5 psi).

5.3.3 GRADE 2—For Types 1 and 2 cellular rubbers, a compression-deflection range of 35 to 63 kPa (5 to 9 psi).

5.3.4 GRADE 3—For Types 1 and 2 cellular rubbers, a compression-deflection range of 63 to 91 kPa (9 to 13 psi).

5.3.5 GRADE 4—For Types 1 and 2 cellular rubbers, a compression-deflection range of 91 to 119 kPa (13 to 17 psi).

5.3.6 GRADE 5—For Types 1 and 2 cellular rubbers, a compression-deflection range of 119 to 168 kPa (17 to 24 psi).

6. Physical Properties—The various grades of cellular rubber shall conform to the requirements as to physical properties in Tables 1, 2, and 3, together with any additional requirements indicated by suffix letters in the grade designations as described in Section 5 and Table 4.

7. Workmanship, Finish, and Appearance—Cellular rubbers furnished under this specification shall be manufactured from natural rubber, synthetic rubber, or rubber-like materials together with added compounding ingredients of such nature and quality that the finished product complies with the specification requirements. In permitting choice in use of those materials by the producer, it is not intended to imply that the different rubber materials are equivalent in respect to all physical properties. Any special characteristics other than those prescribed in this specification which may be desired for specific applications, shall be specified in the product specifications, as they may influence the choice of the type of rubber material or other ingredients used. All materials and workmanship shall be in accordance with good commercial practice, and the resulting cellular rubbers shall be free from defects affecting serviceability.

8. Color—Unless otherwise specified, the color of cellular rubbers shall be black.

9. Test Methods—Unless specifically stated otherwise, all tests shall be made in accordance with the methods specified in Sections 13 through 19 and Table 3.

10. Tolerances on Dimensions—Tolerances on dimensions of cellular rubber products shall be as specified in Table 6.

11. Inspection and Rejection

11.1 All tests and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified. The manufacturer shall afford the inspector all reasonable facilities for tests and inspection.

11.2 The purchaser may make the tests and inspection to govern acceptance or rejection of the material at his own laboratory or elsewhere. Such tests and inspection shall be made no later than 15 days after receipt of the material.

11.3 All samples for testing, provided as specified in 13.2, shall be visually inspected to determine compliance with the material, workmanship, and color requirements.

11.4 Any material that fails in one or more of the test requirements may be retested. For this purpose, two additional tests shall be made for the requirement in which failure occurred. Failure to either of the retests shall be cause for final rejection.

11.5 Rejected material shall be disposed of as directed by the manufacturer.

12. Packaging and Package Marking—The material shall be properly and adequately packaged. Each package or container shall be legibly marked with the name of the material, name or trademark of the manufacturer, and any required purchaser's designations.

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

	Basic Requirements				Requirements Added by Suffix Letters		
					Suffix B1	Suffix F1	Suffix F2
Grade Number	Compression Deflection, 25% Deflection (Limits), kPa (psi)	Oil-Aged 22 h at 70 °C (158 °F), Change in Volume in ASTM Oil No. 3 (Limits), %	Oven-Aged 7 Days at 70 °C (158 °F), Change from Original Compression-Deflection Values (Limits), %	Compression Set, 22 h at 70 °C (158 °F) 50% Deflection, max, %	Compression Set, 22 h at 70 °C (158 °F), 50% Deflection, max, %	Low-Temperature Test at –40 °C (–40 °F), Change from Original Deflection Values, max, %	Low-Temperature Test at –55 °C (–67 °F), Change from Original Deflection Values, max, %
Class A, Non-Oil Resistant							
1A0	3.5–14(0.5–2)	---	±20[1]	15	---	25	25
		---	±20	15	---	25	25
1A1	14–35(2–5)	---	±20	15	---	25	25
1A2	35–63(5–9)	---	±20	15	---	25	25
1A3	63–91(9–13)	---	± 20	15	---	25	25
1A4	91–119(13–17)	---	± 20	15	---	25	25
1A5	119–168(17–24)	---	± 20	15	---	25	25
Class B, Oil-Resistant, Low Swell							
1B0	3.5–14(0.5–2)				---	50	
		–25 to 10	± 20[1]	40	---	50	---
1B1	14–35(2–5)	–25 to 10	± 20	40	---	50	---
1B2	35–63(5–9)	–25 to 10	± 20	40	---	50	---
1B3	63–91(9–13)	–25 to 10	± 20	40	---	50	---
1B4	91–119(13–17)	–25 to 10	± 20	40	---	50	---
1B5	119–168(17–24)	–25 to 10	± 20	40	---		
Class C, Oil-Resistant, Medium Swell							
1C0	3.5–14(0.5–2)						
		+ 10 to 60	±20[1]	50	25	50	---
1C1	14–35(2–5)	+ 10 to 60	±20	50	25	50	---
1C2	35–63(5–9)	+ 10 to 60	±20	50	25	50	---
1C3	63–91(9–13)	+ 10 to 60	±20	50	25	50	---
1C4	91–119(13–17)	+ 10 to 60	±20	50	25	50	---
1C5	119–168(17–24)	+ 10 to 60	±20	50	25	50	---

1. If this grade after aging still falls within the compression-deflection requirement of 3.5 to 14 kPa (0.5 to 2 psi), it shall be considered acceptable even though the change from the original is greater than ±20%.

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

	Basic Requirements				Requirements Added by Suffix Letters
					Suffix B
Grade Number	Compression Deflection 25% Deflection (Limits) kN/m^2(psi)	Fluid-Immersion 7 days at 23 °C (73.4 °F) Change in Weight in ASTM Reference Fuel B, max, % (1)	Oven-Aged 7 Days at 70 °C (158 °F) Change from Original Deflection Values (Limits), %	Water Absorption max, weight % (2)	Compression Set 22 h at Room Temperature 50% Deflection, After 24 h Recovery at Room Temperature, max, %
Class A, Non-Oil Resistant					
2A1	14–35(2–5)		± 30	5	25
2A2	35–63(5–9)		± 30	5	25
2A3	63–91(9–13)		± 30	5	25
2A4	91–119(13–17)		± 30	5	25
2A5	119–168(17–24)		± 30	5	25
Class B, Oil Resistant, Low Swell (3)					
2B1	14–35(2–5)	50	± 30	5	25
2B2	35–63(5–9)	50	± 30	5	25
2B3	63–91(9–13)	50	± 30	5	25
2B4	91–119(13–17)	50	± 30	5	25
2B5	119–168(17–24)	50	± 30	5	25
Class C, Oil Resistant, Medium SwellFootnote 3					
2C1	14–35(2–5)	150	± 30	5	25
2C2	35–63(5–9)	150	± 30	5	25
2C3	63–91(9–13)	150	± 30	5	25
2C4	91–119(13–17)	150	± 30	5	25
2C5	119–168(17–24)	150	± 30	5	25

The figures of 150% maximum Class C and 50% maximum Class B apply to cellular materials having densities of more than 160 kg/m^3 (10 lb/ft^3). For cellular materials with densities 160 kg/m^3 or less, the values of maximum mass change allowed are 250% for Class C and 100% for Class B.

1. This test (see sections 33 to 36 of these specifications) of weight change in Reference Fuel B is used in place of the usual oil resistance test of volume change of No. 3 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 the No. 3 oil.
2. For cellular materials with densities 160 kg/m^3 (10 lb/ft^3) or less, the value of water absorption allowed is 10% max by weight. For densities of more than 160 kg/m^3 (10 lb/ft^3) the value of water absorption is 5% max by weight.
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.

TABLE 3—TOLERANCES ON DIMENSIONS OF CELLULAR RUBBER PRODUCTS FOR GENERAL APPLICATIONS

Form	Thickness Dimension, mm (in)	Thickness Tolerance, ±, mm (in)	Length and Width Dimension, mm (in)	Length and Width Tolerance, ±, mm (in)
Sponge Rubbers				
Sheet and strip	3.2 (1/8 and under	0.4 (1/64)	152 (6) and under	1.6 (1/16)
	Over 3.2 (1/8) to 12.7 (1/2) incl	0.8 (1/32)	Over 152 (6) to 457 (18) incl	3.2 (1/8)
	Over 12.7 (1/2)	1.2 (3/64)	Over 457 (18)	0.5%
Molded or special shapes	6.4 (1/4) and under	0.8 (1/32)	6.4 (1/4) and under	0.8 (1/32)
	Over 6.4 (1/4) to 76.2 (3) incl	1.6 (1/16)	Over 6.4 (1/4) to 76 (3) incl	1.6 (1/16)
			Over 76 (3) to 457 (18) incl	3.2 (1/8)
			Over 457 (18)	0.5%
Expanded Rubbers				
Sheet and strip	3.2 (1/8) to 12.7 (1/2) incl	1.6 (1/16)	152 (6) and under	6.4 (1/4)
	Over 12.7 (1/2)	2.4 (3/32)	Over 152 (6) to 305 (12) incl	9.6 (3/8)
			Over 305 (12)	3%
Molded or special shapes	3.2 (1/8) to 12.7 (1/2) incl	1.6 (1/16)	152 (6) and under	6.4 (1/4)
	Over 12.7 (1/2) to 38.1 (1-1/2) incl	2.4 (3/32)	Over 152 (6) to 305 (12) incl	9.6 (3/8)
	Over 38.1 (1-1/2) to 76.2 (3) incl	3.2 (1/8)	Over 305 (12)	3%

TABLE 4—ASTM TEST METHODS[1]

Basic Requirements and Suffix No Requirement or Suffix Letter	Basic Requirements	1	2	3	4
Compression Deflection	D 1056, Sections 18 to 21				
Heat Resistance	D 1056, Sections 16 to 17, change in compression deflection after aging 7 days at 70 °C (158 °F)				
Oil Resistance (1B and 1C Rubbers Only)	D 1056, Sections 25 to 26, 22 h at 70 °C (158 °F)				
Compression Set (1A, 1B, and 1C Rubbers Only)	D 1056, Sections 22 to 24, 22 h at 70 °C (158 °F) 50% deflection 30-min recovery at RT				
Compression Set (1D and 2D Rubbers Only)	D 1056, Sections 22 to 24, 22 h at 100 °C (212 °F), 50% deflection, 30-min recovery at RT				
Water Absorption (2A, 2B, 2C, and 2D Rubbers Only)	D 1056, Sections 31 to 33				
Suffix A, Heat Resistance		D 1056, Sections 16 to 17, change in compression deflection after aging 22 h at 100 °C ± 1 °C (212 °F)	D 1056, Sections 16 to 17, change in compression deflection after aging 22 h at 125 °C ± 1 °C (257 °F)	D 1056, Sections 16 to 17, change in compression deflection after aging 22 h at 150 °C ± 1 °C (302 °F)	D 1056, Sections 16 to 17, change in compression deflection after aging 22 h at 175 °C ± 1 °C (347 °F)
Suffix B, Compression Set		D 1056, Sections 22 to 24, 22 h at 70 °C (158 °F), 50% deflection, 30-min recovery at RT	D 1056, Sections 22 to 24, 22 h at RT, 50% deflection, 24-h recovery at RT		
Suffix C, Ozone or Weather Resistance		D 1171[2] ozone exposure Method A	D 1171[2], outdoor exposure	D 1171[2], ozone exposure, Method B	
Suffix D, Load Deflection[3]					

TABLE 4—ASTM TEST METHODS[1]

Basic Requirements and Suffix No Requirement or Suffix Letter	Basic Requirements	1	2	3	4
Suffix E, Fluid Resistance		D 1056[4] Sections 34 to 37, 150% max	D 1056[4], Sections 34 to 37, 50% max		
Suffix F, Low-Temperature Resistance		D 1056, Sections 27 to 30, 5 h at –40 °C (–40 °F)	D 1056, Sections 27 to 30, 5 h at –55 °C (–67 °F)	D 1056, Sections 27 to 30, 5 h at –75 °C (–103 °F)	
Suffix G, Tear Resistance[3]					
Suffix H, Flex Resistance[3]					
Suffix J, Abrasion Resistance[3]					
Suffix K, Adhesion Capability[3]					
Suffix L, Water Absorption[3]					
Suffix M, Flammability Resistance[3]					
Suffix N, Impact Resistance[3]					
Suffix P, Staining Resistance[3]					
Suffix R, Resilience[3]					
Suffix Z, Special Requirements[3]					

1. The designations refer to the following methods of ASTM D 1056, Sections 13 to 37, D 1171.
2. Ratings to be arranged between the purchaser and the supplier.
3. Test method and values to be arranged between the purchaser and the supplier.
4. Table 2 for materials having densities of 160 kg/m^3 (10 lb/ft^3) or less.

EXAMPLE—Grade 1A1C1F1 denotes soft sponge rubber containing natural, reclaimed, synthetic, or blends of these rubbers with a compression deflection value of 14 to 35 kPa (2 to 5 pis), having no speciifc solvent or oil resistance and requiring in addition to the basic tests a weather resistance test run in accordance with Method D 1171 and a low-temperature test at –40 °C (–40 °F). Examples of specification converstions are given in Table 5.

TABLE 5—EXAMPLES OF SPECIFICATION CONVERSION

ASTM D 1056 – 68	ASTM D 1056 – 73	ASTM D 1056 – 77	ASTM D 1056 – 85
RE 41 BF1	RE 41 BF1	RE 41 B2F1	2A1 B2F1
SBE 43 BCF2	RE 43 BCE2F2	RE 43 B2C1E2F2	2B3 B2C1F2
SCE 42	RE 42 E1	RE 42 E1	2C2
SB0 12 BF1	SB0 12 BF1	SB0 12 B1F1	1B2 B1F1
SC0 13 CF2	SC0 13 CF2	SC0 13 C2F2	1C3 C2F2

TABLE 6—PHYSICAL REQUIREMENTS OF CLASS D—EXTREME TEMPERATURE-RESISTANT CELLULAR RUBBER (–75 TO + 175 °C (–103 TO +347 °F))

Basic Requirements						Requirements Added by Suffix Letters	
						Suffix A4	Suffix F3
Grade Number	Compression Deflection at 25% Deflection, 23 °C ± 3 °C (73 °F ± 5 °F) (Limits) kPa (psi)	Compression Deflection After Heat Aging, 22 h at 150 °C ± 2 °C (302 °F ± 3.6 °F) Change from Original Compression Deflection, (Limits), %	Compression Deflection at Low Temperature, 5 h at –55 °C ± 2 °C (–67 °F ± 3.6 °F) Change from Original Compression Deflection, max, %	Compression Set Under Constant Deflection (50%), 22 h at 100 °C ± 1 °C (212 °F ± 1.8 °F), max, %	Water Absorption 3 min at Room Temperature Water max, Mass, %	Compression Deflection After Heat Aging 22 h at 175 °C ± 2 °C (347 °F ± 3.6 °F) Change from Original Compression Deflection (Limits), %	Compression Deflection at Low Temperature 5 h at –75 °C ± 2 °C (–103 °F ± 3.6 °F) Change from Original Compression Deflection, max, %
1D1	14–35(2–5)	± 5	5	50	---	± 25	25
1D2	35–63(5–9)	± 5	5	30	---	± 25	25
1D3	63–105(9–15)	± 5	5	30	---	± 25	25
1D4	105–147(15–21)	± 5	5	30	---	± 25	25
1D5	147–203(21–29)	± 5	5	30	---	± 25	25
2D1	14–35(2–5)	± 5	5	80	5	---	---
2D2	35–63(5–9)	± 5	5	60	5	---	---
2D3	63–105(9–15)	± 5	5	60	5	---	---
2D4	105–147(15–21)	± 5	5	60	5	---	---
2D5	147–203(21–29)	± 5	5	60	5	---	---

13. General Test Methods

13.1 Scope—Except as otherwise specified in these methods of testing cellular rubbers, the following methods of the American Society for Testing and Materials and the various test methods in Table 4, applicable in general to vulcanized rubber, shall be complied with as required and are hereby made a part of these methods:

13.1.1 GENERAL PHYSICAL TEST REQUIREMENTS—Practices D 3182 and D 3183.

13.1.2 AGING TEST—Test Method D 573, with modifications as described in Section 14 of this specification.

13.1.3 COMPRESSION SET, SUFFIX B—Method described in Section 16 of this specification.

13.1.4 FLUID IMMERSION, SUFFIX E—Test Method D 471 and Section 17 or 20 of this specification.

13.1.5 LOW-TEMPERATURE TEST, SUFFIXES F1, F2, AND F3—Method described in Section 18 of this specification. Suitable low-temperature cabinets and conditioning procedures are described in Practice D 832.

In case of conflict between provisions of the previous methods and the procedures herein specifically described for cellular rubbers, the latter shall take precedence.

13.2 Sampling

13.2.1 When possible, the completed manufactured product shall be used for the tests specified. Representative samples of the lot being examined shall be selected at random as required.

13.2.2 When it is necessary or advisable to obtain test specimens from the article, as in those cases where the entire sample is not required or adaptable for testing, the method of cutting and the exact position from which specimens are to be taken shall be specified. The apparent density and the state of cure may vary in different parts of the finished product, especially if the article is of complicated shape or of varying thickness, and these factors affect the physical properties of the specimens. Also, the apparent density is affected by the number of cut surfaces as opposed to the number of skin-covered surfaces on the test specimen.

13.2.3 When the finished product does not lend itself to testing or to the taking of test specimens because of complicated shape, small size, metal or fabric inserts, solid covers, adhesion to metal, or other reasons, standard test slabs shall be prepared. When differences due to the difficulty in obtaining suitable test specimens from the finished part arise, manufacturer and purchaser may agree on acceptable deviations. This can be done by comparing results of standard test specimens and those obtained on actual parts.

13.3 Test Specimens and Slabs

13.3.1 TEST SPECIMENS—Standard test specimens shall be disks 28.68 mm (1.129 in) in diameter. The specimens may be cut with a revolving die[2] using a soap solution as a lubricant. If a lubricant is used, the specimens shall be thoroughly dried before proceeding with the testing. In some cases it may be necessary to freeze the cellular rubber to obtain parallel cut edges. When cut from standard test slabs they shall be cut from the center area as shown in Figure 1. The thickness shall be measured as described in 13.3.3.2. As stated under the test methods, the minimum thickness of test specimens is 6.35 mm (1/4 in). Plied-up samples may be used as indicated in the test methods for compression set and compression deflection (see Note in 15.2).

2. A satisfactory die and its method of application are described in Section 4 of ASTM Methods D 575 which appear in the Annual Book of ASTM Standards, Part 37.

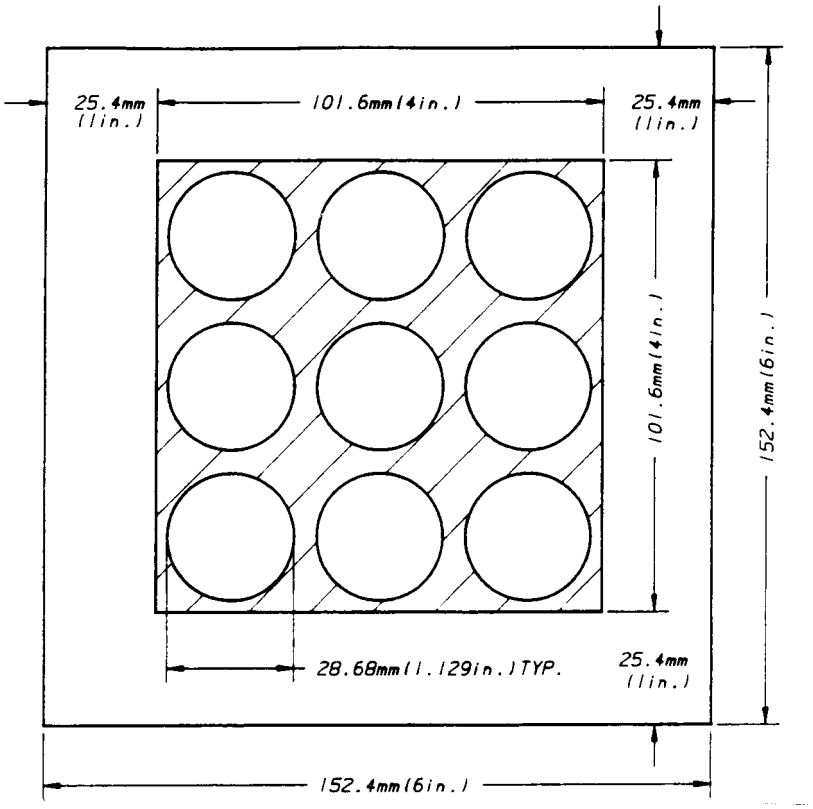

FIGURE 1—LOCATION FROM WHICH STANDARD TEST SPECIMENS ARE TO BE CUT WHEN TESTING STANDARD TEST SLABS OR COMMERCIAL FLAT SHEETS

13.3.2 TEST SLABS—Standard test slabs of all types of cellular rubber shall be pieces 150 mm ± 5 mm (nominally 6 in) square and 12.5 mm ± 0.5 mm (nominally 0.5 in) in thickness made from the same compound and having the same apparent density and state of cure as the product they represent. In all cases the surface skin shall be left intact on both top and bottom faces of the test slab. Standard test slabs shall be prepared either by cutting them from flat sheets of the specified thickness or as described in 13.3.2.1 or 13.3.2.2.

13.3.2.1 When specially prepared standard test slabs of sponge rubber are required, they shall be made using the frame shown in Figure 2 together with top and bottom plates each approximately 12.7 mm (0.50 in) in thickness. The frame and plates shall be made of aluminum or steel. The stock shall be in sheet form cut into squares slightly smaller than the frame cavities. The thickness of the square sheets shall be such as to give the required apparent density when the material is blown during cure to fill the molding cavities. The squares of stock shall be dusted with talc and the excess brushed off to avoid pitting. They shall then be placed in the frame, and fabric sheeting shall be applied on the top and bottom between the frame and the plates to allow venting of gases produced during the cure. This fabric shall be a commercial sheeting with a mass of approximately 135 g/m^2 (4 oz/yd^2), having approximately 2.75 ends/mm (70 ends/in) and 2.36 picks/mm (60 picks/in). The specimens shall be vulcanized in a platen press under conditions of time and temperature chosen to produce the same state of cure in the standard slabs as in the finished products they represent.

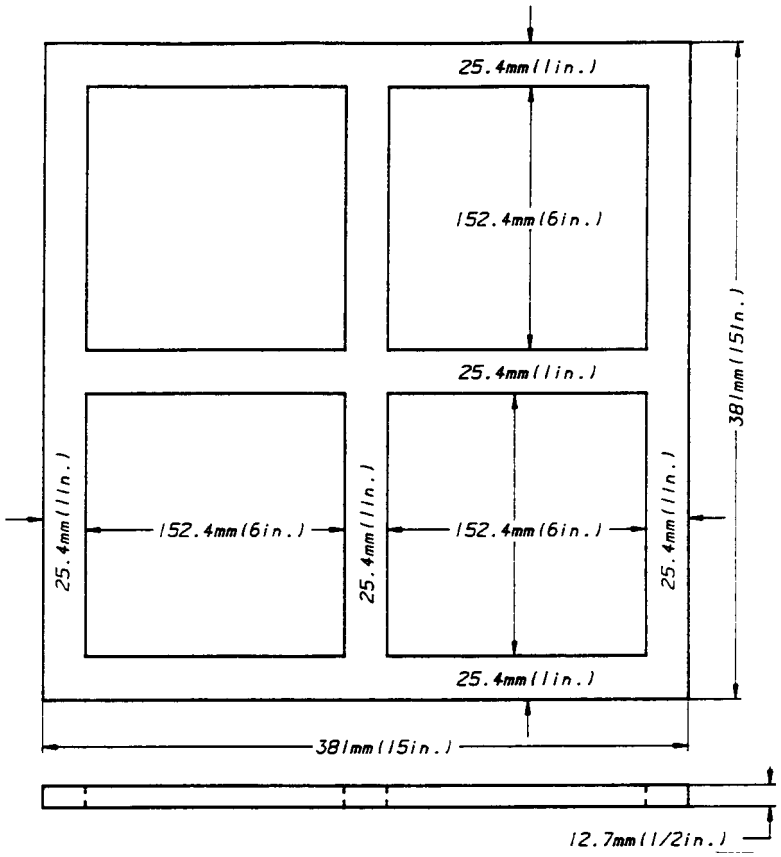

FIGURE 2—FOUR-CAVITY FRAME FOR STANDARD TEST SLABS OF CELLULAR RUBBERS

13.3.2.2 Where specially prepared standard test slabs of expanded rubber are required, they shall be made using the same process that was used for the product to be represented by the test slab. The specimens shall be prepared to have approximately the same density, and shall be vulcanized under conditions of time and temperature chosen to produce the same state of cure, in the standard slabs, as in the finished products they represent.

13.3.3 MEASUREMENTS OF TEST SPECIMENS

13.3.3.1 The length and width shall be measured to 0.5 mm (0.02 in). Care shall be taken not to distort the cellular rubber.

13.3.3.2 Thicknesses up to and including 25.4 mm (1 in) shall be measured using a dial-type gage[3] having a maximum stem and foot mass of 25 g and a foot 31.8 mm (1-1/4 in) in diameter. Thicknesses over 25.4 mm (1 in) shall be measured using a sliding caliper gage or as specified in 13.3.3.1. When a sliding caliper gage is employed, the gage setting shall be made with the gage out of contact with the cellular rubber. The sample shall be passed through the previously set gage and the proper setting shall be the one when the measuring faces of the gage contact the surfaces of the article without compressing it.

13.3.3.3 The steel scale or tape used to measure length or width shall be graduated to 1 mm (1/32 in). The dial gage for measuring thickness shall be graduated to 0.02 mm (0.001 in). The calipers used for measuring thickness shall be graduated to 0.1 mm (0.005 in).

3. A gage similar to Federal Products Co. No. 57 B-1-Y7692 is satisfactory for this purpose.

13.3.3.4 Results reported shall be the average of a minimum of three measurements.

14. Accelerated Aging Tests

14.1 Test Specimen—The test specimen used in any of the aging tests shall be that required by the cellular rubber methods for the particular determination to be employed for measuring the effect of the aging exposure.

14.2 Procedure—The air-oven aging test as described in Test Method D 573 shall be used for cellular rubbers, except that sample size shall be appropriate for compression-deflection testing. Deterioration shall be expressed as percentage change of compression-deflection values.[4] No relation between accelerated aging tests and natural aging is given or implied.

15. Compression-Deflection Tests

15.1 Apparatus

15.1.1 Any compression machine that meets the following requirements will be satisfactory. The machine shall be capable of compressing the specimen at a rate of 12.5 to 50.8 mm/min (0.5 to 2 in/min) gently without impact. The machine may be motor- or hand-driven. It shall be equipped with a gage to measure the deflection caused by the increase in load. The rate of compression of the specimen is specified rather than the rate of the compressing platform of the machine. This is an important consideration when scales are used, since sponges of various compression-deflection characteristics will require different times to compress 25% due to the travel of the scale platform under varying loads.

15.1.2 The deflection shall be read on a dial gage graduated in 0.02 mm (0.001 in). No gage is necessary if the machine automatically compresses the specimen 25%.

15.2 Test Specimens—Standard test specimens shall be used for this test. They shall be cut so that opposite ends are parallel, either from the finished product in a manner agreed upon by the parties concerned or, as shown in Figure 1, from standard test slabs or from flat sheets. The thickness of the test specimens may vary, but shall be measured and stated in the report. The minimum thickness shall be 6.35 mm (1/4 in). Thin samples may be plied up to obtain this thickness, or a standard test slab may be used if agreed upon by the manufacturer and the purchaser.

NOTE—In sponge rubbers, using the same compound, thin sections under 6 mm (0.25 in) do not blow in the same manner as those over 6 mm (0.25 in). The thinner sections are usually higher in compression deflection and density. However, in closed-cell (expanded) rubbers where thin sheets are split from thicker sheets there is usually very little difference between the thin sheet and thicker sheets.

15.3 Procedure—Cellular rubbers less than 6.35 mm (1/4 in) in thickness shall be tested by plying up the proper number of plies to obtain a thickness as near 12.7 mm (1/2 in) as possible. Compress the standard test specimen between the parallel metal plates of the machine until the thickness has been reduced 25%, and take the reading of the load immediately. Repeat the test with the same specimen until the load readings do not change more than 5%. The top and bottom plates shall be at least 38 mm (1.5 in) in diameter.

15.4 Report—The unit load required for the last reading, expressed in kilopascals (pounds per square inch), shall be reported as the result of the compression-deflection test.

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4. The compression-deflection test should be based on the original (before aging) sample thickness.

16. Compression Set Under Constant Deflection (Calculations Based on Amount of Deflection)

16.1 Test Specimens—Standard test specimens shall be used for this test. They shall be cut so that opposite edges are parallel, either from the finished product in a manner agreed upon by the parties concerned, or, as shown in Figure 1, from standard test slabs or from commercial flat sheets. The thickness of the test specimens may vary, but shall be measured and stated in the report. The minimum thickness for open-cell sponge rubber shall be 6 mm (1/4 in). These samples of open-cell sponge rubber may be plied up to obtain this thickness. The minimum thickness for closed-cell expanded rubber shall not be plied up to obtain this thickness. A standard test specimen may be used for either open-cell sponge or closed expanded material, if agreed upon by the manufacture and the purchaser.

16.2 Procedure—The apparatus and procedure shall be the same as that prescribed in Method B of Test Method D 395, except as follows: For open-cell (sponge) rubbers, compress test specimens to 50% of their original thicknesses. Release the load at the end of the test period and measure the thickness after 30 min rest at room temperature. For closed-cell (expanded) rubbers, compress test specimens to 50% of their original thicknesses. Release the load at the end of the test period and measure the thickness after 24 h at room temperature. In both cases (open-cell sponge and closed-cell expanded rubbers) measure the thickness as described in 13.3.3.2. The temperature of the test for open-cell (sponge) rubber shall be 70 °C ± 2 °C (158 °F ± 3.6 °F), except for class TO rubbers. The temperature of the test for closed-cell (expanded) rubbers shall be 23 °C ± 2 °C (73.4 °F ± 3.6 °F), except for class TE rubbers. For class TE and TO rubbers, the temperature of the test shall be 100 °C ± 1 °C (212 °F ± 1.8 °F). The time of the test shall be as specified. Chromium-plated metal plates are not required. Aluminum plates or any stiff plates that are clean and smooth, and that will not deflect measurably under the load necessary for deflection of the specimen, may be used.

16.3 Calculations—Calculate the percentage compression set as follows:

$$\text{Compression set, \%} = [(t_0 - t_1)/(t_0 - t_s)] \times 100 \qquad \text{(Eq. 1)}$$

where:

t_0 = Original thickness
t_1 = Thickness of specimen after specified recovery period
t_s = Thickness of space bar used

17. Oil-Immersion Test—Open-Cell (Sponge), Table 1

17.1 Test Specimens—Standard test specimens approximately 12.5 mm (1/2 in) in thickness shall be used for this test. The diameter and thickness shall be measured before and after immersion in the specified petroleum-base oil for 22 h at 70 °C (158 °F) and the percentage change in volume calculated. Three specimens shall be run on each test and the average of the three values reported.

17.2 Procedure—Follow the procedure of Test Method D 471, using petroleum-base oil No. 3.

18. Low-Temperature Test

Suffix F1, –40 °C (–40 °F)
Suffix F2, –55 °C (–67 °F)
Suffix F3, –75 °C (–103 °F)

18.1 Apparatus—The apparatus shall consist of two parallel plates at least 38 mm (1.5 in) in diameter, one of which is movable and the other one stationary, a means of applying a load, and a means of accurately measuring the distance between the parallel plates.

18.2 Test Specimens—Standard test specimens shall be used for this test. The thickness shall be measured and stated in the report. The minimum thickness shall be 6.3 mm (1/4 in). Plied-up samples are not satisfactory. The specimen shall be dried in a desiccator for 16 h before testing.

18.3 Procedure—Measure the compression deflection of the specimen first at room temperature and record the load in kilopascals (pounds per square inch) necessary to obtain a 25% deflection. Place the specimen in the cold box for 5 h at the specified temperature, at the end of which time apply the previously determined load as rapidly as possible while the specimens are still in the cold box, and record the deflection within 30 s.

18.4 Calculation—Calculate the percentage change in deflection as follows:

$$C = [(D - E)/D] \times 100 \qquad \text{(Eq. 2)}$$

where:

C = Percentage of change in deflection
D = Deflection at room temperature
E = Deflection at temperature of test

19. Water Absorption Test

19.1 Scope—The water absorption test (see Footnote 1 of Table 2) is applicable to expanded rubbers (closed-cell type). It should not be used on sponge rubbers or latex foam rubbers (open-cell type) unless they are completely encased in an added skin.

19.2 Test Specimens—Test specimens approximately 12.5 mm (1/2 in) in thickness and 2500 mm^2 (4 in^2) in area shall be used for this test. Round specimens are preferable.

19.3 Procedure—Submerge specimens in distilled water at room temperature (18 to 35 °C [65 to 95 °F]) 50 mm (2 in) below the surface of the water, and reduce the pressure above the water to 17 kPa (2.5 psi absolute) for 3 min. Release the vacuum and allow the specimen to remain submerged for 3 min at atmospheric pressure. Remove the specimen, blot dry, and calculate the percentage change in mass.

20. Fluid Immersion Test, Closed Cell (Expanded) (see Footnote 2, Table 2)

20.1 Apparatus—Equipment required is analytical balance, tared weighing bottles, screens, ASTM Reference Fuel B, filter paper, 250 cm^3 (8 oz) containers.

20.2 Test Specimens—The test specimens shall be 25 x 50 x 6 mm (nominally 1 x 2 x 1/4 in). It is preferable that the specimens be cut with clean, square edges.

20.3 Procedure—Weigh the specimens to the nearest 0.0001 g. Place a noncorrosive screen having 2-mm openings (10-mesh) on the bottom of the container. Alternatively place specimens of one material and screens into the cans. Use one can per material. Fill the cans with ASTM Reference Fuel B and seal with their lids. Store the cans for 7 days at a temperature of 23 °C ± 2 °C. Remove one specimen at a time from the test fluid. Without squeezing the specimen, place it on top of one sheet of filter paper and immediately place a second sheet of filter paper on top of it. Blot lightly without squeezing, then remove the top filter paper and slide the specimen from the bottom filter paper into a tared weighing bottle. Determine the mass of the specimen to the nearest 0.0001 g.

20.4 Calculation—Calculate the percent change in mass.

21. Notes

21.1 Marginal Indicia—The change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

PREPARED BY THE SAE COMMITTEE ON AUTOMOTIVE RUBBER SPECIFICATIONS

SAE J18 Revised JUL92

Rationale—Revised to correct Table 1 because of typographical errors. Also changed to comply with SAE Electronic Guidelines.

Relationship of SAE Standard to ISO Standard—Not applicable.

Application—This SAE Recommended Practice covers flexible cellular rubber products known as sponge rubbers and expanded rubbers but does not apply to latex foam rubbers. The base material used in their manufacture may be natural rubber, reclaimed rubber, synthetic rubber, or rubber-like materials, alone or in combination. Ebonite cellular rubbers are not included.

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.

In case of conflict between the provisions of this general specification and those of detailed specifications of test for a particular product the latter shall take precedence. Reference to these methods for testing cellular rubber products should specifically state the particular test or tests desired.

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

Reference Section

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

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

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

ASTM D 575—Test for Rubber Properties in Compression

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

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

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

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

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

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