

METRIC

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MILITARY SPECIFICATION

FOAM-IN-PLACE PACKAGING MATERIALS, GENERAL SPECIFICATION FOR

This specification is approved for use by all
Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers flame retardant polyurethane foams for packaging furnished as two-component liquid foam-in-place (FIP) systems (see 6.1).

1.2 Classification. The polyurethane foams and the raw materials for the foams shall be furnished in the following classes, grades and categories. Additional characteristics shall be specified by the procuring activity (see 3.3.9, 6.2 and 6.5):

Class 1 - Rigid

Category 1 - Conventional Strength

Category 2 - High Strength

Class 2 - Flexible

Grade A - (Figure 1)

Grade B - (Figure 2)

(Use Grade with Class 2 only)

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to the Air Force Packaging Technology and Engineering Facility, AFMC LSO/LOP, 5215 Thurlow Street, Wright Patterson AFB OH 45433-5540, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 8135

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

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Class 3 - Semi-Rigid (Figure 3)

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government Documents.

2.2.1 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).

STANDARDS

FEDERAL

FED-STD-101	Test Procedures for Packaging Materials
FED-STD-313	Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

HANDBOOKS

Military

MIL-HDBK-775 Foam-In-Place Packaging, Procedures for

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

2.2.2 Other Government documents and Publications. The following other Government documents and publications form 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)

Title 49, Code of Federal Regulations, Parts 100-199.

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

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Title 29, Code of Federal Regulations, Part 1910.1200

Occupational Safety and Health, Volume I, General Industry Standards and Interpretations, Part 1910.

(Applications for copies should be addressed to the Superintendent of Documents, US Government Printing Office, Washington, DC 20402.)

2.3 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 cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM-C421	Tumbling Friability of Preformed, Block-Type Thermal Insulation, Standard Test Method for (DoD Adopted)
ASTM-D471	Rubber Property - Effect of Liquids, Test Method for (DoD Adopted)
ASTM-D1596	Dynamic Shack Cushioning Characteristics of Packaging Materials, Standard Test for (DoD Adopted)
ASTM-D1621	Compressive Properties of Rigid Cellular Plastics, Standard Test Method for (DoD Adopted)
ASTM-D1623	Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics (DoD Adopted)
ASTM-D2126	Response of Rigid Cellular Plastics to Thermal and Humid Aging, Standard Test Method for (DoD Adopted)
ASTM-D5118	Standard Practice for Fabrication of Fiberboard Shipping Boxes (DoD Adopted)
ASTM-E96	Water Vapor Transmission of Materials (DoD Adopted)

(Application for copies should be addressed to ASTM, 100 Bar Harbor Dr., West Conshohocken PA 19103.)

2.4 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 inspection. When specified (see 6.2), a sample shall be subjected to first article inspection (see 6.3) in accordance with 4.2.2.

3.1.1 Foam dispensing equipment. The foam dispensing equipment used to prepare samples for qualification as specified herein shall be clearly listed in the Certificate of Compliance prepared by the foam-in-place packaging suppliers. A chemical formulation shall be certified as complying with the requirements of this specification when the samples tested are dispensed through approved foam dispensing equipment from the supplier of the chemical formulation. Use of this foam dispensing equipment is required to certify compliance with the requirements of this specification.

3.2 Materials. The materials used in the production of polyurethane foams shall provide a product conforming to the requirements specified herein.

3.2.1 Formulations. Formulations shall be supplied as a two-component liquid system of a polymeric isocyanate type consisting of component A (primarily methylene bisphenyl isocyanate compounds) and component B (polyol compounds) suitable for mixing in foam equipment such as portable systems, semi-portable systems, fixed systems, mechanical pump systems, pneumatic pump systems, compressed gas displacement systems (fixed proportioning or variable proportioning), or any system capable of producing a product conforming to the requirements of this specification, and using the procedures recommended in MIL-HDBK-775. Methylene diisocyanate (MDI) is a commonly used monomer for diphenyl methane diisocyanate and methylene bisphenyl isocyanate. Nevertheless, the more commonly used term, MDI, shall be used in this document. The formulation shall not contain materials which are chemically nonreactive (such as fillers and nonreactive diluents) except for surfactants, fire retardant agents, noncombining catalysts and blowing agent. There shall be no separation of chemical components, stringiness or coagulated particles that will tend to clog dispenser lines and filters of the foam-in-place dispensing equipment. Chlorofluorocarbons (CFCs) or hydrochlorofluorocarbons (HCFCs) shall not be purposely added to any formulation. Where present as a trace or impurity, CFC/HCFC shall be maintained at the lowest feasible levels. Under no circumstances shall CFC/HCFC be present in the product at levels that exceed a specified percentage, by weight. Use of 0.1 percent (maximum, by weight) is recommended.

3.2.1.1 Product information. A product information sheet shall accompany each shipment of chemicals. The sheet, as a minimum, shall provide an item description, chemical and physical properties, handling instructions, and precautions. It shall include the temperature ranges at which the components must be

conditioned prior to foaming. This temperature range shall be in accordance with Table I unless otherwise specified by the procuring activity.

3.2.1.2 Material Safety Data Sheet (MSDS). The contracting activity shall be provided a Material Safety Data Sheet (MSDS) prior to contract award. The MSDS shall be prepared and submitted in accordance with 29 CFR 1910.1200. The MSDS shall be included with each shipment of the material covered by this specification. Contracting officers will identify those activities requiring copies of completed MSDSs prepared in accordance with FED-STD-313 and 29 CFR 1910.1200. The pertinent government mailing addresses for submission of data sheets are listed in Appendix B of FED-STD-313. The Material Safety Data Sheet Receipt Point for Navy and Marine Corps is as follows: Commanding Officer, Industrial Hygiene Directorate (Attn: HAZMAT), Navy Environmental Health Center, 2510 Walmer Avenue, Norfolk, VA 23513-2617.

3.2.1.2.1 Hazardous material warning label. A hazardous material warning label conforming to 29 CFR 1910.1200 shall be a requirement for each unit of issue.

3.2.2 Properties. Foams shall exhibit the properties shown in Table I. Unless otherwise specified, the properties listed are for ambient temperatures of 18°C to 27°C.

3.2.3 Toxicity.

3.2.3.1 Formulations. The formulations shall not contain toluene diisocyanate (TDI), TDI derivatives, methylene chloride (dichloromethane), or any substances regulated as carcinogens in Code of Federal Regulations, Title 29, part 1910, subpart Z of volume 1, General Industry Standards and Interpretations of Occupational Safety and Health Administration. Do not include any materials that are considered: Occupational Safety and Health Administration (OSHA) regulated carcinogens, known/suspected human carcinogens by the International Agency for Research on Cancer (IARC) (latest reports) and/or the National Toxicology Program (NTP) (latest annual report) and/or Navy Occupational Chemical Reproductive Hazards should be excluded from these formulations. The absence of TDI and TDI derivatives shall be determined prior to the initial mixing of components for first article testing.

3.2.3.2 Airborne isocyanate. Navy procurements shall be in accordance with the requirements of 3.2.3.2.1.

3.2.3.2.1 Methylene bisphenyl isocyanate (CAS 101-68-8) determination (Navy). For Navy procurements, the manufacturer or supplier shall:

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a. Disclose the complete information for the product via the Material Safety Data Sheet (MSDS) in sufficient detail to permit an accurate appraisal of the likelihood of generation of methylene bisphenyl isocyanate and other potentially toxic gases, vapors, aerosols, etc. during any anticipated utilization of the

TABLE I. Properties.

CHARACTERISTICS	CLASS 1 (RIGID)	CLASS 2 (FLEXIBLE)		CLASS 3 (SEMI-RIGID)
		GRADE A	GRADE B	
¹ Conditioning temp., range 15°C to specified temperature	29°C (Comp A) 29°C (Comp B)	32°C (Comp A) 32°C (Comp B)	35°C (Comp A) 35°C (Comp B)	24°C (Comp A) 24°C (Comp B)
² Cream time, seconds (max)	40	30	30	5
² Rise time, seconds (max)	120	90	90	30
² Tack free time, seconds (max)	150	150	150	35
³ Reaction temp., (max)	205°C	177°C	177°C	163°C
Cure time to obtain all mechanical properties	72 hrs max	72 hrs max	72 hrs max	72 hrs max
¹ See 3.2.1.1				
² See 6.8				
³ See 3.3.11 and 4.3.3.11, and 6.7				

product. This will require submission of a listing of all ingredients, totaling 100 percent of the formulation, as well as the submission of a current MSDS for each ingredient used in the formulation. The manufacturer shall contact each ingredient supplier within thirty days of documentation submission, in order to certify that each MSDS provided is current. The MSDS shall contain all data elements required by an OSHA Form 174, using this form or similar form containing identical information. This data will be required for occupational health professionals to perform a proper health hazard assessment of the product. In addition, where toxicological and/or industrial hygiene studies have been performed involving the product, copies of these reports shall also be provided as part of the documentation package. Where the product is in commercial use, a minimum of three large-scale users of the product must be identified, with occupational safety/health points of contact, for follow-up by government personnel performing the health hazard assessment.

b. Provide specific precautionary measures, including an MSDS, with each unit of issue to ensure safe use of the product.

c. Forward the MSDS and addendum to the address specified in 6.14.

3.3 Material Tests.

3.3.1 Quality requirements for test specimens. Foams shall comply with mixing requirements of 3.2.1 and shall be prepared in accordance with 4.3.1. Test specimens shall conform to the following parameters:

a. Specimens shall be homogeneous and contain no knit lines.

b. Maximum allowable dimension of blow holes is 13 mm. The concentration of 13 mm diameter blow holes shall not exceed one in 100 square centimeters (10 cm x 10 cm).

3.3.2 Hydrolytic stability. Unless otherwise specified, materials shall meet the requirements of 3.3.2.1 or 3.3.2.2 as applicable (see 6.2 and 6.6).

3.3.2.1 Class 1. After aging in accordance with 4.3.3.2, the average minimum compressive strength of the 15 samples tested in both the parallel and the perpendicular directions. (see 4.3.3.2.1) at yield or 10 percent deflection, whichever is first to occur, shall not vary more than 10 percent from the average value of the 15 samples tested in both the parallel and the perpendicular directions obtained prior to aging (see 4.3.3.9 and 6.5). It is not necessary for both yield and ten percent deflection to occur.

3.3.2.2 Classes 2 and 3. After aging in accordance with 4.3.3.2, the stresses necessary for 20 and 40 percent strains shall be within ± 10 percent of the stresses necessary to cause these same strains on the same unaged specimens when tested in accordance with 4.3.3.2.3.

3.3.3 Water absorption (class 1). The average water absorption by weight, of all the samples, shall not exceed 170 percent when determined in accordance with 4.3.3.3.

3.3.4 Creep (classes 2 and 3). Unless otherwise specified (see 6.2), the maximum percentage creep that occurs under the continuous loading stress necessary to cause an initial 20 percent strain shall not exceed 15 percent when tested in accordance with 4.3.3.4.

3.3.5 Compression set (classes 2 and 3). Unless otherwise specified (see 6.2), the compression set shall not be more than 20 percent of the original thickness (see 4.3.3.5).

3.3.6 Pliability (classes 2 and 3). Unless otherwise specified (see 6.2), the material shall show no cracks, tears or separations when tested in accordance with 4.3.3.6. This requirement is limited to materials having a density of $0.064 \times 10^3 \text{ kg/cm}^3$ or less.

3.3.7 Volume change. The average change in volume of all urethane foam samples after aging shall not be greater than 7 percent of the initial volumes before aging (see 4.3.3.7).

3.3.8 Relative combustibility. The urethane foam shall be tested in accordance with 4.3.3.8. The flame front of each specimen shall not advance to or beyond the 125 mm gage mark specified in the test. There shall be no visual evidence of burning or melting of any specimen at or beyond the 125 mm gage mark. Chlorinated or brominated additives shall not be used for fire retardancy.

3.3.9 Compressive strength (class 1). Unless otherwise specified (see 6.2), the minimum compressive strength at yield or 10 percent deflection, whichever occurs first, shall be as follows (see 4.3.3.9):

Category 1 - 1.50 Kg/cm^2 parallel and 0.85 Kg/cm^2 perpendicular to the direction of foam rise.

Category 2 - 2.00 Kg/cm^2 parallel and 1.00 Kg/cm^2 perpendicular to the direction of foam rise.

It is not necessary for both yield and ten percent deflection to occur. Failure of the average compressive strength value of any set of five specimens to conform to the above requirements shall be cause for rejection. When a category is not specified, the requirements for category 1 shall apply.

3.3.10 Dynamic cushioning properties (classes 2 and 3). The peak G-static stress curves for class 2, grades A and B, and class 3 shall conform to the shapes of the appropriate generalized curves, presented in figures 1, 2, and 3, within the specified tolerance bands of ± 15 percent when tested in accordance with 4.3.3.10. Five peak G-static stress points, approximately equally spaced, shall be required to establish conformance of the class 2, grades A and B materials. Two points shall be established within 10 percent of the static stress values at the extremities of the curve and one at the approximate minimum peak acceleration level point. Three peak G-static stress point shall be required to establish conformance of the class 3 material, one at $0.02 \times 10^1 \text{ Kg/cm}^2$, one at $0.045 \times 10^1 \text{ Kg/cm}^2$, and one at $0.10 \times 10^1 \text{ Kg/cm}^2$ (see Table II and 6.4).

3.3.11 Maximum reaction temperature. The maximum reaction temperature (see 4.3.3.11) shall not be greater than the values listed in Table I.

3.3.12 Cold temperature stability (class 1). The average linear change when tested in accordance with 4.3.3.12 shall not exceed 5 percent.

3.3.13 Friability. When tested in accordance with 4.3.3.13, the cured foam product, prepared by machine dispensing equipment, shall not have a weight loss greater than 14 percent for class 2 and 3 specimens and not have a weight loss greater than 20 percent for class 1 specimens.

3.3.14 Tensile strength (class 1). When specified (see 6.2), the test specified in 4.3.3.14 shall be performed. The tensile strength shall be 2.5 Kg/cm² minimum on parallel specimens and 2.0 Kg/cm² minimum on perpendicular specimens.

3.3.15 Moisture vapor permeability (class 1). When specified (see 6.2), the test specified in 4.3.3.15 shall be performed. The maximum moisture vapor permeability shall be 4×10^{-9} g/(Pa x s x m).

3.3.16 Oil resistance (class 1). When specified (see 6.2), the test specified in 4.3.3.16 shall be performed. There shall be no softening of the oil-immersed samples.

3.4 Minimum shelf life. Manufacturers shall submit certification that components will meet the requirements of this specification after storage (between 10°C and 35°C) for one year, beginning at time of delivery. Components shall be in their original containers, and no additional agitation shall be required prior to foaming operations.

3.5 Identification.

3.5.1 Container. In addition to any special or other identification marking required by this specification or the contract (see 6.2), containers and unitized loads shall be marked in accordance with 49 CFR Parts 172, subpart D and 178, subpart L, as applicable.

3.5.2 Labels. Labels attached to each container shall comply with the OSHA Hazard Communication Standard, 29 CFR 1910.1200, and 49 CFR 172, subpart E. Each container shall be marked on the sides, using waterproof labels, with the following minimum information:

a. Manufacturer's name, address, and proprietary identification.

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TABLE II. Required Test Samples.

TEST	QUANTITY	ORIENTATION ¹	CLASS 1	CLASS 2	CLASS 3
Hydrolytic Stability	15 (5/bun) 15 (5/bun) 3 3	parallel perpendicular parallel perpendicular	100 mm x 100 mm x 50 mm 100 mm x 100 mm x 50 mm N/A N/A	N/A N/A 200 mm x 200 mm x 75 mm 200 mm x 200 mm x 75 mm	N/A N/A 200 mm x 200 mm x 75 mm 200 mm x 200 mm x 75 mm
Water Absorption	3	parallel	100 mm x 100 mm x 25 mm	N/A	N/A
Creep	3	parallel	N/A	150 mm x 150 mm x 75 mm	150 mm x 150 mm x 75 mm
Compression Set	3	parallel	N/A	Creep samples will be used. See 4.5.3.5.	
Pliability	3	parallel	N/A	150 mm x 150 mm x 13 mm	150 mm x 150 mm x 13 mm
Cold Temperature Stability	5	perpendicular	100 mm x 100 mm x 25 mm	N/A	N/A
Volume Change	3	parallel	100 mm x 100 mm x 50 mm	200 mm x 200 mm x 75 mm	200 mm x 200 mm x 75 mm
Combustibility	5	parallel	50 mm x 150 mm x 10 mm	50 mm x 150 mm x 10 mm	50 mm x 150 mm x 10 mm
Compressive Strength	15 (5/bun) 15 (5/bun)	parallel perpendicular	100 mm x 100 mm x 50 mm 100 mm x 100 mm x 50 mm	N/A N/A	N/A N/A
Dynamic Cushioning	3	parallel	N/A	200 mm x 200 mm x 75 mm	200 mm x 200 mm x 75 mm
Flexibility	13	N/A	25 mm x 25 mm x 25 mm	25 mm x 25 mm x 25 mm	25 mm x 25 mm x 25 mm

¹ A parallel sample has its direction of thickness parallel to the direction of foam rise. A perpendicular sample has its direction of thickness perpendicular to the direction of foam rise. See Figure 4.

b. Specification classification (class and grade).

c. Handling precautions - each container of isocyanate shall have the following label:

WARNING: MAY CAUSE EYE, NOSE AND THROAT IRRITATION. MAY CAUSE SHORTNESS OF BREATH DUE TO AN ALLERGIC RESPIRATORY REACTION (e.g., ASTHMA AND LUNG INFLAMMATION). MAY CAUSE SKIN IRRITATION AND ALLERGIC REACTIONS. Use appropriate protection as designated by responsible industrial hygiene personnel. Consult the MSDS and product labels for additional guidance to ensure the safety of this operation.

Do not get in eyes, on skin, or on clothing.

Do not breathe vapors.

Keep container closed.

Use with adequate ventilation.

Avoid water contamination.

d. Storage life and expiration date (month, day and year).

e. Date of manufacture (month, day and year).

f. Mixing ratio by weight and volume.

g. Manufacturer's batch or lot number.

h. Operation and storage temperature ranges.

i. Component designation ("A" for isocyanate, "B" for polyol).

j. The following notation: "For foaming operations IAW MIL-PRF-83671B; the mixing of the contents of this container with any product other than this manufacturer's designated product is expressly forbidden."

3.5.3 Color Coding. All containers shall be color coded on the top and sides with a label measuring 1936 cm² minimum on sides and 968 cm² minimum on top as follows:

a. "A" component: red or yellow.

b. "B" component: blue.

4. VERIFICATION

4.1 Classification of inspection. The inspection requirements specified herein shall be classified as follows:

a. First article inspection (4.2.2)

b. Conformance inspection (4.2.3)

4.2 Inspection and tests.

4.2.1 First article waiver. First article inspection may be waived, by the Air Force Packaging Technology and Engineering Facility (AFPTEF) or the procuring activity, when the procuring activity or contract administrator has data or other evidence to indicate that prior successful first article inspection has been conducted (see 6.2). Only when the first article has been waived by the AFPTEF or procuring activity, may the contractor self-certify that the material will conform to the requirements of this specification.

4.2.2 First article inspection. First article inspection shall consist of all tests in Table III and shall be performed by the contractor, after award of contract and prior to production. First article inspection shall be performed on sample units produced using materials, equipment, and procedures which will be used in fulfilling the contract. First article approval is valid only on the contract on which it is granted, unless extended by the Government to other contracts (see 3.1 and 6.3). In case of dispute, the procuring activity shall require testing on contractor supplied material be performed by either AFPTEF or an independent lab.

4.2.3 Conformance inspection. Quality conformance tests shall consist of all tests in Table IV.

4.3 Testing. The tests specified in Tables III and IV shall be performed to assure compliance with the requirements in section 3. No material shall be tested until the absence of TDI has been verified in accordance with 3.2.3.1.

4.3.1 Preparation of test specimens. Foams shall comply with the mixing requirements in 3.2.1.

4.3.1.1 Preparation of class 1 test specimens. To produce class 1 test samples, it is recommended that foam shall be poured into a 300 mm x 300 mm x 300 mm rigid container lined with polyethylene film material. A minimum of six 300 mm x 300 mm x 300 mm buns shall be prepared. The poured foam shall be allowed to cure for a minimum of 72 hours before cutting test specimens.

4.3.1.2 Preparation of class 2 and 3 specimens. To produce test specimens for classes 2 and 3 with the dimension of thickness perpendicular to the direction of foam rise (perpendicular orientation), it is recommended that foam shall be poured into a 800 mm x 200 mm x 400 mm (L x W x H) or larger rigid container lined with a polyethylene sheet material. To produce test samples with the dimension of thickness parallel to the direction of foam rise (parallel orientation), it is recommended that foam shall be poured into a 800 mm x 400 mm x 200 mm (L x W x H) or larger rigid container lined with a polyethylene sheet material.

TABLE III. First article test requirements and methods.

<u>PROPERTIES</u>	<u>REQUIREMENTS</u>			<u>TEST METHOD</u>
	<u>CLASS 1</u>	<u>CLASS 2</u>	<u>CLASS 3</u>	
Toxicity (airborne)	3.2.3.2.1	3.2.3.2.1	3.2.3.2.1	4.3.3.1.1
Quality requirements for test specimens	3.3.1	3.3.1	3.3.1	Not Applicable
Hydrolytic stability	3.3.2	3.3.2	3.3.2	4.3.3.2
Water absorption	3.3.3			4.3.3.3
Creep		3.3.4	3.3.4	4.3.3.4
Compression set		3.3.5	3.3.5	4.3.3.5
Pliability		3.3.6	3.3.6	4.3.3.6
Volume change	3.3.7	3.3.7	3.3.7	4.3.3.7
Combustibility	3.3.8	3.3.8	3.3.8	4.3.3.8
Compressive strength	3.3.9			4.3.3.9
Dynamic cushioning		3.3.10	3.3.10	4.3.3.10
Maximum reaction temp.	3.3.11 & Table I	3.3.11 & Table I	3.3.11 & Table I	4.3.3.11
Cold temperature stability	3.3.12			4.3.3.12
Friability	3.3.13	3.3.13	3.3.13	4.3.3.13
Tensile strength (when specified by procuring activity)	3.3.14			4.3.3.14
Moisture vapor permeability (when specified by procuring activity)	3.3.15			4.3.3.15
Oil resistance (when specified by procuring activity)	3.3.16			4.3.3.16
Shelf life	3.4	3.4	3.4	Not Applicable

TABLE IV. Conformance test requirements.

<u>PROPERTIES</u>	<u>TEST METHOD PARAGRAPH</u>
Combustibility	4.3.3.8
Identification (drums or canister)	3.5 (visual)

The poured foam for both orientations shall be allowed to cure for a minimum of 72 hours before cutting test specimens.

4.3.1.3 Cutting of test sample. All specimen material shall be taken from the center section of the bun and shall not include any material within 50 mm of any face of the bun. The specimen material shall be homogeneous with no knit lines in the material. A knit line is defined as a visible line in the foam where two or more sections of partially cured material have come in contact with each other during the pour. The concentration of holes with maximum dimension of 13 mm shall not exceed one in 100 square centimeters (10 cm x 10 cm). No holes shall be larger than 13 mm. Samples for specific testing shall be prepared in accordance with Table II. All samples with a perpendicular orientation shall be cut so that the dimension of thickness is perpendicular to the direction of foam rise. All samples with a parallel orientation shall be cut so that the dimension of thickness is parallel to the direction of foam rise (see Figure 4).

4.3.1.4 Selection of test samples. Materials used for testing shall be selected randomly without regard to apparent quality based on visual appearance. However, all specimens selected for testing shall be free of skins and cut so as to avoid rounded or compressed edges.

4.3.1.5 Dimensional measurement procedures. All faces of specimens shall be rectangular, having dimensions in accordance with the appropriate test requirement.

4.3.1.5.1 Measurement of length and width. The length and width of each specimen shall be measured at the center line to the nearest 2 mm.

4.3.1.5.2 Measurement of thickness. Measure thickness by placing the specimen on a flat, level surface. Load its entire top surface to $175 \text{ Pa} \pm 35 \text{ Pa}$ using a rigid, flat plate. Apply this load for 30 seconds and then measure the vertical distance between the base surface and the bottom of the loading plate to the nearest 2 mm. This measurement may be made either by a single point at the center of the cushion top surface or at each of the four corners of the sample. If the four-corner method is used, the average of the four measurements shall be the thickness of the specimen. The thickness of the material shall be the average thickness of the specimens used for testing.

4.3.1.6 Peworking. When required, prework specimens using a compression machine (Instron Compression Tester or equivalent). The machine shall utilize 2 parallel rigid plates large enough to cover the entire surface of a specimen.

a. Set the initial and final distance between the compression plates as specified in the appropriate procedures.

b. Program the machine to compress each specimen 10 times at a rate of 250 mm per minute.

4.3.2 Test conditions. Tests and measurements shall be made at room temperature, 21°C - 27°C. In case of dispute or rejection, the specimens shall be conditioned at 23°C \pm 1°C and 50 percent relative humidity (RH) \pm 5 percent RH for at least 16 hours before being tested or preworked.

4.3.3 Test methods.

4.3.3.1 Airborne toxicity (Navy). For Navy procurements, methylene bisphenyl isocyanate (MDI) concentrations shall be determined by methods and procedures described in paragraph 6.14.

4.3.3.2 Hydrolytic stability. The hydrolytic stability test shall be performed using the appropriate test sequence specified below. Except for aging, the environmental conditions of paragraph 4.3.2 shall apply. Aging shall consist of exposure of test specimens for 14 days at 70°C \pm 1°C and 95 percent RH \pm 5 percent RH. After exposure, the specimens shall be subjected to 49°C \pm 1°C in a mechanically convected dry air oven for 24 hours.

4.3.3.2.1 Test sequence for class 1 materials. Hydrolytic stability for class 1 materials shall be determined on samples obtained after a minimum 72-hour cure time. Five specimens, 100 mm x 100 mm x 50 mm, shall be cut from each of three 400 mm x 400 mm x 400 mm single pour blocks of foam (see Table II) such that the dimension of sample thickness (50 mm) is parallel to the direction of foam rise (see Figure 4). Additionally, five specimens, 100 mm x 100 mm x 50 mm, shall be cut from each of the three sample blocks such that the dimension of sample thickness is perpendicular to the direction of foam rise (see Figure 4). Specimens shall be aged as specified in 4.3.3.2. These specimens shall then be tested for compressive strength values at yield or ten percent deflection, whichever occurs first. It is not necessary for both yield and ten percent deflection to occur. Failure of the average compression strength value, recorded for each set of five specimens, to conform to the requirements of 3.3.2.1 shall be cause for rejection.

4.3.3.2.2 Test sequence for class 2 and 3 materials.

a. Cut six samples, 200 mm x 200 mm x 75 mm, three with parallel orientation and three with perpendicular orientation, prepared in accordance with 4.3.1 (see Table II).

b. Condition specimens in accordance with 4.3.2.

c. Measure the original thickness in accordance with 4.3.1.5.2.

d. Prework the specimens, 48% of their original thickness, in accordance with 4.3.1.6.

e. One hour after preworking the specimens, measure initial thickness for the load/deflection test in accordance with 4.3.1.5.2.

f. Perform the load/deflection test in accordance with 4.3.3.2.3 using the initial thickness from 4.3.3.2.2.e to determine the 20 and 40 percent strain points.

g. Age the specimens as specified in 4.3.3.2.

h. Condition specimens for a minimum of 60 minutes in accordance with the temperature and humidity conditions of 4.3.2.

i. Prework the specimens, 48% of their original thickness, in accordance with 4.3.1.6.

j. Repeat the load/deflection test on aged specimens in accordance with 4.3.3.2.3 using the initial thickness from 4.3.3.2.2.e to determine the 20 and 40 percent strain points.

k. To determine compliance with 3.3.2.2, use the pre-aging and post-aging load/deflection test data to calculate the percent of change for specimens cut parallel to the direction of foam rise. Repeat the calculations for specimens cut perpendicular to the direction of foam rise. The percent of change averages for each group of three shall be used to comply with 3.3.2.2, with the absolute numbers used (regardless of \pm signs).

4.3.3.2.3 Load/deflection (classes 2 and 3). This test shall be performed using a compression machine as described in 4.3.1.6.

a. Set the initial distance between the compression plates to ensure that all cushions will fit easily between the plates.

b. Set the final distance between the plates to 4 mm.

c. Program the machine to compress the specimens at a rate of 5 mm per minute with auto reverse at the end of the compression stroke to return the compression plate to its initial position.

d. Compress each cushion once while recording the force applied at the 20 and 40 percent strain points during the compression half of the cycle.

4.3.3.3 Water absorption (class 1). Three samples shall be tested and examined for conformance to the requirements of 3.3.2. Water absorption shall be determined in accordance with the submersion technique of Method 4035 of FED-STD-101 with the following exceptions:

a. The balance used shall be accurate to ± 0.01 gram with a readability of 0.01 gram.

- b. Test specimens shall be weighed to the nearest 0.01 gram.
- c. Test specimens shall be 100 mm \pm 2 mm square by 25 mm \pm 2 mm thick.
- d. Test specimens shall be submerged in a vessel containing distilled water maintained at 21°C to 24°C.
- e. The submersion period shall be 96 hours \pm 1 hour.

4.3.3.4 Determination of creep (classes 2 and 3). Three specimens, 150 mm x 150 mm x 75 mm, with 75 mm direction parallel to foam rise, shall be prepared in accordance with 4.3.1. Prewrite specimen to 60 percent of its original thickness in accordance with 4.3.1.6. Initial thickness shall be measured in accordance with 4.3.1.5.2. Three minutes after the last compression, the thickness of each specimen shall be measured with a 0.41 kg, 0.24×10^3 Kg/cm², preload in accordance with 4.3.1.5.2. This thickness measurement shall be used as the initial thickness unloaded (T_i) in the compression set calculation. The test specimens shall be loaded to 20 percent initial strain. One hour after continuous loading, the thickness shall be measured and recorded as initial thickness loaded (t_i) for the determination of creep. The specimens shall remain under constant load, and thickness measurements shall be recorded approximately every 24 hours for a total of four 24-hour increments or until the variation between two successive measurements does not exceed one percent of t_i . The final measurements shall be recorded as t_f . The percentage of creep shall be calculated as follows:

$$\text{Percentage of creep} = \frac{(t_i - t_f) \times 100}{t_i}$$

Where t_i = initial thickness loaded
 t_f = final thickness loaded

The creep of the material in a lot shall be the average of the creep of the three specimens (see 3.3.4).

4.3.3.5 Compression set (classes 2 and 3). This test shall be conducted immediately following the test specified in 4.3.3.4. using the same specimens. Four hours after the load is removed, the specimen thickness shall be measured in accordance with 4.3.3.4 and the compression set calculated as follows:

$$(T_i - T_f) \times 100$$

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Compression set = _____

 T_1

Where T_1 = initial thickness unloaded from paragraph 4.3.3.4

T_2 = final thickness after 4 hours in unloaded condition

The percent compression set of the material in a lot shall be the average percent compression set of the three specimens.

The result shall not exceed the requirements of 3.3.5.

4.3.3.6 Pliability (classes 2 and 3). Three samples 150 mm x 150 mm x 13 mm, with parallel orientation, shall be prepared as specified in section 4.3.1 (see Table II, and 4.3.1.3). Within two seconds, each of three specimens shall be bent 180° around a cylinder having a 13 mm diameter in a uniform manner such that the foam shall be pressed against the cylinder. The test shall be conducted at room temperature (see 4.3.2) and at -40°C. For the low temperature test, the specimens shall be conditioned for at least four hours at -40°C and then bent at that temperature or, if not practical, within 5 seconds after removal from the low temperature environment. Each specimen shall be examined for conformance with 3.3.6.

4.3.3.7 Volume change. Three test specimens, prepared as specified in 4.3.1 and conditioned according to 4.3.2, shall be measured and the volume calculated and recorded. The class 1 specimens shall be 100 mm x 100 mm x 50 mm, aged as specified in 4.3.3.2, and re-measured in accordance with ASTM-D2126. The class 2 and 3 specimens shall be 200 mm x 200 mm x 75 mm and subjected to the temperature and humidity conditions only, specified in 4.3.3.2, and re-measured. The volume change of each sample shall be calculated and expressed as a percent of the initial sample volume. The average percent volume change of the samples shall conform to 3.3.7. Final measurements shall be made immediately following aging.

4.3.3.8 Relative combustibility. The combustibility of the foam shall be determined in accordance with the following subparagraphs. After completion of the test, foam samples shall be examined for conformance to 3.3.8. A test shall consist of determining the extent of burning of at least five foam samples. Samples shall be cut from sections at least 40 mm from exterior surfaces. The thickness of each sample shall be parallel to the direction of rise.

4.3.3.8.1 Apparatus.

a. Test chamber. The chamber shall be constructed of heat-resistant material, with controllable ventilation, and shall

provide a quiet draft-free atmosphere around the specimen. The chamber design shall permit normal thermal circulation of air past the specimen during burning. The minimum inner dimensions shall be 600 mm x 300 mm x 75 mm (L x W x H). A closable opening, for ventilation, approximately 25 mm in diameter, shall be located in the top of the chamber. Use of a hood with an exhaust system, either around the chamber or as the test chamber itself, is strongly recommended in order to remove the noxious products of combustion. Test results should be the same whether or not the chamber damper is closed, the hood fan is off, or both. In cases of discrepancy, values obtained with the damper closed or the hood fan off, or both, shall be the valid test results. The chamber/hood shall have a heat-resistant viewing window of sufficient size, and located such that the entire specimen being tested can be observed. The chamber should be easily opened and closed to facilitate test activities. The test organization's operations and equipment shall be approved by the appropriated environmental and/or safety activity.

b. Burner. A standard Bunsen or Tirrill burner (10 mm outside diameter barrel) fitted with a 50 mm wide wing top shall be used. The wing top may have to be opened to approximately 3 mm to provide the flame required in Figure 6. Use flexible metal hose or adequately protected rubber or plastic hose.

c. Fuel supply - propane gas of at least 85 percent purity.

d. Specimen support - wire cloth (wire screen) 6.5 mm mesh using 0.8 mm diameter steel wire. The wire cloth specimen support (75 mm x 200 mm) shall have a 15 mm length bent to form a right angle. This will form the specimen support as shown in Figure 5.

e. Specimen support holder - any holding device that will clamp the wire cloth specimen support horizontally so that the bottom of the bent-up portion is 15 mm above the top of the burner wing top as shown in Figure 5. A typical arrangement consists of two laboratory ring stands with two adjustable flat surface clamps which may be locked in place by set screw and lock nut.

f. Timing device - readable to ± 1 second.

4.3.3.8.2 Test specimens.

a. Five specimens, 50 mm x 150 mm x 10 mm, (L x W x H) with parallel orientation shall be prepared as specified in 4.3.1 (see Figure 4).

b. Material thickness shall be 10 mm \pm 2 mm. Thickness shall be parallel to the direction of rise.

c. Each test specimen shall be marked across the width with one line 125 mm from one end.

4.3.3.8.3 Conditioning. Specimens shall be conditioned prior to test for a minimum of 24 hours in accordance with 4.3.2. Tests shall be made in this atmosphere or immediately after removal therefrom.

4.3.3.8.4 Procedure. See Figures 5, 6, and 7.

a. Clamp the wire cloth specimen support horizontally so that the bottom of the wire cloth is 15 mm above the burner's wing top as shown in Figure 5. Place a layer of aluminum foil on the bottom of the test chamber to catch any dripping or flaming particles. The distance between the wire cloth and the foil shall be between 150 mm and 200 mm. Change the foil after each test if there is any debris on the surface from the previous determination. Burn off any material remaining on the wire cloth from the previous test or use a new wire cloth for each test. If a new wire cloth is not used for each test, the wire cloth should be cool to the touch before being used. If dripping or melting material falls into the wing top, clean it before testing the next specimen.

b. Place the specimen on the support with one end touching the 15 mm bent-up portion of the support. The end of the specimen nearest the gage mark should be away from the bent-up end of the specimen support so that the gage mark is 125 mm away from the bent-up end.

c. Adjust the burner with the wing top to provide a blue flame with a visible portion 40 mm high and a clearly defined inner cone 5 mm high. Place the burner under the upturned end of the specimen support so that one edge of the flame is in line with the upturned end of the wire cloth and the other edge of the flame extends into the front end of the specimen.

d. Start the timing device when the flame is first applied to the specimen. After 60 seconds, move the burner at least 150 mm away from the test specimen. If the flame goes out before reaching the gage mark, the extent of burning is equal to 125 mm minus the distance from the gage mark to the nearest evidence of the flame front, such as charring along the upper surface of the specimen, measured to the nearest 2 mm. Note burning characteristics, such as expansion, as a result of heating, melting, or dripping; also record if the drippings on the foil burn. In some cases, the burning may cease in the first 60 seconds. This will be evident by the disappearance of the flame.

4.3.3.8.5 Calculations.

a. If the flame front passes the gage mark on any one of the five specimens, the lot has failed.

b. If the flame front does not reach the gage mark on any of the five-specimens, average the distance burned in millimeters as measured on the top surface.

4.3.3.8.6 Report. A report in any acceptable format shall include the following:

a. The description of the material including the proprietary designation and complete description per this specification.

b. A description of samples that burned to gage mark.

(EXAMPLE: 150 mm sample was consumed completely.)

c. Record burning characteristics, such as dripping.

d. For samples that did not burn to the gage mark, report the average extent of burning (125 mm - less the distance between the gage mark and closest evidence of burning).

4.3.3.8.7 Precision. The standard deviation for inter laboratory reproducibility is 10 mm.

4.3.3.9 Compressive strength (class 1). The compressive strength shall be determined in accordance with ASTM-D1621, procedure A, and examined for conformance to 3.3.2 and 3.3.9. After a minimum 72-hour cure time, a total of ten specimens 100 mm x 100 mm x 50 mm shall be prepared from each of three 300 mm x 300 mm x 300 mm single pour blocks of foam. Five specimens shall be cut such that the depth dimension of 50 mm is parallel to the direction of foam rise. These specimens shall then be tested for compressive strength values at yield or 10 percent deflection, whichever occurs first. Additionally, five specimens 100 mm x 100 mm x 50 mm shall be cut from each of the same three sample blocks such that the depth dimension of 50 mm is perpendicular to the direction of foam rise, then tested as with the initial fifteen specimens. Failure of the average compressive strength value, recorded for any set of five specimens, to conform to the requirement of 3.3.9 shall be cause for rejection.

4.3.3.10 Dynamic cushioning properties (classes 2 and 3).

4.3.3.10.1 Peak acceleration versus static stress data. The data to plot the peak acceleration in multiples of Gs versus static stress in Pascals, from a drop height of 0.6 m, shall be established in accordance with ASTM-D1596 with exceptions specified herein.

4.3.3.10.2 Specimens. Three specimens, 200 mm x 200 mm x 75 mm \pm 2 mm with parallel orientation shall be prepared as specified in 4.3.1 (see Table IV.)

4.3.3.10.3 Preworking. Each specimen shall be compressed to 60 percent of its original thickness in accordance with 4.3.1.6. A specimen shall be rested for at least 16 hours, but not more than 72 hours before conducting the dynamic test procedure.

4.3.3.10.4 Dynamics test procedure. All test samples shall be measured to determine that samples are within 10 percent of the required thickness of 75 mm before starting the dynamic test procedure. Impact tests shall be conducted on each specimen so that the dropping head compresses the specimen at an initial velocity at impact of $3.43 \text{ m} \pm 0.05 \text{ m}$ per second. This corresponds to a nominal initial free-fall drop height of 0.6 m. The acceleration-time record of the dropping head during compression of the cushion shall be recorded for each drop. With the dropping head at the lowest static stress point, five consecutive drops shall be made on each of the specimens comprising the sample material. At least one minute shall elapse between drops to permit the specimen to regain its shape. A quantity of weight shall then be added to the dropping head to obtain the next required higher static stress point and the drop test procedure repeated. This procedure shall be repeated until the qualifying test values have been obtained. No material samples will be replaced during the test for any reason. If any of the cushions are degraded to a point where they can no longer be impacted, the whole lot shall be rejected.

4.3.3.10.5 Computations. The first reading obtained from each set of drops shall be discarded, and the peak acceleration readings of the remaining four drops shall be averaged. The average values, one for each specimen, shall then be averaged to obtain one value at each static stress point for the sample. The required peak G-static stress points shall be examined for conformance to 3.3.10.

4.3.3.11 Maximum reaction temperature. The maximum reaction temperature shall be determined by monitoring the temperature rise when the mixed chemicals are permitted to expand in a 300 mm x 300 mm x 300 mm corrugated fiberboard container, conforming to ASTM-D5118. Polyethylene film, from 0.7 to 2.0 mil in nominal guage, shall line the inside surface of the container. The flaps of the container shall remain open, and the film shall drape over the sides of the container. A temperature sensor, thermocouple or thermometer, shall be positioned at the center of the container. A sufficient quantity of mixed chemical components shall be poured into the container to expand without restraint and completely fill the container. The temperature shall be monitored for 2 hours, or until the peak temperature is observed, recorded, and the temperature has subsided by at least 5.5°C.

4.3.3.12 Cold temperature stability (class 1). Five samples, measuring 100 mm x 100 mm x 25 mm (L x W x H), with perpendicular orientation, shall be prepared as specified in 4.3.1. Specimens shall be tested in accordance with ASTM D2126 at a test

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temperature of $-40^{\circ}\text{C} \pm 3^{\circ}\text{C}$ and examined for conformance to the requirements of 3.3.12.

4.3.3.13 Friability. Twelve samples shall be prepared as specified in 4.3.1. Friability shall be determined in accordance with the tumbling technique of ASTM-C421 with the following modification: the drying temperature of ASTM-C421, paragraph 5.3 shall be 104°C to 113°C . Samples shall be examined for conformance to the requirements of 3.3.13.

4.3.3.14 Tensile strength (class 1). Testing and sample preparation shall be in accordance with ASTM-D1623. Three samples each shall be prepared for parallel tests and perpendicular tests. Type A or type B test specimens shall be used. Tensile strengths as determined by testing shall conform to the requirements of 3.3.14.

4.3.3.15 Moisture vapor permeability (class 1). Three test specimens, from which the skins have been removed, shall be tested. Specimen thickness shall be parallel to the direction of foam rise. Tests and sample preparation shall be performed in accordance with ASTM-E96, using the Desiccant method under the standard test condition X1.1.1, Procedure A, with the following exceptions:

a. The thickness of the test sample shall be $75 \text{ mm} \pm 2 \text{ mm}$.

b. The specimen holder shall have a diameter of $150 \text{ mm} \pm 6 \text{ mm}$, and its circular edge shall be used as the cutting die during the insertion of the sample. A hydraulic press or similar equipment shall be used to force the specimen holder cutting edge through the entire thickness of the foam sample.

4.3.3.16 Oil resistance.

4.3.3.16.1 Sample preparation. A foam bun having minimum dimensions of $300 \text{ mm} \times 300 \text{ mm} \times 300 \text{ mm}$ shall be poured. The bun shall be trimmed by removing at least 40 mm of material from all four sides, the top, and bottom of the bun. The bun shall be cut into two pieces at a point 100 mm down from the top; this will result in a piece $230 \text{ mm} \times 230 \text{ mm} \times 125 \text{ mm}$. From the top of this piece, a slice measuring $230 \text{ mm} \times 230 \text{ mm} \times 25 \text{ mm}$ shall be cut. A circular die having an inside diameter of 30 mm shall be used for cutting five specimens from the 25 mm thick slice of foam. These 30 mm diameter, 25 mm high samples shall be conditioned for at least 24 hours at $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$ and $50 \text{ percent RH} \pm 5 \text{ percent RH}$.

4.3.3.16.2 Test procedure. Four specimens prepared and conditioned in accordance with 4.3.3.16.1 shall be immersed in No. 2 reference oil of ASTM-D471 at $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$. The fifth specimen shall remain unused in accordance with the conditions specified in 4.3.3.16.1. The test room or chamber shall be maintained at $50 \text{ percent RH} \pm 5 \text{ percent RH}$. After $70 \text{ hours} \pm 1 \text{ hour}$, the specimens shall be removed, lightly blotted and

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compared with the unused specimen. Evidence of softening or degradation shall constitute failure of the samples representing the lot.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be specified in the contract or order (see 6.2). When actual packaging of materials is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department, Defense Agency or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

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

6.1 Intended use. Materials covered by this specification are intended for use as cushioning and blocking/bracing in packages to protect equipment and items from damage by shocks or impacts incurred during shipment and handling.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of specification.
- b. Issue of DODISS to be cited in the solicitation and, if required, the specific issue of individual documents referenced (see 2.1).
- c. Class, grade and category (see 1.2).
- d. After 1 Oct 93, provide certified statement that the product does not contain CFCs and/or HCFCs (see 3.2).
- e. Hydrolytic stability - specify if not required (see 3.3.2 and 6.6).
- f. Maximum allowable percentage creep, if other than specified in 3.3.4 (classes 2 and 3).
- g. Maximum allowable percentage set, if other than as specified in 3.3.5 (classes 2 and 3).
- h. Pliability (classes 2 and 3) - state if not required (see 3.3.6).

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i. Minimum compressive strength, if other than as specified in 3.3.9 (class 1 - see 6.5).

j. Tensile strength (class 1) - specify if required (see 3.3.14).

k. Moisture vapor permeability (class 1) - specify if required (see 3.3.15).

l. Oil resistance (class 1) - specify if required (see 3.3.16).

m. Indicate guaranteed conformance to minimum shelf life requirements of paragraph 3.4

n. Indicate marking requirements (see 3.5).

o. Indicate whether first article inspection is waived (see 4.2.1).

p. Packaging requirements (see 5.1).

6.3 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a preproduction sample, a first article sample, a first production item, a sample selected from the first production items, a standard production item from the contractor's current inventory (see 3.1), and the number of items to be tested as specified in 4.2.2. 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 bid should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering 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.

6.4 Dynamic cushioning. The requirements of 3.3.10 are intended to ensure procurement of a consistently uniform product of a quality attainable by most of the industry. The curves presented in Figures 1, 2, and 3 should be considered as quality assurance requirements only, not as design criteria. For design purposes, complete cushioning data in the form of peak acceleration versus static stress curves can be obtained from other sources, such as MIL-HDBK-304. The acceptable cushioning curves for class 2, grades A and B and class 3 foams are shown in Figures 1, 2, and 3, respectively. Class 2, grades A and B and class 3 foams are not based on specific material densities.

6.5 Compressive strength (class 1). The compressive strength requirements of 3.3.9 were developed from test data obtained on materials with nominal densities of $0.032 \times 10^3 \text{ kg/cm}^3$. If a different density material is specified, the compressive strengths should also be specified. For MIL-HDBK-775, technique VII encapsulated pack, the $0.032 \times 10^3 \text{ kg/cm}^3$ category 2 foam is required. It possesses the higher minimum compressive strengths of 2.00 Kg/cm^2 parallel to the direction of rise and 1.00 Kg/cm^2 perpendicular to the direction of rise.

6.6 Hydrolytic stability. Some polyurethane foams, esters in particular, may not pass this test but satisfactorily meet all other requirements and, in some instances, have dynamic cushioning properties superior to other formulations. Procuring activities may waive the hydrolytic requirements of 3.3.2.

6.7 Maximum reaction temperatures. The maximum reaction temperatures of Table I were based on tests conducted on all classes and grades of materials. If a higher density material than $0.032 \times 10^3 \text{ kg/cm}^3$ is being procured, the maximum reaction temperature should be specified by the procuring activity.

6.8 Definitions. The following terms listed in Table I have these definitions:

a. Cream time - period between "foam pour" of foam chemicals and start of foaming action.

b. Rise time - elapsed time between foam pour and majority (95 percent) of foam expansion after pouring.

c. Tack free time - elapsed time between foam pour and period when semi-cured foam may be touched lightly without stickiness.

6.9 Storage information. The minimum acceptable shelf life of the foam chemical is one year when the storage temperature remained in the 10°C to 35°C conditioning temperature range. The nominal freezing point of isocyanates is approximately -6.7°C . Some materials have been usable following prolonged storage in the -23°C to -12°C range. As a guide, prolonged exposure to 11°C above the 35°C maximum normally halves the shelf life. Exposure to temperatures 11°C below the 10°C minimum conditioning temperature could be expected to double the shelf life. It is important for users to allow adequate intervals for temperature stabilization in the 10°C to 35°C conditioning range.

6.10 Imbalance of components. Volume users may encounter an imbalance of components over an extended period of time due to differences in viscosity, altitude, metering equipment, applications, etc. If this occurs, the needed component (A or B)

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may be procured directly from the original supplier by furnishing the applicable information specified in 3.5.2.

6.11 Maximum isocyanate concentration. The Occupational Safety and Health Administration (OSHA) has promulgated a Permissible Exposure Limit for methylene bisphenyl isocyanate (MDI) (CAS 101-68-8) of 20 parts per billion, as a "ceiling" limit which, by definition, should not be exceeded at any time during the workday, even if exposures at other times during the workday are below 20 ppb, resulting in an average exposure for the workday which does not exceed 20 ppb.

6.12 Approval of dynamic compression testing apparatus. Information regarding dynamic compression testing apparatus approval can be obtained by contacting AFMC LSO/LOPM, 5215 Thurlow St, Wright-Patterson Air Force Base, OH 45433-5540.

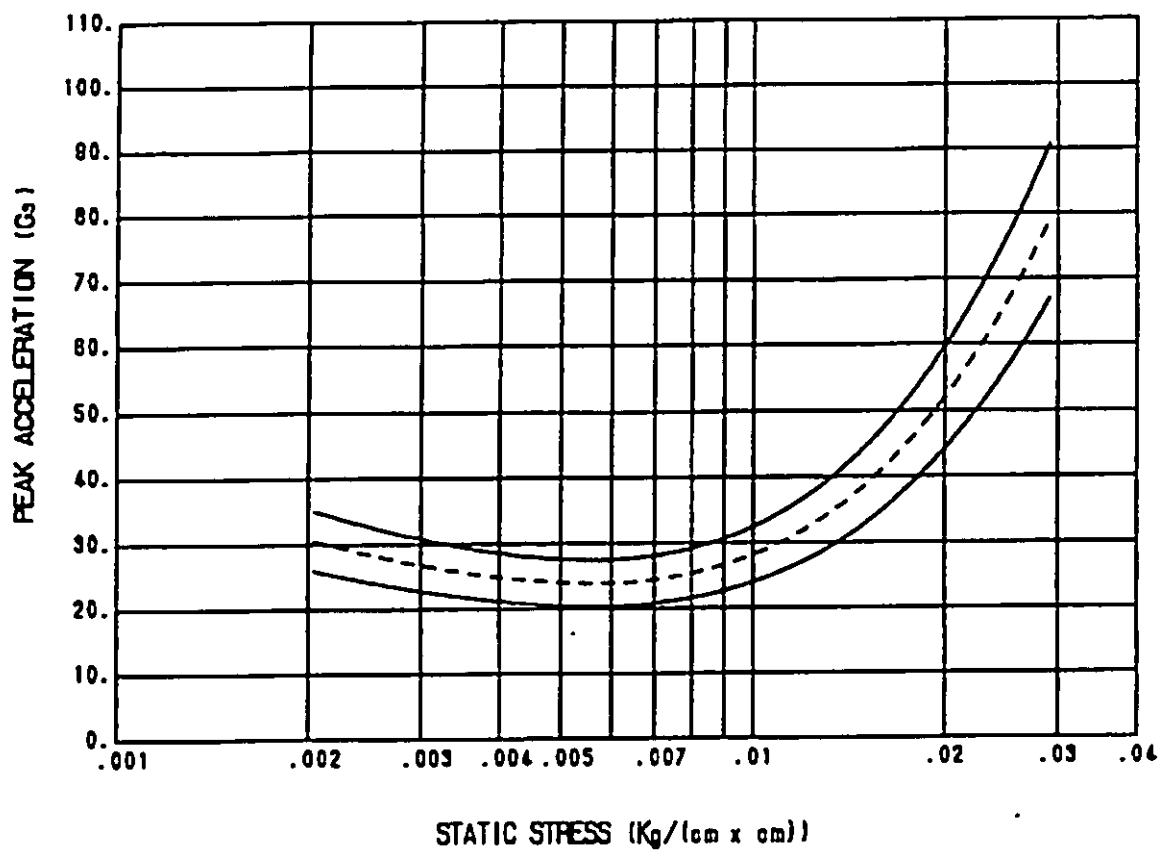
6.13 Subject term (key word) listing.

Polyurethane foam
Cushioning
Flame-resistant foam
FIP
Foam

6.14 Foam-in-place operations (Navy). An evaluation of a worker's exposure to toxic chemicals released during foam-in-place operations shall be performed at each work place, utilizing National Institute for Occupational Safety and Health (NIOSH) recommended sampling and analysis techniques. These determinations shall be accomplished by persons and/or agencies having recognized competence in industrial hygiene, sampling, and analysis. Inquiries relating to the sampling of foam-in-place operations at Navy and Marine Corps facilities should be directed to the Commanding Officer, (Attn: Industrial Hygiene Directorate), Navy Environmental Health Center, 2510 Walmer Avenue, Norfolk, VA 23513-2617.

6.15 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.

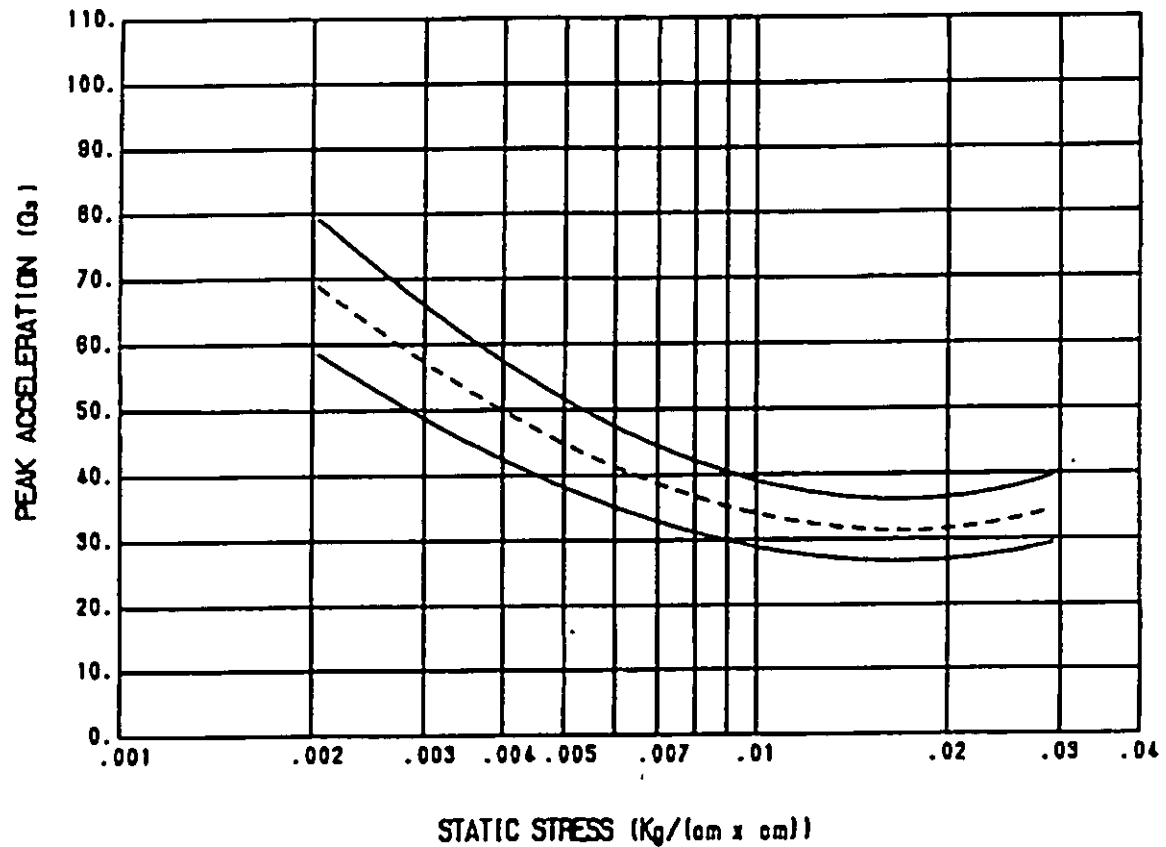
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Peak G - Static Stress Curve
drop height - 0.6 m
sample size - 200 mm x 200 mm x 75 mm
(see 6.4)

FIGURE 1. Class 2, grade A.

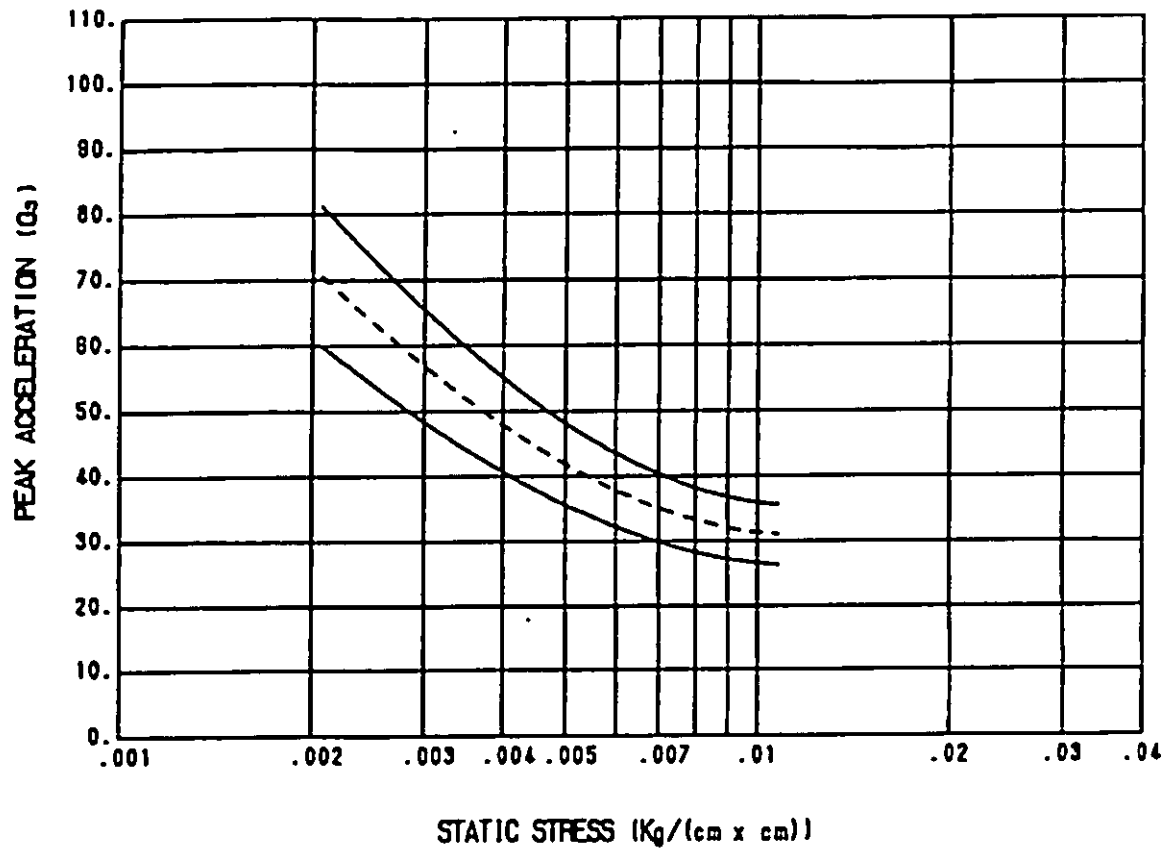
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Peak G - Static Stress Curve
drop height - 0.6 m
sample size - 200 mm x 200 mm x 75 mm
(see 6.4)

FIGURE 2. Class 2, grade B.

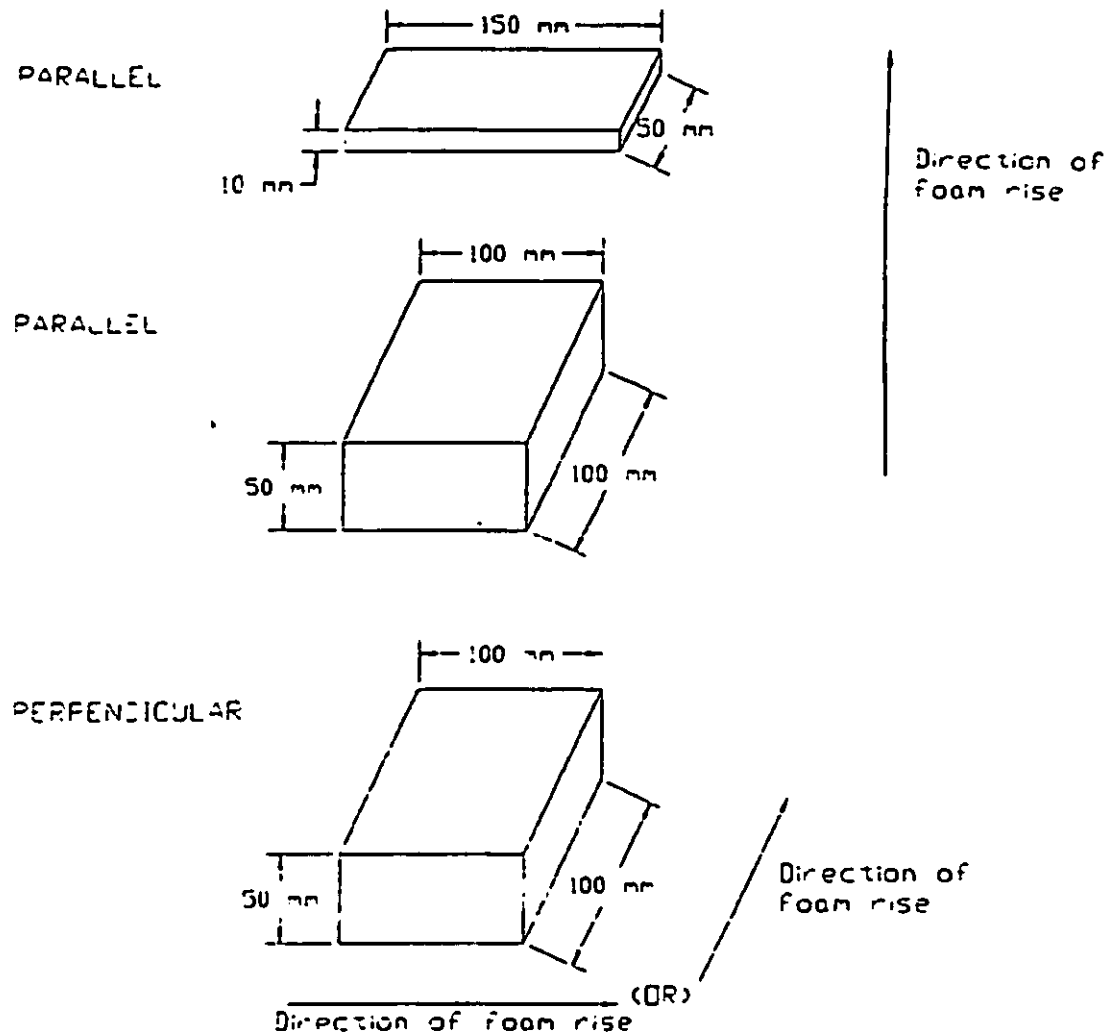
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Peak G - Static Stress Curve
drop height - 0.6 m
sample size - 200 mm x 200 mm x 75 mm
(see 6.4)

FIGURE 3. Class 3.

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FIGURE 4. Example of orientation of foam samples.

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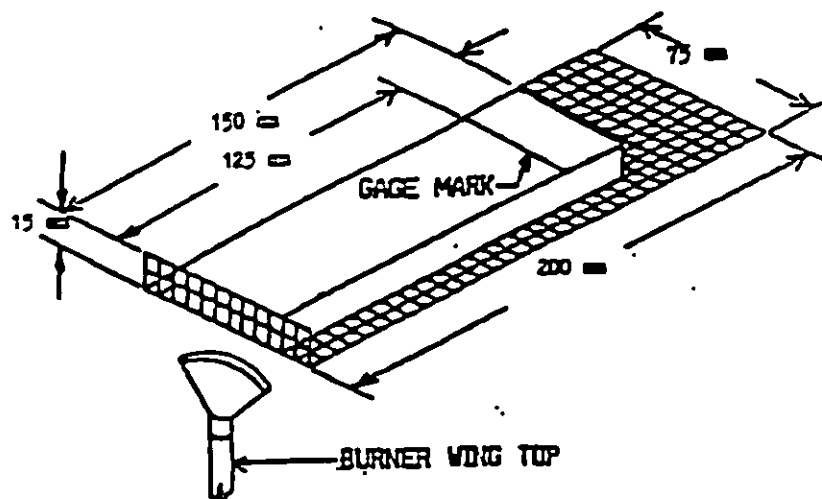


FIGURE 5. Relative positions of burner wing top, specimen, and specimen support.

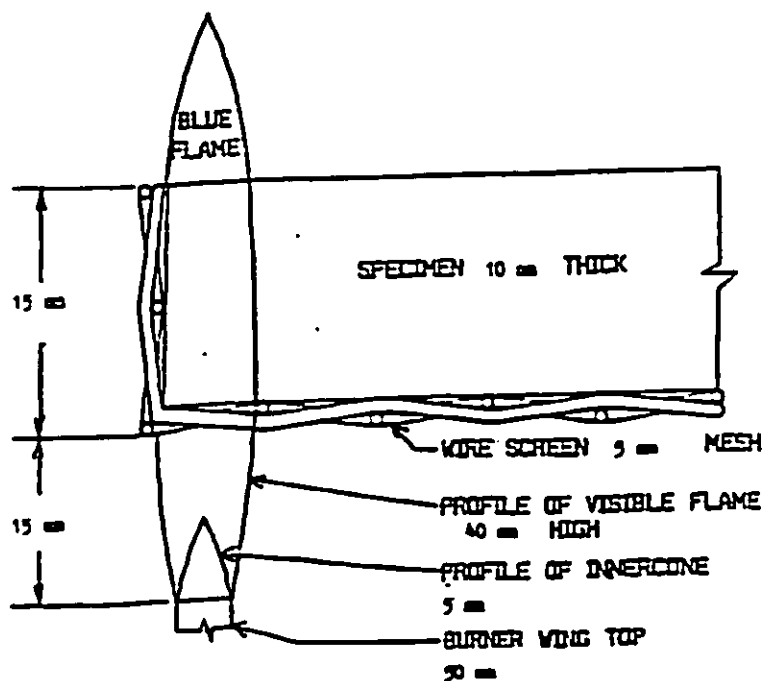


FIGURE 6. Relative positions of burner wing top, flame, specimen, and specimen support.

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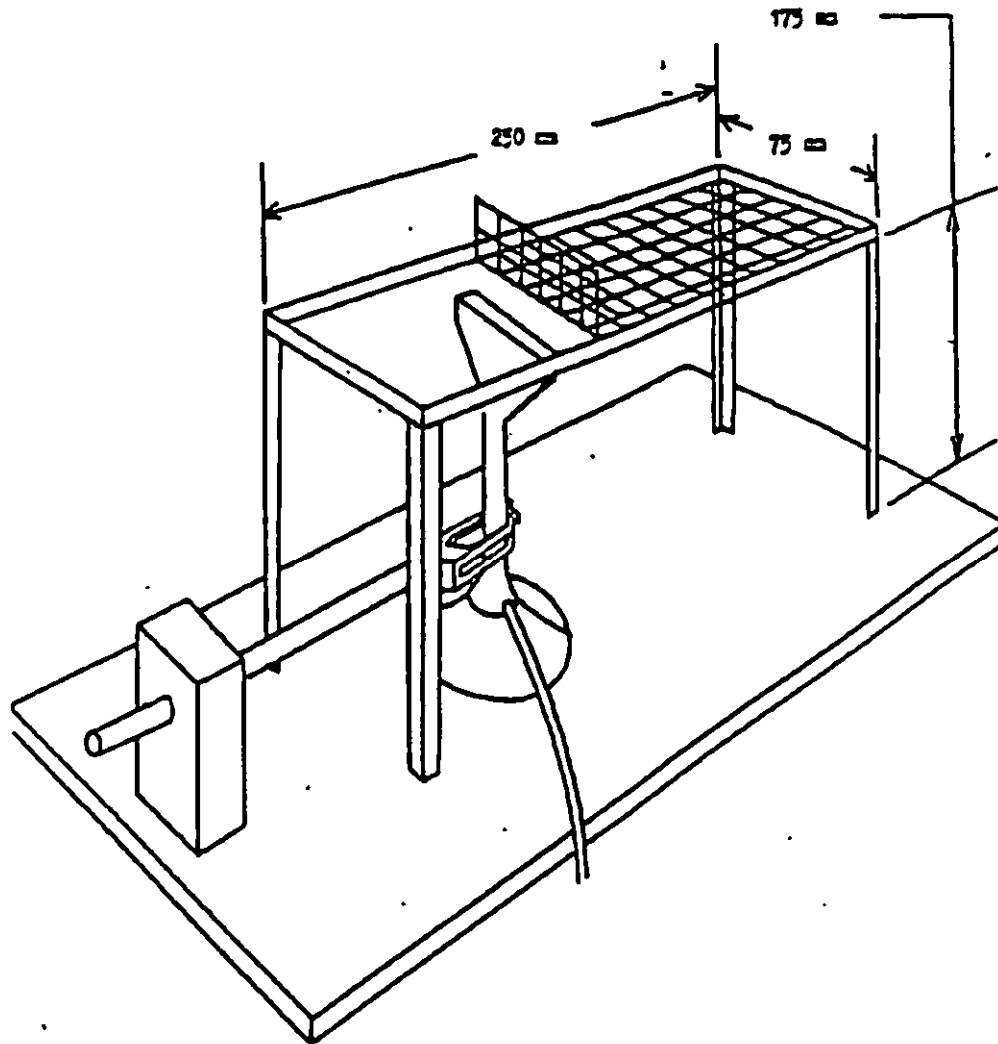


FIGURE 7. Apparatus for support of specimen.

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Custodians:

Army - SM
Navy - SA
Air Force - 69
DLA - DH

Preparing activity:

Air Force - 69
(Project 8135-0701)

Review activities:

Army - AL, AT, AV, CR, EA, MD, ME, MI, MR, MT
Navy - AS, EC, SH, YD1
Air Force - 11, 71, 82, 84, 99
DLA - GS, CC

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.

I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER
MIL-PRF-83671B

2. DOCUMENT DATE (YYMMDD)
970203

3. DOCUMENT TITLE

FOAM-IN-PLACE PACKAGING MATERIALS, GENERAL SPECIFICATION FOR

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE (Include Area Code)
(1) Commercial
(2) AUTOVON
(if applicable)

7. DATE SUBMITTED
(YYMMDD)

8. PREPARING ACTIVITY

a. NAME

Air Force Packaging
Technology and Engineering Facility

b. TELEPHONE (Include Area Code)
(1) Commercial

937-257-4519

(2) AUTOVON
787-4519

c. ADDRESS (Include Zip Code)

AFMC LSO/LOP
5215 Thurlow Street
Wright-Patterson AFB OH 45433-5540

IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:
Defense Quality and Standardization Office
5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466
Telephone (703) 756-2340 AUTOVON 289-2340