

INCH-POUND

MIL-P-21929C  
15 January 1991

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SUPERSEDING  
MIL-P-21929B  
11 August 1969

## MILITARY SPECIFICATION

### PLASTIC MATERIAL, CELLULAR POLYURETHANE, FOAM-IN-PLACE, RIGID (2 POUNDS PER CUBIC FOOT)

*This specification is approved for use by all departments and agencies of the Department of Defense.*

#### 1. SCOPE

**1.1 Scope.** This specification covers only one class of foam, nominal density — 2.0 pounds per cubic foot ( $\text{lb/ft}^3$ ), rigid unicellular polyurethane foam, and the materials required for preparation by the foam-in-place technique.

#### 2. APPLICABLE DOCUMENTS

##### 2.1 Government documents.

**2.1.1 Specifications and standards.** The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

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 55Z3, 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

FSC 9330

**DISTRIBUTION STATEMENT A.** Approved for public release; distribution is unlimited.

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## SPECIFICATIONS

## FEDERAL

PPP-C-96	Cans, Metal, 28 Gage and Lighter
PPP-D-729	Drums, Shipping and Storage, Steel, 55-Gallon (208 Liters)
PPP-P-704	Pails, Metal: (Shipping, Steel, 1 Through 12 Gallons)
TT-E-485	Enamel, Semigloss, Rust-Inhibiting

## STANDARDS

## FEDERAL

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

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-147	Palletized Unit Loads

(Unless otherwise indicated, copies of federal and military specifications and standard are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

**2.1.2 Other Government publication.** The following other Government publication forms a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

## DEPARTMENT OF TRANSPORTATION (DOT)

Code of Federal Regulations – Hazard Communication Standard  
Title 29, Part 1910.1200

(The code of Federal Regulations (CFR) and the Federal Register (FR) are for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. When indicated, reprints of certain regulations may be obtained from the Federal agency responsible for issuance thereof.)

**2.2 Non-Government publications.** The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 471	Standard Test Method for Rubber Property – Effect of Liquids; (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 2126	Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging; (DOD adopted)
D 2341	Standard Specification for Rigid Urethane Foam
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)
E 84	Standard Test Method for Surface Burning Characteristics of Building Materials; (DOD adopted)

(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 National Motor Freight Traffic Association, Inc., ATA TRAFFIC Dept., 2200 Mill Road, Alexandria, VA 22314.)

UNIFORM CLASSIFICATION COMMITTEE AGENT

Uniform Freight Classification Ratings, Rules and Regulations

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

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(Non-Government standards and other publications are normally available from the organizations that prepare or 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 document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

### 3. REQUIREMENTS

**3.1 First article.** When specified (see 6.2), a sample shall be subjected to first article inspection (see 6.5) in accordance with 4.3.

**3.2 Materials.** The contractor shall select the materials used for producing the polyurethane foam specified herein. Unless otherwise specified (see 6.2), the foam shall be prepared by mixing not more than two materials, and not more than one material shall contain isocyanate groups. When specified (see 6.2 and 6.4.2), the cured foam shall not liberate halogen containing substances into the atmosphere.

**3.2.1 Material safety data sheet (MSDS).** The contracting activity shall be provided a material safety data sheet (MSDS) at the time of the contract award. The MSDS shall be provided in accordance with the requirements of FED-STD-313 and 29 CFR 1910.1200, Hazard Communication Standard. When FED-STD-313 is at variance with the CFR, 29 CFR 1910.1200 shall take precedence. FED-STD-313 shall be modified and supplemented accordingly. The MSDS shall be included with each shipment of the material covered by this specification (see 6.6).

**3.3 Physical properties of cured foam.** The physical properties of the cured foam shall be as specified in table I when tested.

**3.4 Color.** The color shall be the natural color of the product.

**3.5 Odor.** The cured foam shall be free of any objectionable odor.

**3.6 Homogeneity of foam.** The cured foam shall be free of non-foamed or soft, tacky particles. The foam shall be composed of small cells of approximately the same size.

**3.6.1 Blow holes.** Blow holes shall be not larger than 1/2 inch, largest dimension, and not more than one blow hole shall occur in any projected area of 6 by 6 inches (see 4.6.2). Not more than three blow holes shall be in three adjacent 1-inch thick layers of the cut sample block (see 4.6.2.1). Frothed-in-place foam shall not exhibit blow holes larger than 1.0 inch, largest dimension.

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**3.7 Storage life.** After storage in original containers for not less than 6 months at temperatures not higher than 75.2 degrees Fahrenheit (°F) (24 degrees Celsius (°C)) and after curing, the materials used to produce the foam shall conform to the requirements of this specification.

TABLE I. *Physical properties.*

Property	Requirement	Test
Density (lb/ft <sup>3</sup> )	2.0 ± 0.5	4.6.1
Compressive strength at 10 percent deformation parallel to foam rise (pounds per square inch (lb/in <sup>2</sup> ), minimum)	20	4.6.4
Volume change after heat aging (percent of original, maximum):		
Expansion	5	4.6.5
Shrinkage	No change	4.6.5
Distortion or other visible change	No change	4.6.5
Humidity aging:		
Volume change (percent of original)	Plus 12, minus 5	4.6.6
Compressive Strength change (percent of original, maximum)	20	4.6.6
Compression set (percent, maximum)	3.5	4.6.7
Water absorption (pounds per square foot (lb/ft <sup>2</sup> ) of cut surface, maximum)	0.12	4.6.8
Unicellularity (percent open cells, maximum)	15	4.6.9
Oil resistance	No softening or visible change	4.6.10
Fire resistance (when specified, see 6.2):		Fire test (see 4.6.12) shall be performed before and after exposure to humidity aging test (see 4.6.6)
Flame spread maximum	25 <sup>1</sup>	
Smoke developed maximum	250	
Specimen thickness	1 inch (nominal)	
	No melting, dripping, or flaming droplets	

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

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**3.8 Identification markings.** Each container for the materials shall be permanently labeled in accordance with FED-STD-313 and shall be marked with the following information:

- a. Manufacturer's name or trade mark
- b. Specification number and nominal density of foam
- c. National stock number
- d. Contract or order number
- e. Manufacturer's identification or code and parts by weight required; identification of isocyanate containing material
- f. Manufacturer's batch number, date of manufacture, and date of expiration
- g. Weight and volume of material in container and volume of foam produced when weight indicated on each of the containers of materials required for foaming is used as specified in 3.9 (see 6.2)
- h. Recommended storage conditions
- i. Precautionary markings.

**3.9 Instructions for use.** Instructions for use shall be included with each shipment of foam materials. Unless otherwise specified (see 6.2 and 6.4.1), the instructions shall provide the following information:

- a. **Materials:**
  - (1) Manufacturer's designation or code for each material required to prepare the foam
  - (2) Recommended storage conditions and maximum usable storage life.
- b. **Preparation of the foam:**
  - (1) Recommended ratio in parts by weight of the materials required for preparing the foam
  - (2) Method of preparation of materials for addition to the foaming mixture, such as stirring, cooling, preheating, or melting
  - (3) Recommended type of mechanical mixing equipment and feeding rate of materials

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- (4) Recommended temperature for mixing materials and temperature of mold or cavity to be filled
  - (5) Recommended cleaning procedure of the test mold prior to use and the mold or cavity to be filled
  - (6) Instructions for foam preparation in closed, completely open, or partially open molds or cavities, and for vertical and horizontal direction of foaming
  - (7) Recommended waiting period between successive pours
  - (8) Recommended curing temperatures and times
  - (9) Clean-up procedures for equipment.
- c. Safety precautions for handling materials and fabrication of foam (see 4.5.2.1)
  - d. Additional information which may be necessary or desirable, such as foaming characteristics and instructions for preparing the foam sample using hand mixing (see 4.5.2).

**3.10 Toxicity.** The materials shall have no adverse effect on the health of personnel when used for its intended purpose. Questions pertinent to this effect shall be referred by the contracting activity to the Naval Medical Command (NAVMEDCOM) who will act as an advisor to the contracting agency.

**3.11 Workmanship.** The materials shall be homogeneous and free from contaminants and foreign materials. Solid materials shall be free from lumps or coarse particles.

#### **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 (examination 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 contract'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

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supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of the 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 inspections.** 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 the examinations and tests as specified in 4.4.3, 4.4.4, and 4.6.

**4.3.1 First article samples.** The first article sample of the materials required for production of the foam shall be sufficient for not less than three sample blocks (see 4.5.2). Two sample blocks shall be furnished to the contracting activity. When conditions for the use of materials which deviate from those covered by the instruction sheet are specified (see 6.2), first article samples of the foam shall be prepared at the lower and higher temperature extremes of the specified temperature range for the materials, mold, and cure, as applicable. Unless otherwise specified (see 6.2), acceptance of the first article samples shall not depend on completion of the storage life test (see 4.6.11). Production shall not be conducted without prior contracting activity approval.

**4.4 Quality conformance inspection.** Quality conformance inspection shall consist of the examinations specified in 4.4.3.1, 4.4.3.2, and 4.4.4.1, and the tests specified in 4.6.1, 4.6.4, 4.6.7, 4.6.8, 4.6.9, and 4.6.12 (see 6.3).

**4.4.1 Lot.** For quality conformance inspection, a lot shall consist of all materials in the ratios required for preparation of the foam and offered for delivery at one time (see 6.3).

**4.4.2 Sampling.**

**4.4.2.1 Sampling for examination of materials.** Unless otherwise specified (see 6.2), sampling for examination of materials shall be in accordance with table II.

**4.4.2.2 Sampling for examination and test of cured foam.** The sample for examination and test of the cured foam shall be one sample block prepared in the test mold (see 4.5.2.2). The sample block shall be prepared by the method specified in 3.9 from the required amounts of materials selected at random from the lot that passes the applicable examination specified in 4.4.3.1 and 4.4.3.2. The contents of the containers shall be thoroughly mixed immediately before withdrawing the samples.



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**4.4.3 Examinations of filled containers.** Filled containers shall be examined in accordance with table III. The lot size, for purposes of determining the sample size in accordance with MIL-STD-105, shall be expressed in units of packages for the examinations specified in 4.4.3.1 and 4.4.3.2.

TABLE II. *Sampling for examination of materials.*

Lot size	Sample size	Accept	Reject <sup>1, 2, 3</sup>
<i>Critical</i>			
2 - 3,200	32	0	1
3,201 - 35,000	125	1	2
35,001 - 150,000	200	2	3
150,000 - 500,000	315	3	4
<i>Major</i>			
2 - 500	13	0	1
501 - 3,200	50	1	2
3,201 - 10,000	80	2	3
10,001 - 35,000	125	3	4
35,001 - 500,000	200	5	6

<sup>1</sup>All defective items must be replaced with acceptable items prior to lot acceptance.

<sup>2</sup>Inspect sample size until reject criteria is reached.

<sup>3</sup>Rejected lots may be screened and resubmitted for inspection and retest.

TABLE III. *Sampling for examination of filled containers.*

Lot size	Sample size	Accept	Reject <sup>1, 2, 3</sup>
<i>Critical</i>			
2 - 3,200	32	0	1
3,201 - 35,000	125	1	2
35,001 - 150,000	200	2	3
150,000 - 500,000	315	3	4
<i>Major</i>			
2 - 500	13	0	1
501 - 3,200	50	1	2
3,201 - 10,000	80	2	3
10,001 - 35,000	125	3	4
35,001 - 150,000	200	5	6
150,001 - 500,000	315	7	8

See footnotes at end of table.

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TABLE III. Sampling for examination of filled containers - Continued.

Lot size	Sample size	Accept	Reject <sup>1, 2, 3</sup>
<i>Minor</i>			
2 - 25	3	0	1
26 - 150	8	1	2
151 - 280	13	1	2
281 - 500	20	2	3
501 - 1,200	32	3	4
1,201 - 3,200	50	5	6
3,201 - 10,000	80	10	11
10,001 - 35,000	125	14	15
35,001 - OVER	200	21	22

<sup>1</sup>All defective items must be replaced with acceptable items prior to lot acceptance.

<sup>2</sup>Inspect sample size until reject criteria is reached.

<sup>3</sup>Rejected lots may be screened and resubmitted for inspection and retest.

**4.4.3.1 Materials.** The sample unit for the examination of materials shall be one package (see 3.9) and the defects shall be classified in accordance with table IV.

TABLE IV. Materials examination - classification of defects.

Defect	Critical	Major	Minor
<i>Certificate of compliance</i> <sup>1</sup>			
Missing		X	
Lacking statement that the foam does not liberate halogen containing substances into atmosphere as specified		X	
<i>Storage life</i>			
Certification missing <sup>1</sup> or lacking test data		X	
Not as specified		X	
<i>Fire resistance</i>			
Certification missing <sup>1</sup> or lacking test data		X	

See footnote at end of table.

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TABLE IV. *Materials examination – classification of defects – Continued.*

Defect	Critical	Major	Minor
<i>Instruction for use</i>			
Missing	X		
Copies not as specified		X	
Required information not as specified		X	
<i>Workmanship</i>			
Liquid materials:		X	
Not homogeneous		X	
Contain dirt		X	
Evidence of gas pressure when containers are opened at specified temperatures			
Solid materials:			
Contain lumps or coarse particles		X	

<sup>1</sup> See 6.3.

**4.4.3.2 Filled containers.** The sample unit found for the examination of materials shall be one package (see 3.9 and section 5) and the defects shall be classified in accordance with table V.

**4.4.3.3 Rejection.** Any sample unit found defective shall be rejected, and if the number of defects exceeds the applicable acceptance number, the entire lot represented by the sample unit shall be rejected.

**4.4.4 Quality conformance inspection of cured foam.** Quality conformance inspection of cured foam shall be conducted on samples selected in accordance with 4.4.2.2. The examination specified in 4.4.4.1 and the tests specified in 4.6.1, 4.6.4, 4.6.7 through 4.6.9, and 4.12 shall be conducted. If any sample in the quality conformance inspection is found not to be in conformance with the requirements of this specification, this shall be cause for rejection of the entire lot.

**4.4.4.1 Examination of cure foam.** The cured foam shall be examined to determine conformance to 3.4 through 3.6.

#### 4.5 Test conditions.

**4.5.1 Conditioning procedures.** Conditioning of test specimens and the atmospheres for testing shall be in accordance with ASTM D 2341. The number of specimens shall be as specified in each testing procedure. The average of test results for each specified test shall be recorded.

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TABLE V. Filled containers examination – classification of defects.

Defect	Critical	Major	Minor
<i>Weight</i> Not as indicated on label			X
<i>Identification marking</i> Not as specified	X		
<i>Condition of container</i> Evidence of corrosion or leakage	X		
Container not new	X		
Containers are not all of the same type			X
Metal thickness not as specified for type of container and product container		X	
Size (capacity) not as specified			X
Internal coating not compatible with product contained	X		
Internal coating not as specified		X	
External coating damaged	X		
External coating not as specified		X	
<i>Condition of packing</i> Not conforming to carrier rules and regulations	X		
Not as specified		X	
Safe delivery not ensured at destination		X	

**4.5.2 Preparation of foam sample.**

**4.5.2.1 Precautions.** The contractor shall have the toxicological formulations and associated information available for review by the contracting activity to evaluate the safety of the material for the proposed use. Since toxic isocyanate fumes (see 3.10) may be evolved during the foaming operation, adequate ventilation shall be provided to reduce the isocyanate concentration in the air below 0.02 part per million or gas masks equipped with the appropriate gas filter shall be worn. Additional personnel protection shall consist of face shields, gloves, and protective clothing.

**4.5.2.2 Test mold.** The mold cavity shall be in the shape of a cube with inside dimensions of approximately 13 inches. Bottom and top surfaces shall be detachable. The top surface shall have 1/2-inch diameter vent holes in each corner located 1/2 inch from the adjacent edges. The mold shall be sufficiently rigid to prevent deformation caused by the pressure of the expanding foam. The mold shall be firmly attached to a stand to permit expelling the foam sample (see 4.5.2.2.1). Materials for mold construction may be metal, wood, or rigid plastics. These materials shall not affect nor be affected by the foaming mixture or the foam sample. A Teflon sheet or film may be

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placed over the bottom surface of the mold to facilitate removal of the bottom of the mold (see 4.5.2.2.1). Mold release agents which do not affect the foaming mixture or foam may be used. Teflon coating may be applied to all interior surfaces of the mold to prevent adhesion of the foam to the mold.

**4.5.2.2.1 Removal from mold.** The cured foam sample shall be removed from the mold without damage. This may be accomplished by removing the bottom and top and separating the sample from the side surfaces of the mold by a thin, long cutting tool if required. The mold is then anchored to a stand with the bottom surface point upwards. The sample is expelled from the mold by placing a square wooden board (approximately 12 inches side length) on top of the flat bottom of the foam sample and applying hand pressure.

**4.5.2.3 Foaming and curing procedure.** Sufficient amounts of materials, selected in 4.4.2.2, shall be used to fill the test mold capacity of approximately 2200 cubic inches (see 4.5.2.2). The preheating of materials and mold, if required, the mixing and pouring of the foaming system, the molding of the foam in the mold, and the curing conditions shall be in accordance with manufacturer's instructions (see 3.9).

#### **4.6 Tests.**

##### **4.6.1 Density determination.**

**4.6.1.1 Preparation of specimen.** After removal from the mold (see 4.5.2.2.1), the molded sample shall be freed of all skin and shall be trimmed to provide plane surfaces, free of irregularities. The resulting sample block shall be the test specimen for the density determination.

**4.6.1.2 Procedure.** The density test shall be conducted in accordance with ASTM D 1622 to determine conformance to table I. One specimen shall be tested. If this specimen fails to pass the test, a second specimen shall be prepared from the same lot of materials in the same manner as the first specimen. The second specimen shall be tested as specified herein. Failure of the second specimen to meet the requirement for density (see table I) shall constitute nonconformance with this specification.

##### **4.6.2 Homogeneity of cured foam.**

**4.6.2.1 Preparation of specimen.** The sample block (see 4.6.1.1) conforming to the requirements for color, odor, and density (see 3.4, 3.5, and table I) shall be sliced perpendicular to the direction of the foam rise into twelve 1-inch thick layers. The cutting operation shall be accomplished without changing the cell structure of the cut surface. The specimen shall consist of the 12 layers.

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**4.6.2.2 Procedure.** Both faces of each of the 12 layers shall be examined visually to determine conformance with 3.6 and 3.6.1. In case of failure, one retest shall be allowed using a second specimen which has been prepared from the same lot by the procedure specified in 4.6.2.1. The second specimen shall be tested and shall meet the color, odor, and density requirements (see 3.4, 3.5, and table I) before determining conformance with 3.6.

**4.6.3 Preparation of specimens for other tests.** The specimen which has been prepared in accordance with 4.6.2.1 and passes the test specified in 4.6.2.2 shall be used for the preparation of the specimens for the tests specified in 4.6.4 and 4.6.10. Every third layer, taken in the order of slicing from the twelve 1-inch thick layers, which constitute the specimen for the test for homogeneity (see 4.6.2.1), shall be used. Each of the four layers taken shall be cut into 4- by 4-inch square pieces. Fifteen 4- by 4-inch pieces, selected at random from the 36 pieces, shall serve as specimens for the tests specified in 4.6.4 through 4.6.8. Dimensions shall be measured to the nearest 0.01 inch. Six additional 4- by 4-inch pieces shall be taken from the remaining pieces. From each of these pieces, three disks shall be cut with a circular metal die of  $1.129 \pm 0.001$  inch diameter (id), and one disk shall be cut with a circular die of  $2.256 \pm 0.001$  inch id. Seven disks cut with the die of 1.129-inch diameter shall be selected at random and three disks cut with the die of 2.256-inch diameter shall also be taken. The remaining pieces and disks shall serve as a pool from which specimens shall be selected at random to replace those specimens which do not conform to the following density requirement. The density of all the pieces and disks which serve as specimens shall be determined in accordance with ASTM D 1622. The die dimension shall be used for calculation of volumes. Any specimens deviating by more than 10 percent from the density of the sample block (see 4.6.1) shall be replaced from the pool until the required number of acceptable test specimens are obtained.

**4.6.4 Compressive strength.** Three 4- by 4-inch specimens (see 4.6.3) shall be tested for compressive strength in accordance with procedure A of ASTM D 1621, except that stress-strain curves and standard deviation shall not be obtained.

**4.6.5 Volume change after heat aging.** Three 4- by 4-inch specimens (see 4.6.3) shall be tested for dimensional stability in accordance with ASTM D 2126, except that the dimensions shall be measured to the nearest 0.01 inch. The aging condition shall be  $200 \pm 1.8$  °F ( $93 \pm 1$  °C) for 14 days and the specimens shall be conditioned after completion of the test without external stress at  $73.4 \pm 1.8$  °F ( $23 \pm 1$  °C) and  $50 \pm 2$  percent relative humidity for not less than 24 hours.

**4.6.6 Volume change after humidity aging.** Three 4- by 4-inch specimens (see 4.6.3) shall be tested for volume change after humidity aging in accordance with procedure D of ASTM D 2126 except the specimen dimensions shall be measured to the nearest 0.01 inch, the relative humidity shall be 100 percent, and the period of aging shall be 7 days. While the aging test is in progress, all specimens shall be measured and volumes shall be calculated at the end of 1, 4, and 7 days to assure that no reversion is present. (Reversion is the progressive swelling of the specimen and the subsequent shrinkage during testing.) After exposure, the specimens shall be dried for 30 minutes at 140 °F (60 °C) and conditioned as specified in 4.6.5. Three additional 4- by 4-inch specimens

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shall be measured and subjected to the aging and recovery conditions together with the three specimens which are tested. The additional specimens shall be used to replace any of the specimens discarded because of warpage. The three specimens which have passed the test for volume change shall be used for the determination of compressive strength after humidity aging. The procedure specified in 4.6.4 shall be used. The compressive strength change after humidity aging shall be calculated from the difference between the results of this test and the results obtained on unaged specimens (see 4.6.4). The humidity of the test chamber shall be verified by wet and dry thermocouples and then recorded.

**4.6.7 Compression set.** Three specimens cut with a die 2.256 inches in diameter (see 4.6.3) shall be used. The thickness shall be measured to the nearest 0.001 inch. The specimens shall be subjected to a static load of 5 lb/in<sup>2</sup> applied parallel to the thickness dimensions at 158 ± 1.8 °F (70 ± 1 °C). After 24 hours, the load shall be removed. The specimens shall recover for 30 minutes resting on their circular face on a flat horizontal surface at 73.4 ± 1.8 °F (23 ± 1 °C), and then the thickness shall be remeasured. Compression set shall be calculated as follows:

$$\text{Compression set, percent} = \frac{t_0 - t_1}{t_0} \times 100$$

where  $t_0$  = thickness prior to test  
 $t_1$  = thickness after recovery.

**4.6.8 Water absorption.** The water absorption shall be determined in accordance with ASTM D 2842 except the specimen shall be immersed under a 10-foot head of distilled water (4.35 lb/in<sup>2</sup>) for 48 hours and only the weight of absorbed water shall be determined. The weights shall be measured in grams and the skinless area dimensions shall be measured in inches.

**4.6.9 Unicellularity.** The unicellularity test shall be conducted in accordance with procedure B of ASTM D 2856.

**4.6.10 Oil resistance.** Four specimens cut with the circular die of 1.129-inch id (see 4.6.3) shall be immersed in No. 2 reference oil in accordance with ASTM D 471 at the conditioning temperature (see 4.5.1). After 70 ± 1 hour, the specimens shall be removed, lightly blotted, and compared with a specimen which has not been immersed in the oil. Evidence of softening or degradation shall constitute failure of the sample representing the lot.

**4.6.11 Storage life.** The materials shall be stored in their original unopened containers for not less than 6 months at not more than 75.2 °F (24 °C). After this period the materials shall be examined visually. Any separation into layers, thickening, gelation, hardening, or precipitation which does not disappear if prepared for addition to the foaming mixture as specified in 3.9, shall constitute nonconformance with the requirement for storage life. The materials which pass this test

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or are uniformly liquid shall be used to produce a foam by the procedure specified in 3.9. After curing, the foam shall be tested as specified herein. Nonconformance of the foam with any of the applicable requirements of this specification shall constitute failure to meet the requirement for storage life. In cases of dispute, the relative humidity during the storage period shall not exceed 55 percent and the storage life period shall be counted from the date of shipment.

**4.6.12 Fire resistance.** When specified (see 6.2), the materials shall be tested for fire resistance in accordance with ASTM E 84 before and after exposure to 150 °F (66 °C) at 100 percent relative humidity for 7 days. Flame spread, smoke development, dry melting, and dripping or flame droplets shall be recorded. The fire resistance test shall be conducted at least once every 18 months, or when a significant change has been made in the basic foam formulation that might adversely affect fire resistance, whichever event occurs first.

**4.7 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.)

**5.1 Packaging.** Packaging shall be level A or C, as specified (see 6.2).

**5.1.1 Level A.** Materials shall be furnished in cans, pails, or drums as specified (see 6.2).

**5.1.1.1 Cans.** The cans shall be in accordance with type V, class 4 of PPP-C-96. The cans shall have exterior coating and side seam striping in accordance with plan B of PPP-C-96. The size of the cans shall be as specified (see 6.2).

**5.1.1.2 Pails.** The pails shall be in accordance with type I, class 3 or 4 of PPP-P-704. A wire bail and handle grip shall be furnished and shall be in accordance with PPP-P-704. Pails shall be provided with plastic push-pull spouts.

**5.1.1.3 Fifty-five gallon drums.** Fifty-five gallon drums shall be in accordance with type II of PPP-D-729. Cap seals shall be furnished. Exterior coating of the drums shall be in accordance with type II of TT-E-485.

**5.1.2 Level C.** Packaging shall afford protection against corrosion, deterioration, and physical damage during shipment from the supply source to the first receiving activity for early use.

**5.2 Packing.** Packing shall be level A, B, or C, as specified (see 6.2).



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**5.2.1 Level A.** Cans shall be packed in containers in accordance with level A of the appendix of PPP-C-96. Pails and drums shall require no additional packing.

**5.2.2 Level B.** Cans shall be packed in containers in accordance with level B of the appendix of PPP-C-96. Pails and drums shall require no additional packing.

**5.2.3 Level C.** Materials, packaged for level A or C, shall be packed in containers of the type, size, and kind commonly used for this purpose in a manner which will ensure acceptance by common carrier at the lowest rates and safe delivery at destination. Shipping containers and packing shall comply with the Uniform Freight Classification Rules or National Motor Freight Classification Rules.

**5.3 Palletization.** When specified (see 6.2), pails and drums shall be palletized in accordance with MIL-STD-147.

**5.4 Marking.** In addition to any special marking required (see 6.2), interior and exterior shipping containers shall be marked with the date (month and year) of manufacture in accordance with MIL-STD-129.

## 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

**6.1 Intended use.** The mixture of the materials for foam-in-place preparation is readily pourable. Heat is developed immediately upon mixing and expansion takes place to fill the mold with a foam which becomes rapidly rigid. Material is primarily intended for the preparation of foam for buoyancy applications and the filling of void spaces which are susceptible to flooding.

**6.2 Acquisition requirements.** Acquisition documents should specify the following:

- a. Title, number, and date of this specification
- b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2)
- c. When first article is required (see 3.1)
- d. Number of materials required for preparation of foam, if other than two; and number of materials containing isocyanate, if other than one (see 3.2)
- e. When cured foam should not liberate halogen-containing substances into the atmosphere (see 3.2)

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- l. When fire resistance is required (see table I and 4.6.12)
- g. Quantity of materials by weight or volume, and weight or volume per container (see 3.8.g)
- h. Instructions for materials and preparation of foam, if other than specified (see 3.9 and 4.3.1)
- i. When first article sample should be other than specified (see 4.3.1)
- j. When acceptance criteria of first article depends on completion of storage life test (see 4.3.1)
- k. Sampling for examination of materials and filled containers, if other than specified (see 4.4.2.1)
- l. Levels of packaging and packing required (see 5.1 and 5.2)
- m. For packaging level A, specify cans, pails, or drums required (see 5.1.1)
- n. For packaging level A cans, specify size required (see 5.1.1.1)
- o. For pails and drums, specify when palletization is required (see 5.3)
- p. Special marking required (see 5.4).

**6.3 Consideration of data requirements.** The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Description (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DOD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

Reference paragraph	DID number	DID title	Suggested tailoring
4.4	DI-T-2072	Test Reports	—
4.4.1 and appendix	DI-MISC-80678	Certification/ Data Report	—

The above DID's were those cleared as of the date of this specification. The current issue of DOD 5050.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

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**6.4 Additional information.**

**6.4.1 Additional requirements and tests.** This note provides guidelines for establishing additional requirements and test methods for specific applications which are not covered by or are outside the range of conditions described in the instructions for use (see 3.9). Since the conditions for in-place preparation of the foam and the size and form of the voids to be filled vary widely, the following suggested requirements are expressed in general terms, and should be considered by the contracting activity:

- a. Temperature ranges for mixing, pouring, foaming, molding, and curing
- b. Maximum curing time
- c. Design and dimensions of special mold simulating obstructions to the free flow of the mixture of materials by irregular configuration of cavity; simulation of method and direction of filling cavity
- d. Viscosity range of materials and their mixture at the specified temperature range (see 6.4.1.a).
- e. Maximum time interval between multiple pours.

**6.4.2** For use on board submersibles, foams which may liberate halogen containing substances into the atmosphere should not be employed except with prior approval of the Naval Sea Systems Command (NAVSEA).

**6.4.2.1** Since the shelf life of the materials used to prepare the foam is limited, orders should be placed only for immediate use or short term storage.

**6.5 First article.** When a first article inspection is required, the contracting officer should provide specific guidance to offerors whether the items should be a first article sample (see 3.1), and the number of items to be tested as specified in 4.3. The contracting officer should also include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

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**6.6 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 FED-STD-313.

**6.7 Subject term (key word) listing.**

Cured foam  
Isocyanate  
Unicellular

**6.8 Changes from previous issue.** Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

**Custodians:**

Army – SM  
Navy – SH  
Air Force – 99

**Preparing activity:**

Navy – SH  
(Project 9330-B171)

**Review activities:**

Army – AV, GL  
Navy – AS, YD, OS, GS, MI

**User activity:**

Army – AT

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

## INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of 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.

<b>I RECOMMEND A CHANGE:</b>		<b>1. DOCUMENT NUMBER</b> MIL-P-21929C	<b>2. DOCUMENT DATE (YYMMDD)</b> 15 January 1991
<b>3. DOCUMENT TITLE</b> PLASTIC MATERIAL, CELLULAR POLYURETHANE, FOAM-IN-PLACE, RIGID (2 POUNDS PER CUBIC FOOT)			
<b>4. NATURE OF CHANGE</b> (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)			
<b>5. REASON FOR RECOMMENDATION</b>			
<b>6. SUBMITTER</b>			
<b>a. NAME (Last, First, Middle Initial)</b>		<b>b. ORGANIZATION</b>	
<b>c. ADDRESS (Include Zip Code)</b>		<b>d. TELEPHONE (Include Area Code)</b> (1) Commercial (2) AUTOVON (If applicable)	<b>7. DATE SUBMITTED (YYMMDD)</b>
<b>8. PREPARING ACTIVITY</b>			
<b>a. NAME</b> Technical Point of Contact (TPOC): Mr. W. Dunham (SEA 51431) PLEASE ADDRESS ALL CORRESPONDENCE AS FOLLOWS:		<b>b. TELEPHONE (Include Area Code)</b> (1) Commercial (2) AUTOVON TPOC: 703-602-0146 8-332-0146	
<b>c. ADDRESS (Include Zip Code)</b> Commander, Naval Sea Systems Command Department of the Navy (SEA 5523) Washington, DC 20362-5101		<b>IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:</b> Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	