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Superseding AMS-R-5001

Rubber Cellular Sheet, Molded and Hand-Built Shapes; Latex Foam

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

STABILIZED NOTICE

This document has been declared "Stabilized" by SAE AMS P, Polymeric Materials Committee, and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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NOTICE

This document has been taken directly from U. S. Military Specification MIL-R-5001B and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE technical standards. The initial release of this document is intended to replace MIL-R-5001B. Any part numbers established by the original specification remain unchanged.

The original Military Specification was adopted as an SAE standard under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of government specifications and standards. TSB rules provide for (a) the publication of portions of unrevised government specifications and standards without consensus voting at the SAE Committee level, and (b) the use of the existing government specification or standard format.

Under Department of Defense policies and procedures, any qualification requirements and associated qualified products lists are mandatory for DOD contracts. Any material relating to qualified products lists (QPL's) has not been adopted by SAE and is not part of this technical report.

1. SCOPE:

1.1 Scope:

This specification covers cored and uncored open cell latex foam rubber sheets, molded and hand-built shapes having good shock-absorbing, vibration-damping, and comfort cushioning characteristics (see 6.1).

1.2 Classification:

1.2.1 Types: Latex foam rubber covered by this specification shall be furnished in the following types as specified (see 6.2):

Type I - Cored
Type II - Uncored

1.2.1.1 Composition: Latex foam rubber covered by this specification shall be furnished in the following compositions as specified (see 6.2):

Composition 1 - Lattices of natural rubber, synthetic natural rubber (polyisoprene) or a combination thereof.

Composition 2 - Lattices of synthetic rubber (non-polyisoprene), or a combination of synthetic natural rubber (polyisoprene) with synthetic rubber.

1.2.2 Classes:

1.2.2.1 Type I: Type I latex foam rubber covered by this specification shall be furnished in the following classes as specified (see 6.2):

Class 1 -Soft
Class 2 - Medium
Class 3 - Firm

1.2.2.2 Type II: Type II latex foam rubber covered by this specification shall be furnished in the following classes as specified (see 6.2):

Class 1 - Soft
Class 2 - Medium
Class 3 - Firm
Class 4 - Extra Firm

1.2.3 Grades: Latex foam rubber covered by this specification shall be furnished in the following grades as specified (see 6.2):

Grade A - Flame Resistant.
Grade B - Nonflame Resistant, moderate low temperature compression.
Grade C - Nonflame Resistant, good low temperature compression.

2. APPLICABLE DOCUMENTS:

The following publications, of the issues in effect on the 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.

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-293	Visual Inspection Guide for Cellular Rubber Items
PPP-B-601	Boxes, Wood, Cleated-Plywood
PPP-B-636	Box, Fiberboard
PPP-B-640	Boxes, Fiberboard, Corrugated, Triple-Mall
MIL-STD-313	Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

2.2 ASTM Publications:

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

ASTM D 1055	Flexible Cellular Material - Latex Foam
ASTM D 4986	Horizontal Burning Characteristics of Cellular Polymeric Materials

3. REQUIREMENTS:

3.1 First article:

Unless otherwise specified (see 6.2), a sample shall be subjected to the first article inspection in accordance with 4.3.

3.2 Material:

The latex foam shall be made from vulcanized rubber lattices of Composition 1 or Composition 2 material as specified (see 6.2). The cells shall be open and interconnecting having a uniform structure. Except for the allowances specified in 3.6, there shall be no large seams in the material and the surfaces of the material shall be porous.

3.2.1 Limitation on age: Material shall not be older than one year from the date of manufacture at the time of shipment to the Government.

3.3 Construction:

3.3.1 Form: Latex foam shall be furnished in the form of sheets, molded shapes, or hand-built shapes as specified (see 6.2). Assembled products may be provided when the finished product desired is larger than it is standard practice in industry to mold in one section.

3.3.2 Cores: Size, shape and distribution of coring shall be at the manufacturer's option, unless otherwise specified by the acquiring activity (see 6.2).

3.4 Surfacing:

Latex foam shall be backed or surfaced with fabric, cement or other material as specified in the contract or purchase order, or by applicable drawings (see 6.2).

3.5 Finish:

3.5.1 Sheets: Unless otherwise specified (see 6.2), sheets shall be Type II and smooth on both faces. Fabric impressions are not objectionable.

3.5.2 Molded or hand-built shapes: Unless otherwise specified (see 6.2), molded or hand-built shapes shall be smooth on all surfaces.

3.6 Allowable manufacturing defects:

The following defects may be allowed in latex foam when their occurrence is incident to standard manufacturing practice and assembly, providing they are corrected as indicated herein and the resulting product conforms with the requirements of this specification and supplementary specifications and drawings

a. Tears occurring during removal from mold which have been completely 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 in width) which have been corrected by addition of material of identical composition and quality as that of the product and by buffing to a level, neat-appearing surface.
c. Low-compression cushions adjusted by the addition of material of identical composition and quality in the core holes in a symmetrical pattern throughout the product, to produce the required uniform compression resistance.

3.7 Tolerances:

Unless otherwise specified in the contract or purchase order (see 6.2), tolerances on dimensions of sheet material shall be as specified in Table 1. Tolerances on dimensions of molded or hand-built shapes shall be as specified by the applicable drawings or specifications.

TABLE I. Tolerances on dimensions of sheet material

Type	Dimension	Range (inches)	Tolerances (inches)	
			Plus	Minus
I	Length and width	0 - 6	.188	.063
		6 - 12	.375	.125
		12 - 24	.500	.250
		24 - 36	.625	.375
		36 - 48	.750	.500
		48 - 60	.875	.625
		60 - 72	1.000	.750
		72 and over	1.125	.875
	Thickness	0 - 3	.125	.063
		3 - 5	.188	.125
		5 and over	.250	.188
II	Length and width	0 - 6	.313	.063
		6 - 12	.500	.125
		12 - 24	.688	.250
		24 - 36	.875	.375
		36 - 48	1.125	.500
		48 - 60	1.250	.625
		60 - 72	1.375	.750
		72 and over	1.500	.875
	Nominal thickness	Up to and including 1/2	.063	.063
		Over 1/2 to 1 inclusive	.125	.063
		Over 1 to 3 inclusive	.188	.125
		3 and over	.250	.188

3.8 Odor:

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

3.9 Indentation:

The force required to produce a 25 percent indentation shall be as specified in Table II for each class of Type I (cored) material and Table III for each class of Type II (uncored) material. Testing shall be conducted in accordance with 4.5.1.

TABLE II. Indentation resistance and apparent density for Type I material

CLASS	INDENTATION RESISTANCE (pounds force to produce a 25% ldentation over a 50 in² area)	APPARENT DENSITY 1/ (lb/cu. in.) (Maximum)													
		GRADE A Thickness (inches)						GRADE B AND C Thickness (inches)							
		1	1.50	2	2.50	3	3.50	Over 3.50	1	1.50	2	2.50	3	3.50	Over 3.50
Soft	10 to 20	.0050	.0047	.0044	.0041	.0039	.0038	.0037	.0039	.0036	.0033	.0030	.0028	.0027	.0026
Medium	Over 20 to 35	.0061	.0057	.0052	.0048	.0046	.0045	.0044	.0050	.0046	.0041	.0037	.0035	.0034	.0033
Firm	Over 35 to 55	.0069	.0065	.0060	.0056	.0054	.0052	.0050	.0058	.0054	.0049	.0045	.0042	.0040	.0038

1/ Apparent density is based on gross volume and includes coring.

TABLE III. Indentation resistance and density for Type II material

CLASS	INDENTATION RESISTANCE (Pounds force to produce a 25% indentation over a 50 in^2 area)	DENSITY (lb/cu. in.) (Maximum)	
		GRADE A	GRADE B AND C
Soft	10 to 25	0.0060	0.0045
Medium	Over 25 to 40	0.0085	0.0055
Firm	Over 40 to 60	0.0100	0.0065
Extra Firm	Over 60 to 85	0.0120	0.0075

3.10 Low temperature compression deflection (percent change):

The maximum percent change in compression deflection at -40°F (-40°C) for each material grade shall be as follows when tested in accordance with 4.5.2:

Grade A - 70%
Grade B - 60%
Grade C - 25%

3.11 Density:

The apparent density for each class of TYpe I material and the density for each class of Type II material shall be as specified in Table II and III respectively when tested in accordance with 4.5.3.

3.12 Flame resistance (Grade A only):

Grade A material shall not support a flame for longer than 50 seconds when tested in accordance with 4.5.4.

3.13 Compression set:

The compression set shall not be greater than 10 percent (expressed as a percentage of the original height) when tested in accordance with 4.5.5.

3.14 Flexing endurance:

After 250,000 compression cycles, there shall be no breakdown of the cellular structure and the compression set shall not be greater than 10 percent when tested in accordance with 4.5.6.

3.15 Resistance to accelerated aging:

After accelerated aging, the change in compression deflection shall not be greater than 15 percent when tested in accordance with 4.5.7.

3.16 Color:

Unless otherwise specified (see 6.2), the color of the latex foam rubber shall be “as manufactured.”

3.17 Identification marking:

In addition to any special marking required by the contract or order (see 6.2), each piece of latex foam rubber shall be marked in a permanent and legible manner in accordance with the marking requirements of MIL-STD-130 and shall also include the Type, Class, Grade, and Date of manufacture. The identification marking shall be stamped or printed with indelible ink which is harmless to the materials.

3.17.1 Sheets: The identification marking on sheet material shall be applied on one side only in rows spaced not more than 5 inches apart of constantly recurring characters not less than .375 inch in height extending either lengthwise or crosswise of the sheet.

3.18 Workmanship:

The latex foam shall be of uniform texture and shall be free from manufacturing imperfections which may impair its serviceability.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for inspection:

Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, 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 ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance: All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Classification of inspection:

The inspection requirements specified herein are classified as follows:

a. First article inspection (see 4.3).
b. Quality conformance inspection (see 4.4).

4.3 First article inspection:

First article inspection shall consist of all the tests in Table IV and the examination for defects in appearance and construction as specified in 4.4.2 for each type, class and grade of latex foam rubber submitted for approval. Prior to contract award, bidders shall provide the procuring activity with a Material Safety Data Sheet (MSDS) prepared in accordance with FED-STD-313. The responsibility for the performance of the first article inspection shall be as specified in the contract or purchase order (see 6.2, 6.2.2, and 6.4). All material supplied to this specification shall be manufactured using the same formulation and methods used to obtain the first article samples unless a change has been approved by the procuring activity.

TABLE IV. First article tests

Test	Requirement Paragraph	Test Method	Number of Tests Required 1/	Report Average Result Numerically To the Nearest
Indentation Resistance	3.9	4.5.1	3	1 Lbf
Low Temp Compression Deflection	3.10	4.5.2	3	0.1 percent
Density	3.11	4.5.3	3	0.0001 lbs./in.^{3}
Flame Resistance Grade A Only	3.12	4.5.4	3	1.0 second
Compression Set	3.13	4.5.5	3	0.1 percent
Flexing Endurance	3.14	4.5.6	3	0.1 percent
Accelerated Aging	3.15	4.5.7	3	0.1 percent

1/ - Test reports shall include individual values on which average results are based.

4.3.1 Sampling for first article inspection: As soon as possible after the award of a contract or purchase order, the contractor shall submit at least three 12 by 12 by 1 inch pieces of Type II material in the grade and class specified in the contract or purchase order for first article inspection. Approval of Type I material will be granted upon approval of samples of Type II material of the same composition. Further production of latex foam rubber by the contractor prior to the approval of the acquiring activity or completion of inspection of the first article shall be at the contractor's risk.

4.4 Quality conformance inspection:

Quality conformance inspection shall consist of inspection for appearance and construction (see 4.4.2), dimensional inspection (see 4.4.3), packaging inspection (see 4.4.4), and physical and mechanical property testing (see 4.4.5). All quality conformance inspections and tests shall be conducted on each lot of material (see 4.4.1). In addition, the contractor shall supply a Material Safety Data Sheet (MSDS), prepared in accordance with FED-STD-313, with each shipment of material from a lot.

4.4.1 Inspection lot: All material of the same type, composition, class, grade and size (or part number) manufactured under the same conditions from the same batch or batches of latex foam rubber compound and offered for delivery at one time shall be considered a lot for purposes of inspection and tests.

4.4.2 Inspection for appearance and construction: Sample units for inspection of appearance and construction shall be selected in accordance with Inspection Level II of MIL-STD-105. The sample unit for this examination shall be one sheet, one molded shape, or one hand-built shape, as applicable. Inspection shall be performed in accordance with Table V. Acceptance criteria shall be as specified in the contract or purchase order (see 6.2 and 6.6).

TABLE V. Inspection for appearance and construction

Examine	Defect	Major	Minor
Appearance	Not uniform in texture, finish or firmness	X	
	Presence of dirt, foreign material, embedded particles		X
Construction	Any defects classified as major or minor defects for latex foam as specified in MIL-STD-293		
	Surface or backing not as specified	X	

4.4.3 Dimensional inspection: Sample units for dimensional inspection shall be selected in accordance with Inspection Level II of MIL-STD-105. The sample unit for this examination shall be one sheet, one molded shape, or one hand-built shape, as applicable. Inspection shall be performed in accordance with Table VI. Acceptance criteria shall be as specified in the contract or purchase order (see 6.2 and 6.6).

TABLE VI. Dimensional inspection

Examine	Defect
Sheets	Any dimension that varies by more than plus or minus the applicable tolerances specified in 3.7, in drawings, or in the contract.
Molded parts	Any dimension that varies by more than plus or minus the specified size or tolerance allowed in the applicable drawings or contract.

4.4.4 Packaging Inspection: Packaging inspection shall be performed to determine that preservation, packing, and markings comply with the requirements of section 5 of this specification. Sample units for packaging inspection shall be selected in accordance with Inspection Level S-2 of MIL-STD-105. The sample unit for this examination shall be one shipping container, fully packed, selected just prior to the closing operation. Shipping containers fully prepared for delivery shall be examined for closure defects. Inspection shall be conducted in accordance with Table VII. Acceptance criteria shall be as specified in the contract or purchase order (see 6.2 and 6.6).

TABLE VII. Packaging inspection

Examine	Defect
Preservation	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. Arrangement or number of units per shipping container not in accordance with contract requirements. Container not as specified or required methods of materials. Any nonconforming 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.

4.4.5 Physical and mechanical property testing: A sufficient number of items to conduct the physical and mechanical property tests specified in Table VIII shall be randomly selected from each lot of material (see 4.4.1). Except as specified below, the required test specimens shall be fabricated from the supplied sheet, molded parts, or hand-built parts, as applicable. No more than one determination per test shall be conducted on each item selected from the lot. For example, conducting two of the three compression set tests on one of the items selected shall not be permitted. If the items supplied are of such shape that test specimens can not be obtained from them, they shall be fabricated from sheets having a length of 12 inches, a width of 12 inches, and a thickness of 1 inch. The sheets shall be identical in cure and composition as the lot of material they represent and no more than one determination per test shall be conducted on each sheet.

TABLE VIII. Physical and mechanical property testing

Test	Requirement Paragraph	Test Method	Number of Tests Required 1/	Report Average Result Numerically To the Nearest
Indentation Resistance	3.9	4.5.1	3	1 Lb_f
Density	3.11	4.5.3	3	0.0001 lbs./in.^{3}
Flame Resistance Grade A Only	3.12	4.5.4	3	1.0 second
Compression Set	3.13	4.5.5	3	0.1 percent

1/ - Test reports shall include individual values on which results are based.

4.5 Test methods:

All tests shall be conducted as specified herein. Tests shall be conducted at a temperature of 75° ± 5°F (24° ± 3°C) unless otherwise specified in the applicable test method.

4.5.1 Indentation test: The indention test shall be conducted in accordance with the method specified in ASTM D1055 (see 6.5). Testing shall be performed on 3 specimens and the average value used to determine conformance with 3.9.

4.5.2 Low temperature compression deflection test (percent change): Testing to determine the percent change in compression deflection after exposure to -40°F (-40°C) shall be conducted in accordance with the low temperature test method (suffix F1) specified in ASTM D1055 (see 6.5). Testing shall be performed on 3 specimens and the average percent change in compression deflection used to determine conformance with 3.10.

4.5.3 Density: The density shall be the average of three determinations. Each determination shall consist of accurately weighing and measuring a sample and dividing the weight by the volume. Samples to be tested shall have been placed in a desiccator for 24 hours immediately prior to density determination. The volume of irregularly shaped products or specimens, which cannot be measured by ordinary means, shall be obtained as follows: If the product has a cored side, the core holes shall be sealed off with cellophane or paper sheeting. The sample shall be placed in a graduated container of slightly larger dimensions than the sample and completely surrounded by 10 to 14 mesh, free flowing seed (such as flaxseed) so that the sample is covered to a depth of 1 inch. The seed shall be added to the graduated container from a point approximately 6 inches above the top of the product. A glass powder funnel having a top diameter of 100 mm and a stem diameter of 18 mm is recommended for adding the flaxseed. The true or apparent volume (as applicable) of the seed plus the sample shall be recorded, the sample removed, and the volume of the seed determined. The volume (or apparent volume) of the latex foam shall be determined by deducting the volume of the seed from the volume of the seed plus the sample. The density (or apparent density in the case of cored material) shall be determined by dividing the weight by the volume.

4.5.4 Flame resistance: The time the material supports a flame shall be determined in accordance with ASTM D 4986 except as specified herein. Testing shall be performed on three specimens 0.250 inches thick by 0.500 inches wide and of any convenient length. Prior to testing, specimens shall be conditioned for a minimum of 48 hours at 73 ± 4°F (23 ± 2°C) and a relative humidity of 50 ± 5 percent. The specimens shall be placed on the support gauze holder such that the thickness by length area is horizontal. The average time of flame propagation shall be used to determine conformance to 3.12.

4.5.5 Compression set: Compression set, expressed as a percentage of the original height, shall be determined in accordance with the method specified in ASTM D 1055 (see 6.5). Testing shall be performed on 3 specimens and the average value used to determine conformance with 3.13.

4.5.6 Flexing endurance: Three specimens shall be tested for flexing endurance in accordance with the flexing method in ASTM D 1055 (see 6.5). After 250,000 cycles, the cellular structure of each specimen shall be visually examined for conformance to 3.14. In addition, the average value for compression set shall meet the requirements in 3.14 when determined as follows:

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

Where:

t_0 = Original specimen height
t_1 = Specimen height one hour after completion of the 250,000 cycles

4.5.7 Resistance to accelerated aging: Three specimens, identical to those required in the low temperature compression deflection test in 4.5.2, shall be conditioned for accelerated aging in accordance with the air-oven method described in ASTM D 1055 (see 6.5). Specimens shall be subjected to 212° ± 2°F (100° ± 1°C) for a period of 70 ± 1/2 hours. After conditioning, the test specimen shall be allowed to rest undeflected and undistorted at 75° ± 5°F (24° ± 3°C) for at least 22 hours before testing for percent change in compression deflection as specified in ASTM D 1055. The average value shall be used to determine conformance to 3.15.

5. PACKAGING:

5.1 Preservation:

Molded shapes shall be wrapped, boxed, or otherwise protected against deformation and abrasion. Latex foam rubber sheets shall be preserved in accordance with supplier's commercial practice.

5.2 Packing:

Packing shall be Level A, B, or C, as specified (see 6.2).

5.2.1 Level A: The latex foam rubber preserved in accordance with 5.1 shall be packed in snug fitting fiberboard boxes conforming to PPP-B-640, Class 2, Grade A, or in overseas type cleated-plywood boxes conforming to PPP-B-601 (see 6.2). Boxes shall be strapped in accordance with the appendix of the applicable box specification.

5.2.2 Level B: The latex foam rubber preserved in accordance with 5.1 shall be packed in snug fitting fiberboard boxes conforming to PPP-B-636, Class - domestic, PPP-B-640, Class 1, Grade B, or in domestic type cleated boxes conforming to PPP-B-601 (see 6.2).

5.2.3 Level C: The latex foam rubber preserved in accordance with 5.1 shall be packed in a manner to ensure carrier acceptance and safe delivery at lowest transportation cost to destination. Containers shall be in accordance with Uniform Freight Classification Rules or regulations of other carriers applicable to the mode of transportation.

5.3 Marking:

In addition to any special marking required by the contract or order (see 6.2), interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129 and shall include the following information:

Stock No. or other identification number as specified in the purchase document

RUBBER,CELLULAR SHEET, MOLDED AND HAND-BUILT SHAPES: LATEX FOAM

MIL-R-5001A

Type _____Composition_____Class_____Grade_____

Manufacturer's Designation No.

Date of manufacture

Name of manufacturer

5.3.1 Precautionary marking: The following precautionary marking shall be included on each exterior shipping container.

"STORE IN A COOL PLACE"