



Designation: D6576 – 20

Standard Specification for Flexible Cellular Rubber Chemically Blown¹

This standard is issued under the fixed designation D6576; 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 establishes requirements for chemically blown cellular rubber.

1.2 In the case of conflict between the provisions of this specification and those of detailed specifications or test methods for a particular product, the latter shall take precedence.

1.3 Unless specifically stated otherwise, by agreement between the purchaser and the supplier, all test methods shall be performed in accordance with the test methods specified in this specification.

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

1.5 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 There is no known ISO equivalent to this specification.

NOTE 1—This specification was revised using the updated test methods and specifications in the latest version of Specification D1056.

1.7 *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

D297 Test Methods for Rubber Products—Chemical Analysis

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

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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.

- D471 Test Method for Rubber Property—Effect of Liquids
D635 Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
D883 Terminology Relating to Plastics
D1055 Specifications for Flexible Cellular Materials—Latex Foam (Withdrawn 2014)³
D1056 Specification for Flexible Cellular Materials—Sponge or Expanded Rubber
E176 Terminology of Fire Standards
E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods
E456 Terminology Relating to Quality and Statistics
E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method
E2935 Practice for Conducting Equivalence Testing in Laboratory Applications
2.2 SAE Standard:⁴
SAE J 1351-1993 Hot Odor Test for Insulation Materials
2.3 Military Standards/Specifications:⁵
MIL STD 105 Sampling Procedures and Tables for Inspection by Attributes
MIL STD 129 Marking for Shipment and Storage
MIL STD 293 Visual Inspection Guide for Cellular Rubber Items
MIL R 6130C Standard Specification for Flexible Cellular Rubber Chemically Blown
2.4 Federal Standards/Specifications:⁵
PPP-B576 Box, Wood, Cleated, Veneer, Paper Overlaid
PPP-B591 Box, Fiberboard, Wood-Cleated
PPP-B601 Box, Wood, Cleated Plywood
PPP-B621 Box, Wood, Nailed and Lock-Corner
PPP-B636 Box, Shipping, Fiberboard

3. Terminology

3.1 Terms used in this standard are defined in accordance with Terminology D883, unless otherwise specified. For terms

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://www.sae.org.

⁵ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

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

relating to precision and bias and associated issues, the terms used in this standard are defined in accordance with Terminology E456. For terms relating to fire, the terms used in this standard are defined in accordance with Terminology E176.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *cellular material, n*—a generic term for materials containing many cells (either open or closed, or both) dispersed throughout the mass.

3.2.2 *closed cell, n*—a product whose cells are totally enclosed by its walls and hence not interconnecting with other cells.

3.2.3 *open cell, n*—a product whose cells are not totally enclosed by its walls and open to the surface, either directly or by interconnecting with other cells.

4. Classification

4.1 *Types*—This specification covers two types of cellular rubber designated as follows:

4.1.1 *Type I*—Open cell (sponge rubber).

4.1.2 *Type II*—Closed cell (expanded rubber).

4.2 *Grades*—Both types are divided into three grades designated by the letters A, B, and C added to the roman numeral prefix.

4.2.1 *Grade A*—Oil- and flame-resistant.

4.2.2 *Grade B*—No requirements for oil, flame resistance, or low temperature.

4.2.3 *Grade C*—Low-temperature resistant (oil and flame resistance not required).

4.3 *Conditions*—Each type and class has been divided into three different conditions. Each condition is based on a specific range of firmness as expressed by compression deflection as follows:

4.3.1	Condition—Super soft	a compression deflection range of	>0 to ≤13.8 kPa (>0 to ≤2 psi)
4.3.2	Condition—Soft	a compression deflection range of	>13.8 to ≤34.5 kPa (>2 to ≤5 psi)
4.3.3	Condition—Soft-medium	a compression deflection range of	>34.5 to ≤62.1 kPa (>5 to ≤9 psi)
4.3.4	Condition—Medium	a compression deflection range of	>62.1 to ≤89.6 kPa (>9 to ≤13 psi)
4.3.5	Condition—Medium-firm	a compression deflection range of	>89.6 to ≤117.2 kPa (>13 to ≤17 psi)
4.3.6	Condition—Firm	a compression deflection range of	>117.2 to ≤172.4 kPa (>17 to ≤25 psi)

5. Significance and Use

5.1 This specification is a revision of MIL R 6130C retaining most of the MIL R 6130C material designations and property requirements while conforming to ASTM form and style. It is intended to establish requirements for chemically blown cellular rubber used by government and industry, and is intended as a direct replacement for MIL R 6130C.

6. Materials and Manufacture

6.1 *Materials*—The materials shall be homogeneous. Except for the following production allowances:

6.1.1 Tears and edge cracks that do not interfere with specified product yield.

6.1.2 Depression and pock marks not exceeding 1 in.

6.1.3 Splices and butt splices.

6.1.4 Laminating sheets to achieve thickness.

6.2 The material shall not include the following:

6.2.1 Cemented, bonded, shredded, or reprocessed cellular rubber.

6.2.2 Grade A cellular rubber shall not contain natural rubber.

6.3 *Form*—Chemically blown cellular rubber shall be furnished as sheets, rolls, or molded shapes as specified, and shall have a uniform cell structure, with thin skin or rind surfaces. Cut or split sheets void of skin or rind surfaces are permitted to be furnished only for Type II material when specified.

6.4 *Skin or Rind*—The surface formed by contact with the mold shall be considered a skin or rind. It shall be of the same compound, and vulcanized integrally with the cellular structure. Type I shall have skin or rind. It is acceptable for Type II to have or not have skin or rind.

6.5 *Cut or Split Sheets (Type II Only)*—When two or more sheets are derived from one thick sheet, the cut or split sheets shall not be required to possess a skin or rind on either major surface.

6.6 *Surfacing*—Cellular rubber shall be backed or surfaced with fabric, adhesive, or other materials, when and as specified in the contract or order or by applicable drawings.

7. Physical Properties

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

8. Tolerances on Dimensions

8.1 Tolerances on dimensions of flexible cellular rubber materials are given in Table 3.

8.2 *Molded Shapes*—Tolerance requirements for molded shapes shall be as specified in drawings, contracts, or by the procuring activity.

8.3 *Sheets and Rolls*—Unless otherwise specified, the tolerance requirements for thickness, lengths and width of sheets shall be as specified in Table 3.

9. Test Methods

9.1 Unless specifically stated otherwise, all test methods shall be in accordance with the test methods specified in Sections 10 – 18.

9.2 *Precision and Bias*—See Section 19.

10. Test Conditions

10.1 *Standard Conditions*—Unless otherwise specified herein, conduct the test method at $23 \pm 2^\circ\text{C}$ ($73.4 \pm 3.6^\circ\text{F}$) and a relative humidity of $50 \pm 10\%$.

10.2 *Specimen Conditioning*—Unless otherwise specified, condition all test specimens at standard conditions for at least 22 h prior to testing.

TABLE 1 Physical Properties^A

Property		Type I Basic Requirements (Open Cell)	Type II Basic Requirements (Closed Cell)	Test Method, Section
Compression deflection, kPa (psi), 25 % deflection	super soft	>0 to ≤13.8 (>0 to ≤2)	>0 to ≤13.8 (>0 to ≤2)	11
	soft	>13.8 to ≤34.5 (>2 to ≤5)	>13.8 to ≤34.5 (>2 to ≤5)	
	soft-medium	>34.5 to ≤62.1 (>5 to ≤9)	>34.5 to ≤62.1 (>5 to ≤9)	
	medium	>62.1 to ≤89.6 (>9 to ≤13)	>62.1 to ≤89.6 (>9 to ≤13)	
	medium-firm	>89.6 to ≤117.2 (>13 to ≤17)	>89.6 to ≤117.2 (>13 to ≤17)	
	firm	>117.2 to ≤172.4 (>17 to ≤25)	>117.2 to ≤172.4 (>17 to ≤25)	
Low-temperature resistance, flex, 180° bend	Grade A –40°C (–40°F)	pass	pass	12
	Grade B –40°C (–40°F)	pass	pass	
	Grade C –55°C (–67°F)	pass	pass	
Accelerated aging, % retention of original 25 % deflection after 7 days at 158°F	all grades and conditions	±20 % ^B	±30 % ^B	13
Recovery, min, %, after 50 % deflection	all grades and conditions	90	60	14
Flame resistance, max, s	Grade A	30	30	15
	Grade B	not required	not required	
	Grade C	not required	not required	
Shrinkage, max, %, 7 days at 158°F	All grades and conditions	not required	10	16
Water Absorption, max, %	all grades and conditions	not required	10 % max for densities 10 lb/ft ³ and under 5 % max for densities over 10 lb/ft ³	17
Oil aging, % change in volume, IRM Oil 902	Grade A	–15 to +30	–15 to +30	18
	Grade B	not required	not required	
	Grade C	not required	not required	
Color	all grades and conditions	as manufactured unless otherwise specified	as manufactured unless otherwise specified	visual

^AUnless otherwise specified, the basic requirements listed are for all types, grades, and conditions.

^BIf the super-soft grade after aging still falls within the compression deflection requirement of 0 – 13.8 kPa (0 – 2 psi), it shall be considered acceptable even though the change from original was greater than ±20 % or ±30 %, respectively.

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TABLE 2 Optional Requirements Added by Suffix Letters

Property		Type I Optional Requirements (Open Cell)	Type II Optional Requirements (Closed Cell)	Test Method Section
Suffix H: Flexing, max, % set in accordance with Specification D1055	all grades and conditions	10	10	Appendix X1
Suffix O: Odor in accordance with SAE J-1351	all grades and conditions	rating to be determined	rating to be determined	Appendix X1
Suffix W: Density in accordance with Specifi- cation D1056	all grades and conditions	density to be determined	density to be determined	
Suffix Y: Sulfur Content, max, % by weight in accordance with Test Methods D297	all grades and conditions	0.60	0.60	Appendix X1

11. Compression Deflection

11.1 Test in accordance with Sections 17 to 22 of Specification **D1056**.

12. Low-Temperature Flex Resistance

12.1 Test in accordance with Sections 57 to 61 of Specification **D1056**. Exposure temperatures shall be in accordance with **Table 4**.

13. Accelerated Aging

13.1 Test in accordance with Sections 35 to 41 of Specification **D1056**.

14. Recovery

14.1 *Specimen Size*—Round test specimen shall be cut 41.3 ± 1 mm (1.625 ± 0.04 in.) in diameter. Specimens taken from either sheets or molded shapes shall have a minimum thickness

TABLE 3 Dimensions and Tolerances of Cellular Rubber Products for General Applications

Sponge Rubber				
Form	Thickness Dimension, mm (in.)	Thickness Tolerance, mm (in.)±	Length and Width Dimension, mm (in.)	Length and Width Tolerance, mm (in.)±
Sheet and strip	3.2 (0.125) and under over 3.2 (0.125) to 12.7 (0.50), incl over 12.7 (0.50)	0.4 (0.016) 0.8 (0.032) 1.2 (0.047)	152 (6) and under over 152 (6) to 457 (18), incl over 457 (18)	1.6 (0.063) 3.2 (0.125) 0.5 %
Molded or special shapes	6.4 (0.250) and under over 6.4 (0.250) to 76.2 (3), incl	0.8 (0.032) 1.6 (0.063)	6.4 (0.250) and under over 6.4 (0.250) to 76 (3), incl over 76 (3) to 457 (18), incl over 457 (18)	0.8 (0.032) 1.6 (0.063) 3.2 (0.125) 0.5 %
Expanded Rubber				
Sheet and strip	12.7 (0.50) and under over 12.7 (0.50)	1.6 (0.063) 2.4 (0.094)	152 (6) and under over 152 (6) to 305 (12), incl over 305 (12)	6.4 (0.250) 9.6 (0.375) 3 %
Molded or special shapes	3.2 (0.125) to 12.7 (0.50), incl over 12.7 (0.50) to 38.1 (1.50), incl over 38.1 (1.50) to 76.2 (3), incl	1.6 (0.063) 2.4 (0.094) 3.2 (0.125)	152 (6) and under over 152 (6) to 305 (12), incl over 305 (12)	6.4 (0.250) 9.6 (0.375) 3 %

TABLE 4 Low-Temperature Flex-Resistance Temperatures

Type	Grade	Temperature
I	A and B	-40 ± 1°C (-40 ± 2°F)
I	C	-55 ± 1°C (-67 ± 2°F)
II	A and B	-40 ± 1°C (-40 ± 2°F)
II	C	-55 ± 1°C (-67 ± 2°F)

of 6.4 mm (0.250 in.) and a maximum thickness of 28.6 mm (1.125 in.). Skin on top face, or bottom face, or both, is allowed. Specimens shall be cut so that opposite edges are parallel. The thickness of the test specimens is permitted to vary, but shall be measured and stated in the report. Measure the thickness of each test specimen to 0.0254 mm (0.001 in.).

14.2 Compress the specimen to 50 ± 1 % of the original thickness for a period of 46 h ± 30 minutes.

14.3 Remeasure the thickness of each specimen 24 h ± 15 minutes after removal from the compression apparatus.

14.4 Calculate the average recovery of three specimens as follows:

$$\text{recovery, \%} = \frac{B}{A} \times 100 \quad (1)$$

where:

A = original thickness, and

B = thickness 24 h ± 15 minutes after removal from apparatus.

14.5 Report—The average recovery of the three specimens to the nearest 0.1 %

14.6 Precision and Bias:

14.6.1 See Section 19.

15. Flame Resistance

15.1 Test in accordance with Test Method D635 with the following exceptions:

15.2 Three specimens shall be tested.

15.3 Specimen Size: 7.0 ± 1 mm (0.275 ± 0.04 in.) thick by 12.7 ± 1 mm (0.5 ± 0.04 in.) wide by 125 ± 5 mm (4.92 ± 0.2 in.) in length.

15.4 Clamp the specimen on one end with its longitudinal axis horizontal.

15.5 The blue flame shall be 38 ± 2 mm (1.49 ± 0.078 in.) in height.

15.6 Apply the flame for 60 ± 1 s.

15.7 Remove the flame after 60 ± 1 s and record the propagation time in seconds.

15.8 Report the average propagation time of the three specimens to the nearest second.

16. Shrinkage

16.1 Scope—This test method covers the evaluation of shrinkage of flexible cellular elastomeric materials.

16.2 Significance and Use—This test method provides a relatively simple and short-term evaluation of in-use performance with regard to shrinkage.

16.3 Apparatus—Air-circulating oven equipped with a control to maintain a temperature of 70 ± 2°C (158 ± 3.6°F) during the test and having an expanded metal shelf, and a steel rule, graduated in millimetres (inches), capable of measuring to minimum increments of 1.0 mm (0.05 in.).

16.4 Test Specimen—Use three specimens approximately 300 by 75 mm (12 by 3 in.) cut from each of the test samples.

16.5 Procedure—At each of two points, approximately 250 mm (10 in.) apart on the centerline of each specimen, place a benchmark. Condition the specimen a minimum of 24 h at a temperature of 23 ± 2°C (73 ± 3.6°F) and measure the distance between the benchmarks to the nearest 1.0 mm (0.05 in.). Place the specimens on an expanded metal shelf in an oven operating at a temperature of 70 ± 2°C (158 ± 3.6°F). After 7 days ± 2 hours, remove the specimens from the oven, condition for at least 2 h at 23 ± 2°C, and remeasure.

16.6 Calculation—Calculate percent shrinkage as follows:

$$\text{change in length, \%} = \frac{L_1 - L_2}{L_1} \times 100 \quad (2)$$

where:

L_1 = original length, and
 L_2 = length after oven-aging.

16.7 *Report*—Report the shrinkage as the average change in length of three specimens between the two benchmarks expressed as a percentage of the length originally measured.

16.8 *Precision and Bias:*

16.8.1 See Section 19.

17. Water Absorption (Type II Only)

17.1 Test in accordance with Sections 43 to 48 of Specification **D1056**.

18. Oil Aging

18.1 Determine the volume of specimens. Measure the diameter and thickness to the nearest 0.40 mm (0.015 in.).

18.2 *Specimen Size*—Round test specimen shall be cut 41.3 ± 1 mm (1.625 ± 0.04 in.) in diameter. Specimens taken from either sheets or molded shapes have a minimum thickness of 6.4 mm (0.250 in.) and a maximum thickness of 28.6 mm (1.125 in.). Skin on top face, or bottom face, or both, is allowed. Specimens shall be cut so that opposite edges are parallel.

18.3 Immerse in petroleum base reference oil IRM 902 of Test Method **D471**.

18.4 Immersion for $70 \text{ h} \pm 30 \text{ min}$ at $70 \pm 2^\circ\text{C}$ ($158 \pm 3.6^\circ\text{F}$).

18.5 At the end of the immersion period, remove the specimen and immediately blot lightly with a paper towel, and measure in accordance with **18.1**.

18.6 *Calculation*—Calculate the percent change in volume as follows:

$$\text{change in volume, \%} = \frac{V_1 - V_2}{V_1} \times 100 \quad (3)$$

where:

V_1 = original volume, and
 V_2 = volume after immersion in oil.

18.7 Report the average of the three specimens to the nearest 0.1 %.

18.8 *Precision and Bias:*

18.8.1 See Section 19.

19. Precision and Bias⁶

19.1 The precision of this test method is based on an interlaboratory study of Specification D6576–07 conducted in 2012. Nine laboratories tested three examples of three different materials. Every “test result” represents an individual determination. Each laboratory reported duplicate results for each sample tested. Practice **E691** was followed for the design and analysis of the data; the details are given in ASTM Research Report No. D20-1261. (**Warning**—The data in **Tables 5-7** shall not be rigorously applied to acceptance or rejection of material, as those data are specific to the interlaboratory study and are not necessarily representative of other lots, conditions, materials, or laboratories. Users of this test method shall apply the principles outlined in Practice **E691** to generate data specific to their laboratory and materials, or between specific laboratories.)

20. Keywords

20.1 cellular; closed-cell; elastomeric; flexible; open cell; rubber

⁶ Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D20-1261. Contact ASTM Customer Service at service@astm.org.

TABLE 5 Recovery - 50 % Compression - 46 Hours @ Room Temperature - 24 Hour Recover (Similar to Compression Set) (%)

Material	Average ^A	Repeatability Standard Deviation	Reproducibility Standard Deviation	Repeatability Limit	Reproducibility Limit
	\bar{x}	s_r	s_R	r	R
Material A-Average	74.503	0.907	1.578	2.540	4.420
Material B-Average	91.467	0.868	1.025	2.430	2.870
Material C-Average	86.449	0.512	1.612	1.435	4.513

^AThe average of the laboratories' calculated averages.