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SUPERSEDING
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FEDERAL SPECIFICATION

PLASTIC MATERIAL, CELLULAR, URETHANE (FLEXIBLE)

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers cellular urethane plastic material designed for such applications as upholstery, general seating, mattresses, and other uses.

NOTE: The material will be designated as urethane foam in this specification.

1.2 Classification.

1.2.1 Type. The urethane foam shall be furnished in the following types as specified (see 6.2):

Type I - Conventional
Type II - Conventional, combustion-modified*
Type III - Filled
Type IV - Filled, combustion-modified*
Type V - High resilience, unfilled
Type VI - High resilience, combustion-modified*

*Additives are designed to lessen combustibility of foams; they do not prevent foams from burning.

1.2.2 Class. Urethane foams, Types I through IV, shall be furnished in the following classes, as specified (see 3.3, 3.5.1, and 6.2):

Class 1 - Super soft.
Class 2 - Soft.
Class 3 - Medium.
Class 4 - Firm.
Class 5 - Extra firm.
Class 6 - Super firm.

Urethane foams, Types V and VI, shall be furnished in the following grades:

Grade HR-I (IFD at 25 percent deflection $\leq$ 67 Newtons/323 sq cm).
Grade HR-II (IFD at 25 percent deflection $>$ 67 Newtons/323 sq cm).

1.2.3 Dimensions and thickness. Dimensions and thickness shall be as specified in the contract or order (see 3.2, table I, and 6.2).

2. APPLICABLE DOCUMENTS

2.1 The following documents, 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.

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

(Single copies of this specification and other Federal Specifications required by activities outside the Federal Government for bidding purposes are available without charge from Business Service Centers at the General Services Administration Regional Offices in Boston, New York, Philadelphia, Washington, DC, Atlanta, Chicago, Kansas City, MO, Fort Worth, Houston, Denver, San Francisco, Los Angeles, and Seattle, WA.

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

Military Standard:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.

(Copies of Military Specifications and Standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials (ASTM) Standard:

D 3574 - Flexible Cellular Materials - Slab, Bonded, and Molded Urethane Foams.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

National Motor Freight Traffic Association, Inc., Agent:

National Motor Freight Classification.

(Application for copies should be addressed to the American Trucking Associations, Inc., Traffic Department, 1616 P Street, N.W., Washington, DC 20036.)

Uniform Classification Committee, Agent:

Uniform Freight Classification.

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

3. REQUIREMENTS

3.1 Material. Urethane foam shall be made from polyhydroxy compounds, isocyanates, and water reacted together to form an expanded flexible open cell product. Auxiliary expanding agents such as halogenated hydrocarbons will be acceptable.

3.1.1 Filler. Filler shall consist of inert mineral powders such as calcium carbonate, barium sulfate, zirconium silicate, or alumina trihydrate.

3.2 Tolerances. Tolerances on thickness, length, and width shall be as specified in table I.

TABLE I. Tolerances on dimensions of urethane foams.

Millimeters			Inches		
Dimensions	Tolerance Plus or minus		Dimensions	Tolerance Plus or Minus	
			(Thickness)		
Up to 6.4	1	1	Up to 1/4	1/16	0
Over 6.4 to 38	2	1	Over 1/4 to 1-1/2	1/16	1/16
Over 38 to 76	3	1.5	Over 1-1/2 to 3	1/8	1/16
Over 76 to 127	5	1.5	Over 3 to 5	3/16	1/16
Over 127	5	3	Over 5	3/16	1/8
			(Length & width)		
Up to 152	3	1.5	Up to 6	1/8	1/16
Over 152 to 305	3		Over 6 to 12	1/8	
Over 305 to 610	6.5		Over 12 to 24	1/4	
Over 610 to 1220	10		Over 24 to 48	3/8	
Over 1220	13		Over 48	1/2	

3.3 Density. The urethane polymer density of all foams shall be determined according to 4.3.3.1 and shall be as specified in table II.

TABLE II. Polymer density of urethane foams.

Types I through IV Minimum			Types V and VI Minimum		
Classes	kg/cu m	lbs/cu ft	Grades	kg/cu m	lbs/cu ft
1	16.0	1.0	HR-I	24.0	1.5
2, 3, 4	24.0	1.5	HR-II	40.0	2.5
5	25.6	1.6			
6	27.2	1.7			

3.4 Tensile strength and elongation. The tensile strength and elongation shall be as specified in table III, when tested as specified in 4.3.3.2.

TABLE III. Tensile strength and elongation of urethane foams.

	Types I and II	Types III and IV	Types V and VI	
			HR-I	HR-II
Tensile strength, minimum				
kilopascals (kPa)	83	55	48	69
lbs/sq in	12	8	7	10
Elongation, minimum				
percent	120	100	100	100

3.5 Force deflection.

3.5.1 Indentation-deflection. When tested as specified in 4.3.3.3, the indentation force deflection (IFD) shall fall within the ranges designated in table IV. IFD values are based on a 380 X 380 X 102-mm (15 X 15 X 4-in) sample.

TABLE IV. Force deflection (indentation-deflection)

Type	Class	IFD (25 percent deflection) Lbs/50 sq in	IFD (25 percent deflection) N/323 sq cm	IFD (65 percent deflection)
	1*	< 18	< 80	
I	2	18 - 23	80 - 106	Measured 25 percent
	3	24 - 30	107 - 137	IFD times support
through	4	31 - 39	138 - 177	factor specified in
	5	40 - 50	178 - 222	3.6.2 gives minimum
IV	6*	> 50	> 222	value
V and VI	HR-I	< or = 15	< or = 67	
	HR-II	> 15	> 67	

* IFD values shall be specified in the contract or purchase order, subject to their normal commercial tolerances (see 6.2).

In those cases where foams having thicknesses of 102 mm (4 in) are not available, the following approximations to the reduced IFD values are to be used:

76 mm (3 in) thick - 90% of the 102 mm IFD value
51 mm (2 in) thick - 80% of the 102 mm IFD value
25 mm (1 in) thick - 70% of the 102 mm IFD value

3.5.2 Support factor. The support factor is the ratio of 65 percent IFD to 25 percent IFD and shall be as follows:

Types I and II..... 1.8 minimum
III and IV..... 2.0 minimum
V and VI..... 2.4 minimum

For example: A type I class 4 material has a 25 percent IFD of 169 Newtons/323 square centimeters (38 pounds/50 square inches). The support factor for type I material is 1.8, and since 1.8 X 169 = 304.2, the minimum acceptable 65 percent IFD is 304 Newtons/323 sq cm (68 pounds/50 sq in).

3.6 Constant deflection compression set (75 percent deflection). The constant deflection compression set shall be a maximum of 15 percent (based on the original thickness, C_t) for all types when tested as specified in 4.3.3.4.

3.7 Steam autoclave effects. The material shall be exposed in a steam autoclave. Exposed material shall conform to the following requirements when tested as specified in 4.3.3.5.

Force deflection change - 20 percent maximum.
Constant deflection compression set - 15 percent maximum.

3.8 Fatigue test. When tested as specified in 4.3.3.6, the material shall meet the following requirements:

Thickness loss
- Types I through IV - 5 percent maximum.
- Types V and VI - 2 percent maximum.

Force deflection loss
- Type I-30 percent maximum.
- Type II-35 percent maximum.
- Types III and IV-25 percent maximum.
- Types V and VI-20 percent maximum.

3.9 Workmanship. Urethane foam shall be uniform in mechanical properties. The finished product shall be free of nonexpanded resin areas and shall show no defects which may affect its serviceability.

3.9.1 Alteration limitations. Under certain manufacturing conditions, material may have to be altered or repaired. This repaired or altered material will be acceptable provided such alterations do not affect the performance, serviceability, size, and shape beyond the tolerances specified in the contract order.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier 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 that supplies and services conform to prescribed requirements.

4.2 Sampling for inspection. Sampling for inspection shall be performed in accordance with the provisions set forth in MIL-STD-105, except where otherwise indicated. For purposes of sampling, an inspection lot for examinations and tests shall consist of material of the same type produced under like conditions in one unchanged process, and submitted for inspection and delivery at one time.

4.3 Inspection of the end item.

4.3.1 Examination of the end item. Examination of the end item shall be made in accordance with the classifications of defects, inspection levels, and acceptable quality levels (AQLs) set forth below. The lot size, for the purpose of determining the sample size in accordance with MIL-STD-105, shall be expressed in units of slabs or molded items for examination in 4.3.2.1 and 4.3.2.2, and in units of shipping containers for examination in 4.3.2.3.

4.3.2 Inspection levels and AQL's for examination. The inspection levels for determining the sample size and the AQL's, expressed as percent defective, shall be as follows:

Examination paragraph	Inspection level	AQL
4.3.2.1	I	1.5
4.3.2.2	S-3	2.5
4.3.2.3	S-3	4.0

4.3.2.1 Examination of the end item for defects in workmanship. The sample unit for the examination specified in table V shall be one slab, one unpackaged molded item, or one carton of packaged material.

TABLE V. Examination of the end item for defects in workmanship

Examine	Defect
Type and class (or grade)	Other than as specified.
Workmanship	Unexpanded resin areas; hard, densified layer; backing or surfacing material not

4.3.2.2 Examination of the end item for defects in dimensions. The sample unit for the examination specified in table VI shall be one slab or one molded item.

TABLE VI. Examination of the end item for defects in dimensions

Examine	Defects
Dimensions	Any variation greater than tolerance specified.
Thickness	Any thickness deviation greater than applicable tolerance specified.

4.3.2.3 Inspection of preparation for delivery. An inspection shall be made to determine that the packing and marking comply with the requirement of section 5. Defects shall be scored in accordance with table VII. Defects of closure shall be examined on shipping containers fully prepared for delivery.

TABLE VII. Classification of preparation for delivery defects

Examine	Defect
Container	Not as specified.
Closure and Strapping (when required)	Not as specified.
Marking	Omitted; incorrect; illegible;improper size, location, sequence, or method of application.
Workmanship	Inadequate application of components such as: incomplete closure of containers, containers distorted or dirty.

4.3.2.4 Testing of the end item. The end item shall be tested for the applicable characteristics listed in 4.3.3. The lot size shall be expressed in units of single packages of completed manufactured product or single slabs. The sample unit quantity for a completed manufactured product shall be one such completed product; for slab stock, the sample shall be 3600 sq cm (4 sq ft) of the material with a thickness of 102 mm (4 in) and shall be cut from the near-vertical mid-point of the bun and at least 30 meters (100 feet) from the start of the run. No more than one sample unit shall be taken from any slab. The inspection level for determining the sample size for tests shall be S-1 except that no less than three sample units shall be randomly selected throughout the lot. The lot shall be unacceptable if one or more units fail to meet any requirements specified.

4.3.3 Testing of end item.

4.3.3.1 Density. Apparent density shall be measured according to ASTM D 3574. The urethane polymer density of a foam is taken to be 100 percent minus percent of the filler times apparent density. Filler is taken as ash content measured as follows:

Weigh to the nearest milligram a 1-gram sample of the foam into a porcelain or silica crucible, approximately 55-cc capacity, which has been ignited and weighed. Place the crucible in an electric muffle furnace with controls necessary to hold the temperature at 550° ± 25° C. Determine the temperature with a calibrated thermocouple-sensing element placed at approximately the geometric center of the furnace cavity and connected to an exterior temperature readout device. Place no more than two crucibles in the furnace at one time and position them directly below the thermocouple. Immediately close the door completely and do not open it for one hour. After one hour, open the furnace door 3 to 5 cm and continue heating for 30 minutes or until all carbonaceous material is burned off.

Remove the crucible from the furnace, cool in a desiccator, and weigh. Calculate the percent of ash as follows:

$$\text{Ash, percent} = \frac{(A - B)}{C} \times 100$$

where A = grams of ash plus crucible,
B = grams of crucible,
C = grams of foam sample.

4.3.3.2 Tensile strength and elongation. Tensile strength and elongation shall be tested according to ASTM D 3574.

4.3.3.3 Force deflection. The indentation force deflection (IFD) shall be measured according to ASTM D 3574, test B_1.

4.3.3.4 Constant deflection compression set. The constant deflection compression set shall be measured according to ASTM D 3574.

4.3.3.5 Steam autoclave test. Material shall be tested according to ASTM D 3574 as follows:

polyester foams of types I - IV	Procedure J_1
polyether foams of types I - IV	Procedure J_2
all foams of types V and VI	Procedure J_1

4.3.3.6 Fatigue test. Material shall be tested according to ASTM D 3574, test I_1.

4.3.4 Standard conditioning. Unless otherwise specified, samples for test shall be conditioned undeflected and undistorted at a temperature of 23° ± 1.1°C (73.4° ± 2°F) and in an atmosphere having a relative humidity of 50 ± 2 percent for at least 12 hours before being tested. These conditions shall prevail throughout the test.

5. PREPARATION FOR DELIVERY

5.1 Packing. Packing shall be level A or Commercial, as specified (see 6.2).

5.1.1 Level A. Urethane foam shall be packed in a snug-fitting cleated plywood or nailed wood box lined with waterproof barrier material. The barrier material shall be sealed at the edges with waterproof tape or adhesive. The gross weight of each container shall not exceed 200 pounds.

5.1.2 Commercial. Urethane foam shall be packed in containers to insure safe delivery at destination, to provide for safe redistribution by the initial receiving activity, and shall be acceptable by common carrier under National Motor Freight Classification or Uniform Freight Classification.

5.2 Unitization. When shipments to Government depots are full car or truckload, the packed urethane foam shall be unitized for shipment and handling in accordance with normal commercial practice. The unitized load shall not exceed 2,500 pounds in weight, 63 inches in height, 45 inches in width, and 56 inches in length.

5.3 Marking. Marking shall be as specified in the contract.

6. NOTES

6.1 Intended use. Urethane foam is intended for use in general seating applications and other uses requiring a material capable of absorbing shock and vibration.

6.2 Ordering data. Purchasers should select the preferred options permitted herein, and include the following information in procurement documents:

(a) Title, number, and date of this specification.
(b) Type and class or grade required; also dimensions and thickness (see 1.2.1, 1.2.2, and 1.2.3).
(c) IFD values required for classes 1 or 6, if applicable (see 3.5.1).
(d) Any applicable federal, state, or local combustibility regulations (see 6.3).
(e) Packing required (see 5.1).

Type II - Electrical type material.

6.3 Combustibility. Urethane foams shall meet any specified federal, state, or local regulations relating to the end use of the product (see 6.2).

MILITARY CUSTODIANS:

Army - MR
Navy - SH
Air Force - 99

Preparing activity:

GSA-FSS

Civil Agency Coordinating Activity:

GSA-FSS

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