

MIL-I-24172A(SH)  
19 November 1986  
SUPERSEDING  
MIL-I-24172(SHIPS)  
4 October 1965  
(See 6.7)

## MILITARY SPECIFICATION

### INSULATION, PLASTIC, CELLULAR POLYURETHANE, RIGID PREFORMED AND FOAM-IN-PLACE

This specification is approved for use within the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

#### 1. SCOPE

1.1 Scope. This specification covers a rigid cellular plastic material identifiable as urethane foam.

1.2 Classification. Urethane foams shall be of the following types and classes, as specified (see 6.2):

##### Type I - Preformed

Class 1 - 1.7 to 2.5 pounds per cubic foot density

Class 2 - 2.5 to 4.0 pounds per cubic foot density

##### Type II - Foam-in-place

Class 1 - 1.7 to 2.5 pounds per cubic foot density

Class 2 - 2.5 to 4.0 pounds per cubic foot density

#### 2. APPLICABLE DOCUMENTS

##### 2.1 Government documents.

2.1.1 Specification and standards. The following specification and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

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FSC 5640

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SPECIFICATION

MILITARY

MIL-F-16884 - Fuel, Naval Distillate.

STANDARDS

FEDERAL

FED-STD-313 - Material Safety Data Sheets Preparation and the Submission of.

MILITARY

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

(Copies of specifications and standards required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- C 177 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Guarded Hot Plate. (DoD adopted)
- C 203 - Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation.
- D 756 - Standard Practice for Determination of Weight and Shape Changes of Plastics Under Accelerated Service Conditions. (DoD adopted)
- D 1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics. (DoD adopted)
- D 1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics. (DoD adopted)
- D 2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.
- D 2856 - Standard Test Method for Open Cell Content of Rigid Cellular Plastics by the Air Pycnometer. (DoD adopted)
- D 3951 - Standard Practice for Commercial Packaging. (DoD adopted)
- E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials. (DoD adopted)
- E 96 - Standard Test Methods for Water Vapor Transmission of Materials.

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

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NATIONAL MOTOR FREIGHT TRAFFIC ASSOCIATION, INC., AGENT  
National Motor Freight Classification

(Application for copies should be addressed to the National Motor Freight Traffic Association, Inc., ATA TRAFFIC Dept., 2200 Mill Road, Alexandria, VA 22314.)

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Material. The basic ingredients used to formulate type I material and the components for type II material shall be an organic polyisocyanate and a polyol resin containing a halocarbon blowing agent.

3.1.1 The polyol used in this plastic material shall be free of both trimethylol propane and pentaerythritol.

3.1.2 Material safety data sheet. The contracting activity shall be provided a material safety data sheet (MSDS) at the time of contract award. The MSDS is form OSHA-20, found in and part of FED-STD-313. The MSDS shall be included with each shipment of the material covered by this specification (see 6.5).

3.2 Color. Unless otherwise specified (see 6.2), the color of the foamed material shall be the color of the product as normally manufactured.

3.3 Odor. The foamed material shall be free from any objectionable odor when wet or dry.

3.4 Uniformity. Type I material, and type II material when prepared as specified in 4.5.2.2, shall be homogeneous throughout and firm in composition. There shall be no blowholes greater than 1/2 inch in diameter or large accumulations of unexpanded resin or other large occlusions.

3.5 Property values. Types I and II materials shall conform to the property values shown in table I when tested as specified in 4.5.

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TABLE I. Type I and type II property values.

Inspection	Requirement	Test
Density, apparent	Class 1 - 1.7 to 2.5 pounds per cubic foot Class 2 - 2.5 to 4.0 pounds per cubic foot	4.5.3
Compressive strength at yield point or 10 percent deflection	Class 1 - Minimum of 20 lb/in <sup>2</sup> in the direction of the rise of the foam Class 2 - Minimum of 40 lb/in <sup>2</sup> in the direction of the rise of the foam	4.5.4
Fire resistance	Flame spread 25 (max) <sup>1</sup> Smoke developed 250 (max) Specimen thickness 1 inch (nominal) No melting, dripping or flaming droplets before and after exposure to 4.5.10	4.5.5
Unicellularity	10 percent maximum open cells	4.5.6
Thermal conductivity (K factor)	Maximum 0.16 Btu in/hr-square foot minus °F	4.5.7
Resistance to oil	No evidence of attack (softening swelling or dissolving)	4.5.8
Heat aging	Maximum of 3 percent volume change	4.5.9
Humid aging	Maximum of 3 percent change in each linear dimension	4.5.10
Water absorption	0.08 pounds average per square foot of cut surface	4.5.11
Water vapor transmission	Maximum of 2.0 perm inches	4.5.12
Flexural strength	Maximum of 40 lb/in <sup>2</sup>	4.5.13
Low temperature aging	Maximum volume change of plus or minus 4 percent No cracking	4.5.14

<sup>1</sup> Not to be construed as a fire hazard classification. Refers to test method only.

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3.6 Dimensional form and tolerances, type I. The preformed board shall have dimensional uniformity with square corners and sides, and ends shall be parallel. The length, width and thickness of the board shall be as specified (see 6.2) with the following tolerances:

Length - Plus 1/16 minus 0 inch per linear foot.  
 Width - Plus 1/16 minus 0 inch per linear foot.  
 Thickness - Up to 2 inches, plus or minus 1/32 inch.  
                   Greater than 2 inches, plus or minus 1/16 inch.

3.7 Type II, foam-in-place. Prior to production, the foam system shall be tested as specified (see 4.2).

3.7.1 Cure temperature. The foam shall cure at ambient temperature as specified (see 6.2 and 6.3) and attain the physical properties described herein within 48 hours after mixing.

3.7.2 Component ratio. The volume ratio between components for producing the required foam shall be a maximum of three to one.

3.8 Workmanship. The preformed foam (type I) and the component ingredients for the foam-in-place (type II) shall be processed in such a manner as to be uniform in quality and shall meet the requirements specified herein, as applicable, and shall be free from other defects that will affect life, serviceability or appearance.

#### 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 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 assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must 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 assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.2 Quality conformance tests (type II only). Quality conformance tests shall be conducted to determine conformance to all of the specified tests and requirements of this specification. Sufficient quantities of foam ingredients shall be taken to produce at least six sample test blocks as specified in 4.5.2. When a temperature range for mixing and foaming the base ingredients is specified (see 4.5.2.2, 6.2 and 6.3), three test blocks of foam shall be

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prepared at each specified temperature. The contractor shall not proceed with production without written approval of the quality conformance test results by the activity concerned. Quality conformance tests are not required for foam formulations previously supplied under contract which have been tested and found to conform to this specification, provided that no changes have been made in the test mold (see 4.5.2.1), materials, material production techniques, formulation, mixing instructions and handling characteristics (see 4.5.2.2, 6.2 and 6.3) in the foam formulation subsequent in these tests.

#### 4.3 Sampling.

4.3.1 Lot. For purposes of sampling, a lot shall consist of all material from one production batch offered for delivery at one time.

4.3.2 Sampling for visual dimensional examination (type I only). A random sample of preformed boards shall be selected from each lot offered for Government inspection in accordance with MIL-STD-105 at inspection level II. The acceptable quality level (AQL) shall be 1.0 percent defective major and 4.0 percent defective minor. Major and minor defects shall be as specified in MIL-STD-105.

#### 4.3.3 Sampling for quality conformance inspection.

4.3.3.1 Type I only. From each lot (see 4.3.1) sufficient samples, shall be prepared from separate boards selected at random and tested as specified in 4.5.3 through 4.5.14. If any of the samples tested is found to be not in accordance with this specification, this shall be cause for rejection of the entire lot represented by the sample.

4.3.3.2 Type II only. Two containers of resin shall be selected at random from each lot (see 4.3.1). A 2-quart sample shall be taken from each of the two containers, placed in separate clean, dry, metal or glass containers and sealed and marked. Containers from which the samples have been removed shall be repadded with dry nitrogen and sample containers shall also be padded with dry nitrogen. In a similar manner samples of polyisocyanate, in quantities proportional to the resin as designated by the contractor's foaming instructions, shall also be selected, packaged, and marked. Containers from which the polyisocyanate samples have been removed shall be repadded with dry nitrogen and sample containers shall also be padded with dry nitrogen. The selected samples shall be foamed, prepared and then tested as specified in 4.5.3 through 4.5.14.

4.4 Sampling for examination of filled containers (type II only). A random sample of filled containers shall be selected from each lot offered for inspection in accordance with MIL-STD-105 at inspection level I and AQL of 1.5 percent defective major and 6.5 percent defective minor to verify conformance to all stipulations of this specification regarding fill, marking and other requirements not involving tests. Major and minor defects shall be as defined in MIL-STD-105.

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4.5 Test methods.

4.5.1 Test conditions. Unless otherwise specified (see 6.2), the atmospheric conditions surrounding the specimen prior to and during the test shall be  $23 + 1$  degrees Celsius ( $^{\circ}\text{C}$ ) ( $73.4 + 2$  degrees Fahrenheit ( $^{\circ}\text{F}$ )) and  $50 \pm 2$  percent relative humidity. The conditioning period prior to the test shall be a minimum of 24 hours.

4.5.2 Preparation of sample block (type II only).

4.5.2.1 Sample mold. Sample test molds shall be constructed in accordance with either 4.5.2.1.1, 4.5.2.1.2 or 4.5.2.1.3 as specified (see 6.2).

4.5.2.1.1 Steel. The mold shall be constructed of 1/8-inch thick steel. It shall consist of a steel box without a top and having inside dimensions of 13 inches in each direction. The bottom shall be removable and provided with devices for securing it to the sides. On the outside of each of two opposite sides a steel flange, 13 inches in length and 2 inches in width, shall be firmly attached at the midpoint of the outside surface with the 13-inch dimension parallel to the top and bottom surfaces of the box. The inside surfaces shall be dry and clean. A mold release agent may be used.

4.5.2.1.2 Plywood. The mold shall be constructed identical to that of 4.5.2.1.1, except that 1/2-inch thick plywood shall be used as the construction material.

4.5.2.1.3 Special test mold. When a special test mold is required for a specific application, thickness and type of material, dimensions, volume, and special configuration (if any) of the mold, construction for free rise or restraint (using top cover) and any other requirements which may be necessary for suitable mold shall be as specified (see 6.2).

4.5.2.2 Sample preparation. Foaming characteristics of the material shall be determined during the foaming of the test sample. Unless otherwise specified (see 6.2), proportions and mixing of the base ingredients and preheating of the resin, if required, shall be in accordance with the contractor's instructions. Mechanically stir a sufficient quantity of base ingredients, and pour into the specified mold (see 4.5.2.1 and 6.2). If applicable (see 4.5.2.1.3), a top cover shall be secured. The foam shall be allowed to air cure in the mold for 48 hours prior to removal. The minimum temperature of the air and mold shall be as specified (see 6.2 and 6.3).

4.5.2.2.1 Precautions. Isocyanate fumes may be present when these foams are prepared. Adequate ventilation shall be provided or air masks shall be worn. Goggles, rubber gloves and protective clothing shall also be worn.

4.5.2.3 Removal from mold. Following the specified cure period, if necessary, a long thin spatula shall be used to cut the foam free from the mold. After the top, where applicable (see 4.5.2.1.3), and bottom covers are removed, the flanges on the sides of the mold shall be placed on blocks with the original bottom up and a 12-3/4 by 12-3/4 inch piece of 1-inch plywood shall be placed over the flat surface of the foam. Light, steady pressure shall be applied by hand to the plywood to force the foam from the mold.

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4.5.2.4 Preparation of test specimens. After determining the density as specified in 4.5.3, the required specimens shall be prepared from the block free from skin in such a manner that the possibility of overheating is minimized. Prior to testing, the density of each specimen shall be calculated by accurately weighing and measuring its dimensions. Any specimen whose density is not within 10 percent of that of the sample block shall be subject to rejection and replaced with a suitable new specimen.

4.5.3 Density. The density of the foamed material shall be determined in accordance with ASTM D 1622. The average density of the five specimens shall be reported.

4.5.4 Compressive strength. The compressive strength of the foamed material shall be determined in accordance with ASTM D 1621, procedure A, except that three specimens shall be used and the specimen size shall be 1 inch by 4 by 4 inches. The average value of the three specimens shall be reported.

4.5.5 Fire resistance. The fire resistance of the foamed material shall be determined in accordance with ASTM E 84 before and after exposure as specified in 4.5.10.

4.5.6 Unicellularity. Unicellularity shall be determined in accordance with ASTM D 2856, procedure B.

4.5.7 Thermal conductivity. The thermal conductivity of the foamed material shall be determined in accordance with ASTM C 177 at a mean temperature of 75°F.

4.5.8 Resistance to oil. One specimen, approximating a 1-inch cube, shall be immersed in fuel oil in accordance with MIL-F-16884. After 70 hours the specimen shall be removed, lightly blotted with paper toweling and compared to an imaged specimen of similar size for evidence of softening, swelling or dissolving.

4.5.9 Heat aging. The dimensions of two specimens, 1 inch by 4 by 4 inches, shall be recorded to the nearest 0.01 inch after being conditioned for 24 hours as specified in 4.5.1. The specimens shall then be placed in an oven for a 24-hour period and the oven shall be maintained at  $60 \pm 1^\circ\text{C}$  ( $140 \pm 1.8^\circ\text{F}$ ). Upon completion of the exposure period, the specimens shall again be conditioned for 24 hours as specified in 4.5.1 and the dimensions remeasured to the nearest 0.01 inch. The average percent volume change for the two specimens shall be calculated and reported.

4.5.10 Humid aging. The dimensions of two specimens, 1 inch by 4 by 4 inches, shall be recorded to the nearest 0.01 inch after being conditioned for 24 hours as specified in 4.5.1. The specimens shall then be placed upon a shelf in a container with a level of water sufficient to maintain an atmosphere of 90 to 100 percent relative humidity. The container, loosely covered, shall then be placed in an oven for 7 days at a temperature of  $60 \pm 1^\circ\text{C}$  ( $140 \pm 1.8^\circ\text{F}$ ). Upon completion of the exposure period, the specimens shall again be conditioned for 24 hours as specified in 4.5.1 and their dimensions remeasured to the nearest 0.01 inch. The average percent change in each linear dimension of both specimens shall be calculated and reported.



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4.5.11 Water absorption. The water absorption of the foamed material shall be determined in accordance with ASTM D 2842 and the average value for three specimens reported.

4.5.12 Water vapor transmission. The water vapor transmission shall be determined in accordance with ASTM E 96 dessicant method.

4.5.13 Flexural strength. The flexural strength shall be determined in accordance with ASTM C 203. An average value for four specimens, 12 by 3 by 1-1/2 inches thick, shall be reported.

4.5.14 Low temperature aging. The volume change due to low temperature aging shall be determined at minus 40°F in accordance with ASTM D 756, procedure E, except that three specimens, 1 inch by 3 by 3 inches, shall be used. The average values obtained from the three specimens at the conclusion of each of the two cycles shall not exceed the maximum volume change as required by 3.5. After exposure to low temperature aging, the specimens shall be examined for evidence of cracking.

4.6 Inspection of packaging. Sample packages and packs, and the inspection of the preservation-packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

## 5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition. For the extent of applicability of the packaging requirements of referenced documents listed in section 2, see 6.4.)

5.1 Commercial. Preformed or foam-in-place urethane foam shall be packaged and marked in accordance with ASTM D 3951.

## 6. NOTES

6.1 Intended use. The material covered by this specification is intended primarily for insulation of refrigerator spaces.

6.2 Ordering data. Acquisition documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Type and class material required (see 1.2).
- (c) Color, if different (see 3.2).
- (d) Dimensions for type I material (see 3.6).
- (e) Ambient cure temperature conditions (see 3.7.1).
- (f) Atmospheric conditions, if different (see 4.5.1).
- (g) Sample test mold required (see 4.5.2 through 4.5.2.1.3).
- (h) Handling characteristics required for type II only (see 4.5.2.2 and 6.3).

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6.3 Handling characteristics for type II material. For any specific application it may be necessary to specify the following characteristics:

- (a) The temperature range required for mixing and foaming the basic ingredients.
- (b) Temperature range for air and mold prior to foaming.
- (c) Mixing time.
- (d) Flow time.
- (e) Rise time.
- (f) Permissible time lapse between pourings, if multiple pours are needed to fill the cavity.

6.4 Sub-contracted material and parts. The packaging requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.5 Material safety data sheets. Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in appendix B of FED-STD-313.

6.6 Subject term (key word) listing.

Foam material  
Insulation  
Plastic  
Polyisocyanate

6.7 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activity:  
Navy - SH  
(Project 5640-N113)

**INSTRUCTIONS:** In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge (*DO NOT STAPLE*), and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

**NOTE:** This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

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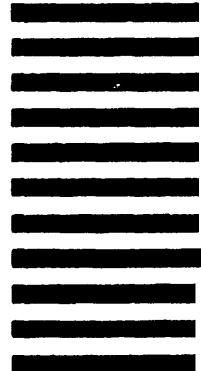


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## STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER MIL-I-24172A(SH)	2. DOCUMENT TITLE INSULATION, PLASTIC, CELLULAR POLYURETHANE, RIGID PREFORMED AND FOAM-IN-PLACE
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3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION (Mark one)

 VENDOR USER MANUFACTURER OTHER (Specify): \_\_\_\_\_

b. ADDRESS (Street, City, State, ZIP Code)

## 5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

## 6. REMARKS

7a. NAME OF SUBMITTER (Last, First, MI) - Optional

b. WORK TELEPHONE NUMBER (Include Area Code) - Optional

c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional

8. DATE OF SUBMISSION (YYMMDD)

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82 MAR

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