

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard



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Rubber, Cellular, Chemically Blown

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1. SCOPE:

1.1 Scope:

This specification establishes requirements for chemically blown cellular rubber.

1.2 Classification:

The cellular rubber shall be furnished in the following types, grades and conditions:

1.2.1 Types:

Type I - Open cell (sponge rubber)

Type II - Closed cell (expanded rubber)

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1.2.2 Grades:

Grade A - Oil and flame resistant
Grade B - Nonoil resistant
Grade C - Low temperature, nonoil resistant

1.2.3 Conditions:

Soft
Medium
Firm

2. APPLICABLE DOCUMENTS:

The following publications of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

2.1 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

C-C-91	Candle, Illuminating
PPP-B-576	Box, Wood, Cleated, Veneer, Paper Overlaid
PPP-B-591	Box, Fiberboard, Wood-Cleated
PPP-B-601	Box, Wood; Cleated Plywood
PPP-B-621	Box, Wood, Nailed and Lock-Corner
PPP-B-636	Box, Shipping, Fiberboard

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

FED-STD-313 Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

2.2 Code of Federal Regulations:

Available from Superintendent of Documents, Government Printing Office, Washington DC 20402.

29 CFR Labor

2.3 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 297 Rubber Products-Chemical Analysis
ASTM D 471 Rubber Property-Effect of Liquids
ASTM D 1055 Flexible Cellular Materials-Latex Foam
ASTM D 1056 Flexible Cellular Materials-Sponge or Expanded Rubber

2.4 Uniform Classification Committee Agent:

Available from Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.

Uniform Freight Classification Rules

3. REQUIREMENTS:

3.1 Materials:

The materials shall be homogeneous. Except for the production allowances specified in 3.2.4, the material shall not include cemented, bonded, shredded, or reprocessed cellular rubber. Grade A cellular rubber shall not contain natural rubber. Grades B and C cellular rubber shall be unrestricted in composition.

3.2 Design and construction:

- 3.2.1 Form: Chemically blown cellular rubber shall be furnished as sheets or molded shapes as specified, and shall have a vulcanized uniform cellular structure, with thin skin or rind surfaces. Cut or split sheets void of skin or rind surfaces may be furnished only for Type II material when specified by the procuring activity (see 6.2).
- 3.2.2 Skin or rind: The smooth surface formed by contact with the mold shall be considered a skin or rind. It shall be the same compound, and vulcanized integrally with the cellular structure.
 - 3.2.2.1 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 (see 3.2.1). Only longitudinal splitting of the thickness shall be permitted.
- 3.2.3 Surfacing: Cellular rubber shall be backed or surfaced with fabric, cement, or other materials when and as specified in the contract or order (see 6.2), or by applicable drawings.

3.2.4 Production allowances: The following defects and manufacturing methods are permitted in chemically blown cellular rubber when their occurrence is incident to standard manufacturing practice and assembly, provided they are corrected as indicated herein and the resulting product conforms with the requirements of this specification and applicable supplementary specifications and drawings:

3.2.4.1 Defects:

- a. Tears occurring during removal from mold, carefully cemented together.
- b. Changes in the volume of product during cure resulting in shallow surface depressions or minor changes in size (not exceeding 1 inch) corrected by addition of material of identical composition and quality as that of the product, and buffing to a level, neat-appearing surface.

3.2.4.2 Manufacturing methods:

- a. Assembled products, where the finished product desired is larger than it is standard practice in industry to mold in one section.
- b. Hand-built shapes, where the order is small and the nature of the shape is such as to make molding uneconomical.

3.3 Finish:

3.3.1 Sheets: Sheets shall have a smooth skin or rind on both faces, unless otherwise specified (see 3.2.1). Fabric impressions are not objectionable.

3.3.2 Molded Shapes: Molded shapes shall have a smooth skin or rind on all surfaces, unless otherwise specified. Marks left by mold partings or gates should be as small as practicable.

3.4 Color:

The color of the material shall be "as manufactured," unless otherwise specified.

3.5 Odor:

The cellular rubber shall be free from any objectionable odor. When specified, material shall be treated to minimize the odor (see 6.2).

3.6 Physical properties:

Physical properties of the cellular rubber shall conform to the requirements specified in Table I.

TABLE I. Physical properties

Property	Requirement 1/		Test Paragraph
	Type I	Type II	
Apparent density			4.5.1
lbs/cu in. (kg/m ³) max			
soft	0.020 (0.544 x 10 ³)	.015 (0.415 x 10 ³)	
medium	0.027 (0.747 x 10 ³)	.020 (0.554 x 10 ³)	
firm	0.030 (0.830 x 10 ³)	.030 (0.747 x 10 ³)	
Compression deflection			4.5.2
load, psi (kPa), for 25% deflection			
soft	2 to 7 (14 to 48)	2 to 7 (14 to 48)	
medium	over 7 to 14 (48 to 96)	over 7 to 14 (48 to 96)	
firm	over 14 to 21 (96 to 144)	over 14 to 21 (96 to 144)	
Low Temperature resistance, % retention of orig. 25% deflection			
Grade A	30	30	
Grade B	30	30	
Grade C	45	45	
Accelerated aging, % retention of original 25% deflection	55 to 145	70 to 130	4.5.4
Recovery %, min after 50% deflection	90	70	4.5.5
Flexing, % set, max	10	10	4.5.6
Flame resistance, seconds, max, Grade A, only	30	30	4.5.7
Shrinkage, %, max	-	15	4.5.8
Water absorption, %, max	-	5	4.5.9
Oil aging, % change in volume			4.5.10
Grade A, only	-15 to +30	-15 to +30	
Sulfur content, %, by wt, max.	0.60	0.60	4.5.11

1/ Unless otherwise specified, the requirement is for all types, grades and conditions.

3.7 Dimensions and tolerances:

3.7.1 Dimensions: The dimensions of sheets or molded shapes shall be as specified by the procuring activity (see 6.2).

3.7.2 Tolerances:

3.7.2.1 Sheets: Unless otherwise specified, the tolerance requirements for thickness, lengths and widths of sheets shall be as specified in Table II.

TABLE II. Dimensions and Tolerances

Dimension	Tolerance	
Thickness	Type I	Type II
under 0.125 inch (3.18 mm)	± 0.016 (0.4 mm)	± 0.047 (1.19 mm) -0.016 (0.4 mm)
0.125 to 0.500 (3.18 to 12.7 mm)	± 0.031 (0.8 mm)	± 0.063 (1.59 mm)
over 0.500 (12.7 mm)	± 0.063 (1.59 mm)	± 0.094 (2.38 mm)
Length & width		
under 36 inch (91 cm)	± 0.25 (6.35 mm)	± 0.25 (6.35 mm)
36 (91 cm) and over	± 0.75 (1.91 cm) -0.0	± 0.75 (1.91 cm) -0.0

3.7.2.2 Molded shapes: Tolerance requirements for molded shapes shall be as specified in drawings, contracts or by the procuring activity (see 6.2).

3.8 Identification marking:

Each piece of cellular rubber shall be marked, if size permits, in a permanent and legible manner using marking material which will not harm the rubber. The marking shall include:

MIL-R-6130C

Type

Grade

Condition

NSN (when applicable)

Manufacturer's part no. (when applicable)

Contract or order no.

Manufacturer's name or trade mark

Quarter and calendar year of cure

3.8.1 Sheets: Marking on sheet material shall be applied to one side only in rows spaced not more than 5 inches (12.7 cm) apart in constantly recurring characters not less than 0.375 inch (9.53 mm) in height extending either lengthwise or crosswise over the sheet.

3.9 Age controls:

Cellular rubber covered by this specification shall not be delivered to any government activity when it is more than 4 quarters old (see 3.8).

3.10 Workmanship:

The chemically blown cellular rubber shall be manufactured by such processes as to produce materials meeting all the requirements of this specification.

3.11 Use of Carcinogenic agents:

The use of carcinogenic agents in a concentration of greater than 0.1% in the manufacture/fabrication of Grade A, Oil and flame resistant packaging material is prohibited. See 6.6 to determine which chemicals are carcinogens.

3.11.1 Material Safety Data Sheets: The contracting activity shall be provided a Material Safety Data Sheet (MSDS) prior to contract award. The MSDS shall be prepared and submitted in accordance with FED-STD-313 and 29 CFR 1910.1200. In the event of a conflict the 29 CFR 1910.1200 shall take precedence. The MSDS shall be included with each shipment of the material covered by this specification.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for inspection:

Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of inspections:

The examination and testing of the cellular rubber shall be classified as quality conformance inspection (see 4.3).

4.3 Quality conformance:

4.3.1 Lot formation: Unless otherwise specified, a lot shall consist of all the material of the same type, grade and condition, manufactured at one time, forming part of one contract or order and submitted for acceptance at the same time and place.

4.3.2 Prior approval: Whenever a manufacturer has delivered an acceptable product meeting all the requirements of this specification, the procuring activity may, at its discretion, waive the inspections so identified by Footnote 2/ in Table V for a period of time not to exceed two years. This option applies only to the products of the same type, grade and condition.

4.3.3 Sampling and inspection procedures:

4.3.3.1 Visual: The sample unit for visual inspection shall be one sheet or molded part as applicable. Samples shall be randomly selected from each lot in accordance with Inspection Level I of MIL-STD-105. Each sample unit shall be inspected as specified in Table III. Odor examination shall be conducted at this time and be included as part of the defect scoring. The Acceptable Quality Level (AQL) shall be 2.5 major and 6.5 total defects per 100 units.

TABLE III. Visual inspection.

Examination	Defect	Major	Minor
Appearance	Not uniform in texture, finish or firmness.	X	
	Dirt, foreign material, imbedded particles.		X
	Production defects not corrected (3.2.4).	X	
Construction	Any defects classified as major or minor as specified in MIL-STD-293.		X
	Skin or rind not as specified.		X
	Odor		X

4.3.3.2 Dimensional: The sample unit shall be one sheet or molded part as applicable. The sample shall be selected in accordance with Inspection Level S-3 of MIL-STD-105, and may be randomly selected from other samples visually inspected. The sample shall be inspected in accordance with Table IV. The AQL shall be 1.5 percent defective.

TABLE IV. Dimensional inspection

Examination	Defect
Sheets and molded parts	Any dimension that varies more than the plus or minus tolerances specified in 3.7, the applicable drawing or the contract.

4.3.3.3 Physical properties: Sufficient cellular rubber shall be selected from each lot to complete the testing specified in Table V. Failure of the product to pass any requirement in Table V shall be cause to reject the lot represented by the material.

TABLE V. Physical properties

Property	Rqmt para	Test para	No. of specimens	Results reported to <u>1/</u>
Apparent density	Table I	4.5.1	3	0.001 unit
Compression deflection	Table I	4.5.2	3	0.1 psi
<u>2/</u> Low temperature resistance	Table I	4.5.3	3	0.1%
<u>2/</u> Accelerated aging (heat)	Table I	4.5.4	3	1%
Recovery	Table I	4.5.5	3	0.1%
<u>2/</u> Flexing	Table I	4.5.6	3	0.1%
<u>2/</u> Flame resistance	Table I	4.5.7	2	Second
<u>2/</u> Shrinkage	Table I	4.5.8	3	0.1%
Water absorption, Type II	Table I	4.5.9	3	0.1%
<u>2/</u> Oil aging	Table I	4.5.10	2	0.1%
<u>2/</u> Free sulfur	Table I	4.5.11	3	0.01%

1/ All test results shall be reported as the average value. All results shall be shown on test report.

2/ These inspections may be waived by the procuring activity in accordance with the provisions of 4.3.2.

4.3.3.4 Packaging inspection: Shipping containers, just prior to closure shall be randomly selected from each lot in accordance with Inspection Level I of MIL-STD-105. The sample unit shall be one shipping container. The lot size shall be the number of shipping containers. The AQL shall be 4.0 percent defective. Samples shall comply with the requirements of Section 5 and Table VI. In addition, shipping containers fully prepared for delivery shall be examined for closure defects.

TABLE VI. Packaging inspection

Examine	Defect
Packaging (as applicable)	
Sheets	Paper separator sheets omitted.
Molded shapes	Not wrapped, boxed or otherwise protected against abrasion and deformation. Unit package not as specified. Packaging material not as specified.
Packing	Not in accordance with contract requirements. Arrangements or number of units per shipping container not in accordance with contract requirements. Container not as specified or required methods or materials.
	Any non-conforming component, component missing, damaged or otherwise defective affecting serviceability.
	Inadequate application of components, such as: incomplete closures of case liners, container flaps, loose or inadequate strapping, bulged or distorted containers.
Count	Less than specified or indicated quantity.
Weight	Gross weight exceeds specified requirements.
Markings	Interior or exterior markings (as applicable) omitted, illegible, incorrect, incomplete or not in accordance with contract requirements. Precautionary markings missing or not as specified.

4.4 Testing conditions:

4.4.1 Standard conditions: Unless otherwise specified herein, all tests shall be conducted at $24^{\circ} \pm 3^{\circ}\text{C}$ ($75^{\circ} \pm 5^{\circ}\text{F}$) and a relative humidity of 50 ± 4 percent.

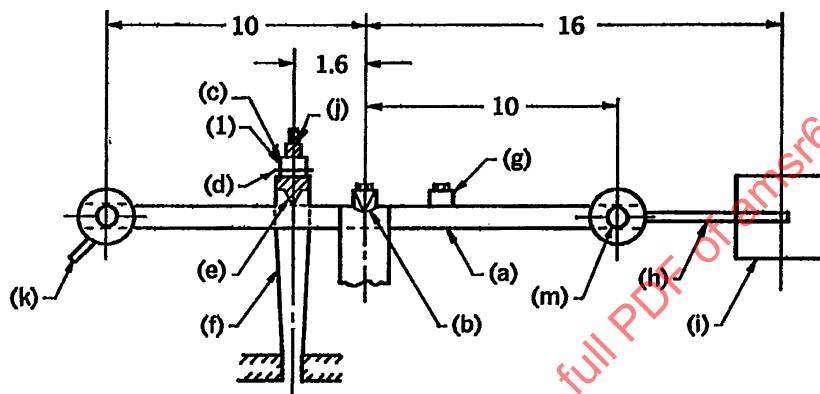
4.4.2 Specimen conditioning: Unless otherwise specified, all test specimens shall be conditioned at standard conditions for at least 22 hours prior to testing.

4.5 Test methods:

4.5.1 Apparent density: The density of regular shaped items (easily measured parts and sheets) shall be determined by accurately measuring to determine volume and weighing. Three samples shall be used. The density of irregular shaped items shall be determined by any acceptable procedure. The free flowing powder or seed method is one such procedure.

4.5.2 Compression deflection:

4.5.2.1 Apparatus: The test apparatus shall be such that the deflection plates remain parallel when the load is applied. Apparatus as shown in Figure 1 may be used.



Deflection lever ratio of machine is 16 to 1.6.

Deflection of 0.10 inch at specimen equals a vertical displacement of 1 inch on oscillogram.

- (a) Balance lever (supported at center by (b)).
- (b) Knife edges.
- (c) Circular depressor plate 1-5/8 dia.
- (d) Perforated metal base plate 2-1/2 square.
- (e) Knife edge.
- (f) Stabilizing arm (to render the compression surfaces parallel).
- (g) Counterbalance.
- (h) Pen arm.
- (i) Oscillogram (to automatically record deflections).
- (j) Micrometer head.
- (k) Fastening hook.
- (l) Test specimen.
- (m) Point of application of load (load lever ratio 10 to 1.6).

Dimension in inches.

FIGURE 1. Apparatus for compression deflection test.

4.5.2.2 Procedure: The following procedure shall be observed when apparatus shown in Figure 1 is used. If an apparatus other than that shown by Figure 1 is used, applicable portions of the following procedure shall apply. The test specimens shall be cut exactly 1.625 inches (4.128 cm) in diameter. Specimens taken from either sheets or molded shapes shall have a minimum thickness of 0.25 inch (0.64 cm) and a maximum thickness of 1.125 inches (2.86 cm). Specimens may have a rind on the top and bottom faces only. All specimens shall have parallel top and bottom faces. The test specimen (1) shall be placed on the base plate (d), and the depressor plate (c) shall be placed on top of the specimen. Several alternate compressions and decompressions shall be made on Type I specimens to expel trapped air. Perfect balance of lever (a) shall be obtained by adjusting the position of counterbalance (g). The lever shall then be fastened to the hook (k), and the micrometer head (j) lowered until it just contacts the depressor plate. A 10-gram preload shall be applied. The hook (k) shall be disengaged, and a reference line traced on the recording drum (i). Standard weights shall be added stepwise at point (m) at 1-minute intervals to deflect the specimen at least 25 percent. Standard weights shall be used which have been so selected that a minimum of four equal weights is required to obtain 25 percent deflection on any cellular test specimen, regardless of its degree of softness or firmness. A load-deflection curve shall be obtained, and the load at 25 percent deflection read from the curve. The load shall be calculated in pounds per square inch (kilopascals). The test shall be run in triplicate and the results averaged. The test specimens shall be used for low temperature resistance (4.5.3).

4.5.3 Low temperature resistance: Low temperature resistance shall be determined as specified in Sections 26 thru 29 of ASTM D 1056 using the test specimens and room temperature load data obtained in 4.5.2. Exposure temperatures shall be as specified in Table VII.

TABLE VII. Low temperature resistance temperatures.

Type	Grade	Temperature
I	A & B	-41° ±1°C (-42° ±2°F)
I	C	-55° ±1°C (-67° ±2°F)
II	A & B	-31° ±1°C (-24° ±2°F)
II	C	-55° ±1°C (-67° ±2°F)

4.5.4 Accelerated aging: Specimens of the dimensions used for testing in 4.5.2.2 shall be aged in a circulating air oven for 70 ±1 hours at 100° ±1°C (212° ±2°F). After aging, the specimens shall be cooled to standard conditions and remain undeflected and undistorted for 22 hours. Each specimen shall then undergo testing as specified in 4.5.2. A load deflection curve shall be obtained by adding 4 equal weights at 1 minute intervals. The total load shall equal that which was required to deflect an unaged specimen to 25 percent (original deflection). The deflection of the aged specimen shall be noted. Percent retention of the original deflection shall be calculated as follows:

Retention of original deflection, percent = $W \times 4$

where: W = The deflection of the aged specimen under original deflection load.

- 4.5.5 Recovery: The thickness of each test specimen (prepared as specified in 4.5.2) shall be measured to 0.001 inch (0.025 mm) and then compressed to 50 percent of original thickness for a period of $46 \pm 1/2$ hours. One minute after removal from the compression apparatus, the thickness of each specimen shall be re-measured and the recovery calculated as follows:

$$\text{Recovery, percent} = \frac{B}{A} \times 100$$

where: A = Original thickness

B = Thickness 1 minute after removal from apparatus.

- 4.5.6 Flexing: Flexing shall be in accordance with ASTM D 1055 (Sections 24 thru 26) except the test shall be run in triplicate with specimens 2 by 2 by 1 inch (50 by 50 by 25 mm) thick. Each specimen shall undergo 250,000 cycles of flexing. The amplitude of compression and decompression shall be 50 percent of the original thickness of each specimen. Compression set shall be calculated in accordance with Section 19.1 of ASTM D 1055.
- 4.5.7 Flame resistance: One end of a strip specimen 0.25 by 0.5 inch (6.35 by 12.7 mm) wide shall be held in a candle (C-C-91, or equal) flame for exactly 1 minute, as shown in Figure 2. The specimen shall be removed from the flame and the time the specimen burns shall be recorded as the flame propagation time. The test shall be performed in an area free from drafts.
- 4.5.8 Shrinkage (Type II): Shrinkage shall be determined on triplicate specimens 1.625 inches (41.3 mm) in diameter by 1 inch (25.4 mm) thick. The specimens shall be held overnight in a desicator, and then the volume determined by the free-flow seed method, as specified in 4.5.1. After the original volume has been determined, the specimens shall be conditioned in a circulating air oven at $60^\circ \pm 1^\circ\text{C}$ ($140^\circ \pm 2^\circ\text{F}$) for 7 days. After removal from the oven, the specimens shall be cooled for 2 hours (to room temperature) in a desicator, and again the volume shall be determined by the free-flowing seed method. Percent shrinkage shall be calculated as follows:

$$\text{Percent change in volume} = \frac{V_1 - V_2}{V_1} \times 100$$

where: V_1 = Original volume

V_2 = Volume after oven aging