

# Sponge - and Expanded Cellular-Rubber Products — SAE J18 DEC79

SAE Recommended Practice  
Completely Revised December 1979

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# SPONGE- AND EXPANDED CELLULAR-RUBBER PRODUCTS—SAE J18 DEC79

## SAE Recommended Practice

Report of the Nonmetallic Materials Committee, approved January 1952, and completely revised December 1979.  
Conforms substantially with ASTM D 1056.

**1. Scope**—These specifications and methods of testing apply to cellular-rubber products known as sponge rubbers and expanded rubbers, but do not apply to latex foam rubbers. The base material used in their manufacture may be natural rubber, synthetic rubber, or rubberlike materials, alone or in combination. Ebonite cellular rubbers are not included.

Extruded or molded shapes or 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 cases of conflict between the provisions of this general specification and those of a detailed specification, the latter shall take precedence. References to these methods for testing cellular-rubber products should specifically state the particular test or tests desired.

### 2. Description of Terms

**2.1 Flexible**—A flexible cellular organic polymeric material will not rupture 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 at a temperature between 18 and 29°C (65 and 85°F).

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

**2.3 Rubber**—A material that is capable of recovering from large deformation 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. 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 (18 to 29°C or 65 to 85°F) to twice its length and held 1 min before release.

**2.4 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 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 a cellular rubber product is put determines the thickness of the added skin required. Products subject to abrasion or those which must withstand absorption of water or transmission of gases will ordinarily require an applied skin coating. Expanded (closed cell) rubber does not usually require an added skin because it is somewhat more abrasion resistant than open cell sponges and does not absorb water or transmit gases because of its closed cell structure. In all cases where a skin is applied, there should be good adhesion between it and the cellular rubber.

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

**2.6 Expanded Rubber**—Cellular rubbers having closed cells made from a solid rubber compound.

### 3. Manufacture

**3.1 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.

**3.2 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.

**4. Types of Cellular Rubbers**—These specifications cover three types of cellular rubbers designated by the prefix letters R, S, and T as follows:

**4.1 Type R**—Cellular rubbers made from natural rubber, reclaimed rubber, synthetic rubber, or rubberlike materials, alone or in combination, where specific resistance to the action of petroleum-base oils is not required.

**4.2 Type S**—Cellular rubbers made from synthetic rubbers or rubberlike materials, alone or in combination, having specific requirements for resistance to the action of petroleum-base oils or other organic fluids.

**4.3 Type T**—Cellular rubber made from synthetic rubber or rubberlike materials, alone or in combination, for resistance to extreme temperatures.

### 5. Classes, Grades, and Suffixes of Cellular Rubbers

**5.1 Classes**—Type S rubbers are divided into two classes designated by the letters B and C added to the prefix S as follows:

**5.1.1 Class SB**—Cellular rubbers made from synthetic rubber or rubberlike materials having oil resistance with low swell.

**5.1.2 Class SC**—Cellular rubbers made from synthetic rubber or rubberlike materials having oil resistance with medium swell.

Type R, S, and T rubbers are divided into two classes designated by the letter O for open cell sponge rubbers and E for closed cell (expanded) rubbers.

**5.2 Grades**—Each type of cellular rubber has a number of grades. Grades are designated by numbers following prefix letters.

Grade numbers shall consist of two digits, the first of which identifies the kind of cellular rubber as follows:

- 1—Sponge rubbers
- 4—Expanded rubbers

The second digit is used to indicate the degree of firmness of the cellular rubbers, the softer grades being identified with the lower numbers and the firmer grades being identified with the higher numbers (see Tables 1, 2, and 4).

**5.3 Suffix Letters**—Suffix letters may be added singly or in combination after any grade number to indicate additional requirements beyond those specified in Tables 1, 2, and 4 as basic requirement. The significance of the approved suffix letters is shown in Table 3. The test methods and values must be arranged between the purchaser and supplier.

**6. Material and Workmanship**—Cellular rubbers furnished under these specifications shall be manufactured from natural rubber, synthetic rubber, or rubberlike materials together with added compounding ingredients of such nature and quality that a finished product complies with the specification requirements. In permitting choice in use of those materials by the producer, it does not imply that the different rubber materials are equivalent in respect to all physical properties. Any special characteristics other than those prescribed in these specifications 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.

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

**6.2 Physical Properties**—The various grades of cellular rubber shall conform to the requirements as to physical properties prescribed in Tables 1, 2, and 4 together with any additional requirements indicated by suffix letters in the grade designations as described in Section 5, Classes, Grades, and Suffixes of Cellular Rubbers.

**6.3 Methods of Testing**—Unless specifically stated otherwise, all tests shall be made in accordance with the methods specified in Section 7, General Methods.

**6.4 Tolerances on Dimensions**—Tolerances on dimensions of cellular rubber products are given in the Appendix (Table 5). These tolerances are published as information for guidance only and shall not be considered as part of these specifications.

**6.5 Packaging and 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.

**6.6 Inspection and Rejection**—All tests and inspections 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 inspections.

The purchaser may make the tests and inspection to govern acceptance or rejection of the material at his own laboratory or elsewhere. All samples for testing, provided as specified in paragraph 7.6, Sampling, shall be visually inspected to determine compliance with material, workmanship, and color requirements.

Any material which fails in one or more of the test requirements may be

The  $\phi$  symbol is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

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

Basic Requirements						Replacements Added by Suffix Letters		
Grade No.	Compression Deflection, 25% Deflection (Limits)		Oil-Aged 22 h at 70°C (158°F), Change in Volume in ASTM Oil No. 3 (Limits), %	Oven-Aged 7 d at 70°C (158°F), Change from Original Deflection Values (Limits), %	Compression Set, 22 h at 70°C (158°F), -50% Deflection, max, %	Suffix B	Suffix F1	Suffix F2
	kPa	psi				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, %
Type R, Non-Oil Resistant								
RO 10	3.5-14	0.5-2	—	±20 <sup>a</sup>	15	—	25	25
RO 11	14-35	2-5	—	±20	15	—	25	25
RO 12	35-63	5-9	—	±20	15	—	25	25
RO 13	63-91	9-13	—	±20	15	—	25	25
RO 14	91-119	13-17	—	±20	15	—	25	25
RO 15	119-168	17-24	—	±20	15	—	25	25
Type S, Class SB, Oil-Resistant, Low Swell								
SBO 10	3.5-14	0.5-2	-25 to +10	±20 <sup>a</sup>	40	—	50	—
SBO 11	14-35	2-5	-25 to +10	±20	40	—	50	—
SBO 12	35-63	5-9	-25 to +10	±20	40	—	50	—
SBO 13	63-91	9-13	-25 to +10	±20	40	—	50	—
SBO 14	91-119	13-17	-25 to +10	±20	40	—	50	—
SBO 15	119-168	17-24	-25 to +10	±20	40	—	50	—
Type S, Class SC, Oil-Resistant, Medium Swell								
SCO 10	3.5-14	0.5-2	+10 to +60	±20 <sup>a</sup>	50	25	50	—
SCO 11	14-35	2-5	+10 to +60	±20	50	25	50	—
SCO 12	35-63	5-9	+10 to +60	±20	50	25	50	—
SCO 13	63-91	9-13	+10 to +60	±20	50	25	50	—
SCO 14	91-119	13-17	+10 to +60	±20	50	25	50	—
SCO 15	119-168	17-24	+10 to +60	±20	50	25	50	—

<sup>a</sup>If this grade after aging still falls within the compression-deflection requirement of 7 + 7, 3.5 kPa (1 + 1, -1/2 psi), it shall be considered acceptable even though the change from the original load deflection is greater than ±20%.

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

Basic Requirements						Requirement Added by Suffix Letters
Grade No.	Compression Deflection, 25% Deflection (Limits)		Fluid Immersion, 7 d at 23°C (73.4°F), Change in Weight in ASTM Reference Fuel B, max, % <sup>a</sup>	Oven-Aged 7 d at 70°C (158°F) Change from Original Deflection Values (Limits), %	Water Absorption, max, weight % <sup>b</sup>	Suffix B
	kPa	psi				Compression Set, 22 h at Room Temperature, 50% Deflection, After 24 h Recovery at Room Temperature, max, %
Type R, Non-Oil Resistant						
RE 41	14-35	2-5	—	±30	5	25
RE 42	35-63	5-9	—	±30	5	25
RE 43	63-91	9-13	—	±30	5	25
RE 44	91-119	13-17	—	±30	5	25
RE 45	119-168	17-24	—	±30	5	25
Type S, Class SB, Oil-Resistant, Low Swell						
SBE 41	14-35	2-5	50	±30	5	25
SBE 42	35-63	5-9	50	±30	5	25
SBE 43	63-91	9-13	50	±30	5	25
SBE 44	91-119	13-17	50	±30	5	25
SBE 45	119-168	17-24	50	±30	5	25
Type S, Class SC, Oil-Resistant, Medium Swell						
SCE 41	14-35	2-5	—	±30	5	25
SCE 42	35-63	5-9	—	±30	5	25
SCE 43	63-91	9-13	—	±30	5	25
SCE 44	91-119	13-17	—	±30	5	25
SCE 45	119-168	17-24	—	±30	5	25

<sup>a</sup>This test of weight change in Reference Fuel B is used in place of the usual oil resistance test of volume change in 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, which results in some shrinkage of the test sample. This shrinkage counteracts the swell which would normally occur, thus invalidating test data based on volume change. Reference Fuel B is used because it produces a wider and more consistent differentiation among the R, SB, and SC grades than does the No. 3 oil.

<sup>b</sup>For cellular materials with densities of 160 kg/m<sup>3</sup> (10 lb/ft<sup>3</sup>) or less, the value of water absorption allowed is 10% max by weight. For densities of more than 160 kg/m<sup>3</sup> (10 lb/ft<sup>3</sup>), the value of water absorption is 5% max by weight.

TABLE 3—ASTM METHODS OF TEST<sup>a</sup>

Basic Requirements and Suffix Number Requirement or Suffix Letter	Basic	1	2	3	4
Compression Deflection	D 1056 Sections 17-20				
Heat Resistance	D 1056 Sections 15-16 Change in compression deflection after aging 7 days at 70°C (158°F)				
Oil Resistance (SBO and SCO Rubbers Only)	D 1056 Sections 24-25 22 h at 70°C (158°F)				
Compression Set (RO, SBO, and SCO Rubbers Only)	D 1056 Sections 21-23 22 h at 70°C (158°F) 50% deflection 30 min recovery at RT				
Water Absorption (RE and TE Rubbers Only)	D 1056 Sections 30-32				
Suffix A, Heat Resistance		D 1056 Sections 15-16 Change in compression deflection after aging 22 h at 100 ± 1°C (212°F)	D 1056 Sections 15-16 Change in compression deflection after aging 22 h at 125 ± 1°C (257°F)	D 1056 Sections 15-16 Change in compression deflection after aging 22 h at 150 ± 1°C (302°F)	D 1056 Sections 15-16 Change in compression deflection after aging 22 h at 175 ± 1°C (347°F)
Suffix B, Compression Set		D 1056 Sections 21-23 22 h at 70°C (158°F), 50% deflection, 30 min recovery at RT	D 1056 Sections 21-23 22 h at RT, 50% deflection, 24 h recovery at RT		
Suffix C, Ozone or Weather Resistance		D 1171 <sup>c</sup> Ozone exposure Method A	D 1171 <sup>c</sup> Outdoor exposure	D 1171 <sup>c</sup> Ozone exposure Method B	
Suffix D, Load Deflection <sup>b</sup>					
Suffix E, Fluid Resistance		D 1056 <sup>d</sup> Sections 33-36 150% max	D 1056 <sup>d</sup> Sections 33-36 50% max		
Suffix F, Low Temperature Resistance		D 1056 Sections 26-29 5 h at -40°C (-40°F)	D 1056 Sections 26-29 5 h at -55°C (-67°F)	D 1056 Sections 26-29 5 h at -75°C (-103°F)	
Suffix G, Tear Resistance <sup>b</sup> Suffix H, Flex Resistance <sup>b</sup> Suffix J, Abrasion Resistance <sup>b</sup> Suffix K, Adhesion Capability <sup>b</sup> Suffix L, Water Absorption <sup>b</sup> Suffix M, Flammability Resistance <sup>b</sup> Suffix N, Impact Resistance <sup>b</sup> Suffix P, Staining Resistance <sup>b</sup> Suffix R, Resilience <sup>b</sup> Suffix Z, Special Requirements <sup>b</sup>					

<sup>a</sup>The designations refer to the following methods of the American Society for Testing and Materials.\*

D 1056, Specification for Sponge and Expanded Cellular Rubber Products, Sections 12-36.

D 1171, Test for Weather Resistance Exposure of Automotive Rubber Compounds.

<sup>b</sup>Test method and values to be arranged between the purchaser and the supplier.

<sup>c</sup>Ratings to be arranged between the purchaser and the supplier.

<sup>d</sup>See Table 2 for materials having densities of 160 kg/m<sup>3</sup> (10 lb/ft<sup>3</sup>) or less.

Note: Example—Grade RO11 C1F1 denotes soft sponge rubber containing natural, reclaimed, synthetic, or blends of these rubbers with a compression deflection value of 14–35 kPa (2–5 psi), having no specific solvent or oil resistance, and requiring in addition to the basic tests, a weather resistance test run in accordance with ASTM D 1171, Test for Weather Resistance Exposure of Automotive Rubber Compounds.\* Ozone Chamber Exposure Method A, and a low temperature test at -40°C (-40°F). Examples of specification conversion are given in Table 5.

\*1978 Annual Book of ASTM Standards Part 37.

TABLE 4—PHYSICAL REQUIREMENTS OF TYPE T—EXTREME TEMPERATURE RESISTANT CELLULAR RUBBER -75 to +175°C (-103 to +347°F)

Grade Numbers	Basic Requirements					Requirements Added by Suffix Letters		
	Compression Deflection at 25% Deflection		Compression Deflection After Heat Aging	Compression Deflection at Low Temperature	Compression Set Under Constant Deflection (50%)	Water Absorption	Compression Deflection After Heat Aging (Suffix A4)	Compression Deflection at Low Temperature (Suffix F3)
	23 ± 3°C (73 ± 5°F)		22 h/ 150 ± 2°C (302 ± 3.6°F)	5 h/ -55 ± 2°C (-67 ± 3.6°F)	22 h/ 100 ± 1°C (212 ± 1.8°F)	3 min/Room Temperature	22 h/ 175 ± 2°C (347 ± 3.6°F)	5 h/ -75 ± 2°C (-103 ± 3.6°F)
	(limits) kPa	(psi)	Change from Original Compression Deflection, (Limits), %	Change from Original Compression Deflection, Max %	Max %	Water Max, Mass %	Change from Original Compression Deflection, (Limits), %	Change from Original Compression Deflection, Max %
TO 11	14–35	( 2–5 )	±5	5	50	—	±25	25
TO 12	35–63	( 5–9 )	±5	5	30	—	±25	25
TO 13	63–105	( 9–15 )	±5	5	30	—	±25	25
TO 14	105–147	(15–21)	±5	5	30	—	±25	25
TO 15	147–203	(21–29)	±5	5	30	—	±25	25
TE 41	14–35	( 2–5 )	±5	5	80	5	—	—
TE 42	35–63	( 5–9 )	±5	5	60	5	—	—
TE 43	63–105	( 9–15 )	±5	5	60	5	—	—
TE 44	105–147	(15–21)	±5	5	60	5	—	—
TE 45	147–203	(21–29)	±5	5	60	5	—	—

TABLE 5—TOLERANCES ON DIMENSIONS OF CELLULAR RUBBER PRODUCTS FOR GENERAL APPLICATIONS

Form	Thickness				Length and Width			
	Dimensions		Tolerance		Dimensions		Tolerance	
	mm	in	mm	in	mm	in	mm	in
Sponge Rubbers								
Sheet and strip	3.18 and under Over 3.18 to 12.7, incl Over 12.7	1/8 and under Over 1/8 to 1/2, incl Over 1/2	0.40 0.79 1.19	1/64 1/32 3/64	152 and under Over 152 to 457, incl Over 457	6 and under Over 6 to 18, incl Over 18	1.59 3.18 5%	1/16 1/8 5%
Molded or special shapes	6.35 and under Over 6.35 to 76.2, incl	1/4 and under Over 1/4 to 3, incl	0.79 1.59	1/32 1/16	6.35 and under Over 6.35 to 76.2, incl Over 76.2 to 457, incl Over 457	1/4 and under Over 1/4 to 3, incl Over 3 to 18, incl Over 18	0.79 1.59 3.18 5%	1/32 1/16 1/8 5%
Form	Thickness				Length and Width			
	Dimensions		Tolerance		Dimensions		Tolerance	
	mm	in	mm	in	mm	in	mm	in
Expanded Rubbers								
Sheet and strip	3.18 to 12.7, incl Over 12.7	1/8 to 1/2, incl Over 1/2	1.59 2.38	1/16 3/32	152 and under Over 152 to 305, incl Over 305	6 and under Over 6 to 12, incl Over 12	6.35 9.53 3%	1/4 3/8 3%
Molded or special shapes	3.18 to 12.7, incl Over 12.7 to 38.1, incl Over 38.1 to 76.2, incl	1/8 to 1/2, incl Over 1/2 to 1-1/2, incl Over 1-1/2 to 3, incl	1.59 2.38 3.18	1/16 3/32 1/8	152 and under Over 152 to 305, incl Over 305	6 and under Over 6 to 12, incl Over 12	6.35 9.53 3%	1/4 3/8 3%

retested. For this purpose, two additional tests shall be made for the requirement in which failure occurred. Failure of either of the retests shall be cause for final rejection.

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

**7. General Methods**—Except as otherwise specified in the methods of testing cellular rubbers given in ASTM D 1056, the following methods of test of the American Society for Testing and Materials, applicable in general to vulcanized rubber, shall be complied with as required and hereby made a part of these test methods.

**7.1 General Physical Requirements**—See ASTM D 1056.

**7.2 Aging Test**—See ASTM D 572, ASTM D 573, and ASTM D 1056.

**7.3 Compression Set, Suffix B**—See ASTM D 395.

**7.4 Low Temperature Test, Suffix F**—See method described in ASTM D 1056.

**7.5 Fluid Immersion**—See ASTM D 471. In case of conflict between provisions of the above methods and the procedure herein specifically de-

scribed for cellular rubbers, the latter shall take precedence.

**7.6 Sampling**—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.

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, more 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.

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