INCH-POUND

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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 resistant polyurethane foams 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 3.14, 6.2 and 6.6):

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)

Class 3 - Semi-Rigid (Figure 3)

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 Evaluation Activity, HQ AFMC/LGTP, 5215 Thurlow St, Wright-Patterson AFB, OH 45433-5540, 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 8135

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).

SPECIFICATIONS

FEDERAL

BB-N-411	Nitrogen, Technical
PPP-B-636	Boxes, Shipping, Fiberboard

MILITARY

MIL-F-87075	Foam-In-Place Packaging Systems, General Specification for

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

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
MIL-STD-1191	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.)

2.1.2 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)

Title 29, Code of Federal Regulations, Part 1910.1200

Occupational Safety and Health, Volume I, General Industry Standards and Interpretations, Parts 1910, 1910.1200 and Subpart Z.

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

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).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM-C421	Tumbling Friability of Preformed, Block-Type Thermal Insulation, Standard Test Method for
ASTM-D471	Rubber Property - Effect of Liquids, Test Method for
ASTM-D1596	Shock Absorbing Characteristics of Packaging Cushioning Materials, Standard Test for
ASTM-D1621	Plastics, Rigid Cellular, Compressive Properties of Rigid Cellular Plastics, Standard Test Method for
ASTM-D1623	Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics
ASTM-D2126	Response of Rigid Cellular Plastics to Thermal and Humid Aging, Standard Test Method for, DOD Adopted
ASTM-D3951	Standard Commercial Packaging, Practice for
ASTM-E96	Water Vapor Transmission of Materials in Sheet Form

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

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 inspection. This specification makes provisions for first article inspection (see 4.4.3).

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 meeting the requirements of MIL-F-87075 and using the procedures specified in MIL-STD-1191. Methylene diisocyanate (MDI) is a commonly used misnomer 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 agents. 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. Procurement of materials that contain chlorofluorocarbons (CFCs) or hydrochlorofluorocarbons (HCFCs) are prohibited.

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.

TABLE I. Properties.

CHARACTERISTICS	CLASS 1 (Rigid)	CLASS 2 (Flexible)		CLASS 3(Semi-Rigid)
		GRADE A	GRADE B	
[1]Conditioning temp., range 60°F (15.6°C) to specified temperature	85 (29.4) [Comp A] 85 (29.4) [Comp B]	90 (32.2) [Comp A] 90 (32.2) [Comp B]	95 (35) [Comp A] 95 (35) [Comp B]	75 (23.9) [Comp A] 75 (23.9) [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 temperature, °F (max)	360	350	350	325
°C (max)	182.2	176.7	176.7	162.8
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 6.9
[3]See 3.16 and 4.5.3.11

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 FED-STD-313 and 29 CFR 1910.1200. In the event of a conflict, 29 CFR 1910.1200 shall take precedence. The MSDS shall be included with each shipment of the material covered by this specification. Contracting officers will identify those activitites 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, Attn: HMIS Code 341, 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 65°F to 85°F (18.3°C to 29.4°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. 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 and 3.2.3.2.2.

3.2.3.2.1 Maximum concentration (Navy). For Navy procurements, the maximum MDI concentration in the test chamber, when tested in accordance with 4.5.3.12.1, shall not exceed twenty parts per billion.

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

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 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 another 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 6.16.

3.3 Density. The density of foam-in-place material may be specified (see 6.2). Permissible variation from the specified density shall be ± 10 percent. Densities shall be determined in accordance with 4.5.3.1.

3.4 Hydrolytic stability. Unless otherwise specified, materials shall meet the requirements of 3.4.1 or 3.4.2 as applicable (see 6.2 and 6.7).

3.4.1 Class 1. After aging in accordance with 4.5.3.2, the average minimum compressive strength of the 15 samples tested in both the parallel and the perpendicular directions (see 4.5.3.2.1) 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 4.5.3.9 and 6.6). It is not necessary for both yield and ten percent deflection to occur.

3.4.2 Classes 2 and 3. After aging in accordance with 4.5.3.2, 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 4.5.3.2.3.

3.5 Water absorption (class 1). The average water absorption by weight, of all the samples, shall not exceed 170 percent when determined in accordance with 4.5.3.3.

3.6 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 4.5.3.4.

3.7 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 4.5.3.5).

3.8 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 4.5.3.6. This requirement is limited to materials having a density of 4 lb/ft^3(64 kg/m^3) or less.

3.9 Minimum shelf life. Manufacturers shall submit certification that components will meet the requirements of this specification after storage (between 50°F (10°C) and 95°F (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.

3.10 Quality requirements for test specimens. Foams shall comply with mixing requirements of 3.2.1 and shall be prepared in accordance with 4.5.1. 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 0.5 in. (1.3 cm). The concentration of 0.5 in. (1.3 cm) diameter blow holes shall not exceed one in sixteen square inches (4 in. x 4 in.) (one in 104 square centimeters (10.2 cm x 10.2 cm)).

3.11 Cold temperature stability (class 1). The average linear change when tested in accordance with 4.5.3.13 shall not exceed 5 percent.

3.12 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 4.5.3.7).

3.13 Relative combustibility. The urethane foam shall be tested in accordance with 4.5.3.8. The flame front of each specimen shall not advance to or beyond the 5 in. (12.7 cm) gage mark specified in the test. There shall be no visual evidence of burning or melting of any specimen at or beyond the 5 in. (12.7 cm) gage mark.

3.14 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:

Category 1 - 20 psi (13.8 x 10^4 Pa) parallel and 12 psi (82.8 x 10^3 Pa) perpendicular to the direction of foam rise.

Category 2 - 30 psi (20.7 x 10^4 Pa) parallel and 15 psi (10.3 x 10^4 Pa) 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.

3.15 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 $\pm$ 15 percent when tested in accordance with 4.5.3.10. 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 points shall be required to establish conformance of the class 3 material, one at 0.03 psi (20.7 Pa $\pm$ 3.5 Pa x 10 Pa), one at 0.065 psi (55.2 Pa $\pm$ 3.5 x 10 Pa) and one at 0.14 psi (10.3 Pa $\pm$ 0.36 x 10^2 Pa) (see table II and 6.5).

TABLE II. Required test samples.

TEST	QUANTITY	ORIENTATION[1]	CLASS 1	CLASS 2	CLASS 3
Density	3	Parallel	4 in. x 4 in. x 2 in.	8 in. x 8 in. x 3 in.	8 in. x 8 in. x 3 in.
Hydrolytic Stability	15 (5/bun)	Parallel[2]	4 in. x 4 in. x 2 in.	N/A	N/A
	15 (5/bun)	Perpendicular[2]	4 in. x 4 in. x 2 in.	N/A	N/A
	3	Parallel	N/A	8 in. x 8 in. x 3 in.	8 in. x 8 in. x 3 in.
	3	Perpendicular	N/A	8 in. x 8 in. x 3 in.	8 in. x 8 in. x 3 in.
Water Absorption	3	Parallel	4 in. x 4 in. x 1 in.	N/A	N/A
Creep	3	Parallel	N/A	6 in. x 6 in. x 3 in.	6 in. x 6 in. x 3 in.
Compression Set	3	Parallel	N/A	Creep test samples will be used. See 4.5.3.5.	
Pliability	3	Parallel	N/A	6 in. x 6 in. x 1/2 in.	6 in. x 6 in. x 1/2 in.
Cold Temperature Stability	5	Parallel	4 in. x 4 in. x 1 in.	N/A	N/A
Volume Change	3	Parallel	4 in. x 4 in. x 2 in.	8 in. x 8 in. x 3 in.	8 in. x 8 in. x 3 in.
Combustibility	5	Parallel	2 in. x 6 in. x 1/2 in.	2 in. x 6 in. x 1/2 in.	2 in. x 6 in. x 1/2 in.
Compressive Strength	15 (5/bun)	Parallel	4 in. x 4 in. x 2 in.	N/A	N/A
	15 (5/bun)	Perpendicular	4 in. x 4 in. x 2 in.	N/A	N/A
Dynamic Cushioning	3	Parallel	N/A	8 in. x 8 in. x 3 in.	8 in. x 8 in. x 3 in.
Friability	12	N/A	1 in. x 1 in. x 1 in.	1 in. x 1 in. x 1 in.	1 in. x 1 in. x 1 in.

[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.

[2]See figure 5.

TABLE II. Required test samples - Continued.

TEST	QUANTITY	ORIENTATION[1]	CLASS 1	CLASS 2	CLASS 3
Density	3	Parallel	10.2 cm x 10.2 cm x 5.1 cm	20.3 cm x 20.3 cm x 7.6 cm	20.3 cm x 20.3 cm x 7.6 cm
Hydrolytic Stability	15 (5/bun)	Parallel[2]	10.2 cm x 10.2 cm x 5.1 cm	N/A	N/A
	15 (5/bun)	Perpendicular[2]	10.2 cm x 10.2 cm x 5.1 cm	N/A	N/A
	3	Parallel	N/A	20.3 cm x 20.3 cm x 7.6 cm	20.3 cm x 20.3 cm x 7.6 cm
	3	Perpendicular	N/A	20.3 cm x 20.3 cm x 7.6 cm	20.3 cm x 20.3 cm x 7.6 cm
Water Absorption	3	Parallel	10.2 cm x 10.2 cm x 2.5 cm	N/A	N/A
Creep	3	Parallel	N/A	15.2 cm x 15.2 cm x 7.6 cm	15.2 cm x 15.2 cm x 7.6 cm
Compression Set	3	Parallel	N/A	Creep test samples will be used. See 4.5.3.5.	
Pliability	3	Parallel	N/A	15.2 cm x 15.2 cm x 1.3 cm	15.2 cm x 15.2 cm x 1.3 cm
Cold Temperature Stability	5	Parallel	10.2 cm x 10.2 cm x 2.5 cm	N/A	N/A
Volume Change	3	Parallel	10.2 cm x 10.2 cm x 5.1 cm	20.3 cm x 20.3 cm x 7.6 cm	20.3 cm x 20.3 cm x 7.6 cm
Combustibility	5	Parallel	5.1 cm x 15.2 cm x 1.3 cm	5.1 cm x 15.2 cm x 1.3 cm	5.1 cm x 15.2 cm x 1.3 cm
Compressive Strength	15 (5/bun)	Parallel	10.2 cm x 10.2 cm x 5.1 cm	N/A	N/A
	15 (5/bun)	Perpendicular	10.2 cm x 10.2 cm x 5.1 cm	N/A	N/A
Dynamic Cushioning	3	Parallel	N/A	20.3 cm x 20.3 cm x 7.6 cm	20.3 cm x 20.3 cm x 7.6 cm
Friability	12	N/A	2.5 cm x 2.5 cm x 2.5 cm	2.5 cm x 2.5 cm x 2.5 cm	2.5 cm x 2.5 cm x 2.5 cm

[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.

[2]See figure 5.

3.16 Maximum reaction temperature. The maximum reaction temperature (see 4.5.3.11) shall not be greater than the values listed in table I.

3.17 Friability. When tested in accordance with 4.5.3.14, 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.

3.18 Tensile strength (class 1). When specified (see 6.2), the test specified in 4.5.3.15 shall be performed. The tensile strength shall be 35 psi (24.1×10^4 Pa) minimum on parallel specimens and 28 psi (19.3×10^4 Pa) minimum on perpendicular specimens.

3.19 Moisture vapor permeability (class 1). When specified (see 6.2), the test specified in 4.5.3.16 shall be performed. The maximum moisture vapor permeability shall be 3 perm-inches (4×10^{-9} g/(Pa x s x m)).

3.20 Oil resistance (class 1). When specified (see 6.2), the test specified in 4.5.3.17 shall be performed. There shall be no softening of the oil-immersed samples.

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 specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

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

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. First article inspection (see 4.4.3).

b. Quality conformance inspection (see 4.4.4).

c. Inspection of packaging (see 4.6).

4.3 Sampling. Sampling and inspection procedures shall be in accordance with MIL-STD-105. For purposes of sampling, a lot shall consist of all component A from the same batch along with a proportional amount by volume of component B, all from one batch. The A and B components from the two batches shall be submitted for acceptance at one time. Guidance for inspection level and an Acceptable Quality Level (AQL) is provided in 6.4.

4.4 Inspection and tests.

4.4.1 Inspection of containers at contractor's plant. Each sample container specified in 6.4.1 shall be examined for defects of construction and closure, for evidence of leakage, and for unsatisfactory marking; each sample container shall be weighed to determine the amount of contents. Containers having one or more defects, or less than the required fill, shall be rejected.

4.4.2 Waiving of first article inspection. The first article inspection may be waived at the prerogative of the procuring activity or representative provided the contractor submits certified data that components of the same formulation have been recently tested and the material will conform to the requirements of this specification. This waiver process is commonly referred to as self-certification. See 4.1 for responsibility of inspection.

4.4.3 First article inspection. First article inspection shall consist of the tests in table III and shall be performed by the contractor, after award of contract and prior to production, at a location acceptable to the Government. 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.

TABLE III. First article test requirements and methods.

PROPERTIES	REQUIREMENTS CLASS 1	CLASS 2	CLASS 3	TEST METHOD
Toxicity (airborne)	3.2.3.2.1	3.2.3.2.1	3.2.3.2.1	4.5.3.12.1
Density (when specified by procuring activity)	3.3	3.3	3.3	4.5.3.1
Hydrolytic stability	3.4	3.4	3.4	4.5.3.2
Water absorption	3.5			4.5.3.3
Creep		3.6	3.6	4.5.3.4
Compression set		3.7	3.7	4.5.3.5
Pliability		3.8	3.8	4.5.3.6
Shelf life	3.9	3.9	3.9	Not Applicable
Quality requirements for test specimens	3.10	3.10	3.10	Not Applicable
Cold temperature stability	3.11			4.5.3.13
Volume change	3.12	3.12	3.12	4.5.3.7
Combustibility	3.13	3.13	3.13	4.5.3.8
Compressive strength	3.14			4.5.3.9
Dynamic cushioning		3.15	3.15	4.5.3.10
Maximum reaction temperature	3.16 & Table I	3.16 & Table I	3.16 & Table I	4.5.3.11
Friability	3.17	3.17	3.17	4.5.3.14
Tensile strength (when specified by procuring activity)	3.18			4.5.3.15
Moisture vapor permeability (when specified by procuring activity)	3.19			4.5.3.16
Oil resistance (when specified by procuring activity)	3.20			4.5.3.17

4.4.3.1 Test report. The contractor, upon completion of the first article tests, shall prepare a test report and furnish three copies of the report to the procuring activity. The report shall include the numerical and visual results of each test. The proposed corrective actions, if any, shall be included in the supplementary report. Retest results shall also be included.

4.4.4 Quality conformance inspection. Acceptance tests shall consist of the tests in table IV.

TABLE IV. Acceptance test requirements.

PROPERTIES	TEST METHOD PARAGRAPH
Density (when required)	4.5.3.1
Combustibility	4.5.3.8
Color Coding (drums or canisters)	5.4.3 (Visual)

4.5 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.

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

4.5.1.1 Preparation of class 1 test specimens. To produce class 1 test samples, foam shall be poured into a 12 in. x 12 in. x 12 in. (30.5 cm x 30.5 cm x 30.5 cm) rigid container lined with polyethylene sheet material. A minimum of six 12 in. x 12 in. x 12 in. (30.5 cm x 30.5 cm x 30.5 cm) buns shall be prepared. The poured foam shall be allowed to cure for a minimum of 72 hours before cutting test specimens.

4.5.1.2 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), foam shall be poured into a 30 in. x 7 in. x 12 in. (76.2 cm x 17.8 cm x 30.5 cm) [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), the foam shall be poured into a 30 in. x 12 in. x 7 in. (76.2 cm x 30.5 cm x 17.8 cm) [L x W x H] or larger rigid container lined with a poly-

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

4.5.1.3 Cutting of test samples. All specimen material shall be taken from the center section of the bun and shall not include any material within 1.5 in. (3.8 cm) 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 0.5 in. (1.3 cm) shall not exceed one in sixteen square inches (4 in. x 4 in.) [one in 104 square centimeters (10.2 cm x 10.2 cm)]. No holes shall be larger than 0.5 in. (1.3 cm). 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). A suggested way of cutting class 1 samples is shown in figure 5.

4.5.1.4 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.

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

4.5.1.5.1 Measurement of length and width. The length and width of each specimen shall be measured at the center line to the nearest 0.0625 in. (0.16 cm).

4.5.1.5.2 Measurement of thickness. Measure thickness by placing the specimen on a flat, level surface. Load its entire top surface to 0.025 psi $\pm$ 0.005 psi (172 Pa $\pm$ 34 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 0.0625 in. (0.16 cm). 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.

4.5.1.6 Preworking. 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 10 in. (25.4 cm) per minute.

4.5.2 Test conditions. Tests and measurements shall be made at room temperature, 70°F to 80°F (21.1°C to 26.7°C). In case of dispute or rejection, the specimens shall be conditioned at 73.4°F ± 2°F (23°C ± 1.1°C) and 50 percent relative humidity (RH) ± 5 percent RH for at least 16 hours before being tested or preworked.

4.5.3 Test methods.

4.5.3.1 Density. Three specimens from the same sample block shall be prepared in accordance with 4.5.1, the thickness of each specimen determined in accordance with 4.5.1.5.2 and the weight of each specimen determined to the nearest 0.01 gram. The density of each specimen shall be determined in accordance with the following formula:

$$D = \frac{3.81w}{L \times W \times T}$$

Where: D = density in pounds per cubic foot
w = weight of specimen in grams
L = length of specimen in inches
W = width of specimen in inches
T = thickness of specimen in inches

(or the following metric formula:

$$D = \frac{w}{L \times W \times T}$$

Where: D = density in grams per cubic centimeter
w = weight of specimen in grams
L = length of specimen in centimeters
W = width of specimen in centimeters
T = thickness of specimen in centimeters)

The density of the material in a lot shall be the average of the densities of the three specimens.

4.5.3.1.1 Rejection of sample. If specimens from the sample block fail to meet the requirements of 3.3, the sample block shall be discarded, and new specimens from a second sample shall be prepared. If specimens from the second sample block fail to meet the above requirements, the entire lot represented by the sample block shall be rejected.

4.5.3.2 Hydrolytic stability. The hydrolytic stability test shall be performed using the appropriate test sequence specified below. Except for aging, the environmental conditions of paragraph 4.5.2 shall apply. Aging shall consist of exposure of test specimens for 14 days at 158°F ± 2°F (70°C ± 1.1°C) and 95 percent RH ± 5 percent RH. After exposure, the specimens shall be subjected to 120°F ± 2°F (49°C ± 1.1°C) in a mechanically convected dry air oven for 24 hours.

4.5.3.2.1 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, 4 in. x 4 in. x 2 in. (10.2 cm x 10.2 cm x 5.1 cm), shall be cut from each of three 12 in. x 12 in. x 12 in. (30.5 cm x 30.5 cm x 30.5 cm) single pour blocks of foam (see table II, and figure 5) such that the dimension of sample thickness (2 in.) is parallel to the direction of foam rise (see figure 4). Additionally, five specimens, 4 in. x 4 in. x 2 in. (10.2 cm x 10.2 cm x 5.1 cm), 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 4.5.3.2. 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 3.4.1 shall be cause for rejection.

4.5.3.2.2 Test sequence for class 2 and 3 materials.

a. Cut six samples, 8 in. x 8 in. x 3 in. (20.3 cm x 20.3 cm x 7.6 cm), three with parallel orientation and three with perpendicular orientation, prepared in accordance with 4.5.1 (see table II).

b. Condition specimens in accordance with 4.5.2.

c. Measure the original thickness in accordance with 4.5.1.5.2.

d. Prework the specimens in accordance with 4.5.1.6 using an initial plate gap of 3.100 in. (7.9 cm) and a final plate gap of 1.600 in. (4.1 cm).

e. One hour after preworking the specimens, measure initial thickness for the load/deflection test in accordance with 4.5.1.5.2.

f. Perform the load/deflection test in accordance with 4.5.3.2.3 using the initial thickness from 4.5.3.2.2.e to determine the 20 and 40 percent strain points.

g. Age the specimens as specified in 4.5.3.2.

h. Condition specimens for a minimum of 60 minutes in accordance with the temperature and humidity conditions of 4.5.2.

i. Prework the specimens in accordance with 4.5.1.6 using an initial plate gap of 3.100 in. (7.9 cm) and a final plate gap of 1.600 in. (4.1 cm).

j. Repeat the load/deflection test on aged specimens in accordance with 4.5.3.2.3 using the initial thickness from 4.5.3.2.2.e to determine the 20 and 40 percent strain points.

k. To determine compliance with 3.4.2, 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 3.4.2, with the absolute numbers used (regardless of ± signs).

4.5.3.2.3 Load/deflection (classes 2 and 3). This test shall be performed using a compression machine as described in 4.5.1.6.

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 1.6 in.

c. Program the machine to compress the specimens at a rate of 0.20 in. per minute (0.5 cm 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.

4.5.3.3 Water absorption (class 1). Three samples shall be tested and examined for conformance to the requirements

of 3.5. 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 4 in. ± 1/8 in. (10.16 cm ± 0.3 cm) square by 1 in. ± 1/8 in. (2.54 cm ± 0.3 cm) thick.

d. Test specimens shall be submerged in a vessel containing distilled water maintained at 70°F to 75°F (21.1°C to 23.8°C).

e. The submersion period shall be 96 hours ± 1 hour.

4.5.3.4 Determination of creep (classes 2 and 3). Three specimens, 6 in. x 6 in. x 3 in. (15.2 cm x 15.2 cm x 7.6 cm), with 3 in. (7.6 cm) direction parallel to foam rise, shall be prepared in accordance with 4.5.1. Prework specimen to 60 percent of its original thickness in accordance with 4.5.1.6. Initial thickness shall be measured in accordance with 4.5.1.5.2. Three minutes after the last compression, the thickness of each specimen shall be measured with a 0.9 lb (0.41 kg), 0.025 psi (1.7 x 10^3 Pa), preload in accordance with 4.5.1.5.2. 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 1 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 3.6).

4.5.3.5 Compression set (classes 2 and 3). This test shall be conducted immediately following the test specified in 4.5.3.4

using the same specimens. Four hours after the load is removed, the specimen thickness shall be measured in accordance with 4.5.3.4 and the compression set calculated as follows:

$$\text{Compression set} = \frac{(T_i - T_f) \times 100}{T_i}$$

Where T_i = initial thickness unloaded from paragraph 4.5.3.4
T_f = 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 3.7.

4.5.3.6 Pliability (classes 2 and 3). Three samples, 6 in. x 6 in. x 1/2 in. (15.2 cm x 15.2 cm x 1.3 cm), with parallel orientation, shall be prepared as specified in section 4.5.1 (see table II, and 4.5.1.3). Within two seconds, each of three specimens shall be bent 180° around a cylinder having a 1/2 in. (1.3 cm) diameter in a uniform manner such that the foam shall be pressed against the cylinder. The test shall be conducted at room temperature (see 4.5.2) and at -40°F (-40°C). For the low temperature test, the specimens shall be conditioned for at least four hours at -40°F (-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 3.8.

4.5.3.7 Volume change. Three test specimens, prepared as specified in 4.5.1 and conditioned according to 4.5.2, shall be measured and the volume calculated and recorded. The class 1 specimens shall be 4 in. x 4 in. x 2 in. (10.2 cm x 10.2 cm x 5.1 cm), aged as specified in 4.5.3.2, and remeasured in accordance with ASTM-D2126. The class 2 and 3 specimens shall be 8 in. x 8 in. x 3 in. (20.3 cm x 20.3 cm x 7.6 cm) and subjected to the temperature and humidity conditions only, specified in 4.5.3.2, and remeasured. 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 3.12. Final measurements shall be made immediately following aging.

4.5.3.8 Relative combustibility. The combustibility of the foam shall be determined in accordance with the following sub-paragraphs. After completion of the test, foam samples shall be examined for conformance to 3.13. A test shall consist of

determining the extent of burning of at least five foam samples. Samples shall be cut from sections at least 1 1/2 in. (3.8 cm) from exterior surfaces. The thickness of each sample shall be parallel to the direction of rise.

4.5.3.8.1 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 24 in. x 12 in. x 30 in. (61 cm x 30.5 cm x 76.2 cm) [L x W x H]. A closable opening, for ventilation, approximately 1 in. (2.5 cm) 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 organizations's operations and equipment shall be approved by the appropriate environmental and/or safety activity.

b. Burner. A standard Bunsen or Tirrill burner (3/8 in. (1 cm) outside diameter barrel) fitted with a 2 in. (5.1 cm) wide wing top shall be used. The wing top may have to be opened to approximately 1/8 in. (0.32 cm) to provide the flame required in figure 7. 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 (3 in. x 8 in. (7.6 cm x 20.3 cm)) shall have a 5/8 in. (1.6 cm) length bent to form a right angle. This will form the specimen support as shown in figure 6.

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 1/2 in. (1.3 cm) above the top of the burner wing top as shown in figure 6. 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.

4.5.3.8.2 Test specimens.

a. Five specimens, 2 in. x 6 in. x 1/2 in. (5.1 cm x 15.2 cm x 1.3 cm) [L x W x H], with parallel orientation shall be prepared as specified in 4.5.1 (see table 4).

b. Material thickness shall be 1/2 in. ± 1/16 in. (1.3 cm ± 0.2 cm). Thickness shall be parallel to the direction of rise.

c. Each test specimen shall be marked across the width with one line 5 in. (12.7 cm) from one end.

4.5.3.8.3 Conditioning. Specimens shall be conditioned prior to test for a minimum of 24 hours in accordance with 4.5.2. Tests shall be made in this atmosphere or immediately after removal therefrom.

4.5.3.8.4 Procedure. See figures 6, 7, and 8.

a. Clamp the wire cloth specimen support horizontally so that the bottom of the wire cloth is 1/2 in. (1.3 cm) above the burner's wing top as shown in figure 6. 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 6 in. (15.2 cm) and 8 in. (20.3 cm). 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 5/8 in. (1.6 cm) 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 5 in. (12.7 cm) away from the bent-up end.

c. Adjust the burner with the wing top to provide a blue flame with a visible portion 1 1/2 in. (3.8 cm) high and a clearly defined inner cone 1/4 in. (0.6 cm) 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 6 in. (15.2 cm) away from the test specimen. If the flame goes out before reaching the gage mark, the extent of burning is equal to 5 in. (12.7 cm) 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 1/16 in. (0.2 cm). 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 yellow or characteristic flame.

4.5.3.8.5 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 inches as measured on the top surface.

4.5.3.8.6 Report. The report 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: Six-inch (15.2-centimeter) 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. (Five in. (12.7 cm) - less the distance between the gage mark and closest evidence of burning.)

4.5.3.8.7 Precision. The standard deviation for interlaboratory reproducibility is 3/8 in. (1.0 cm).

4.5.3.9 Compressive strength (class 1). The compressive strength shall be determined in accordance with ASTM-D1621, procedure A, and examined for conformance to 3.4.1 and 3.14. After a minimum 72-hour cure time, a total of ten specimens 4 in. x 4 in. x 2 in. (10.2 cm x 10.2 cm x 5.1 cm) shall be prepared from each of three 12 in. x 12 in. x 12 in. (30.5 cm x 30.5 cm x 30.5 cm) single pour blocks of foam. Five specimens shall be cut such that the depth dimension of 2 in. (5.1 cm) 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 4 in. x 4 in. x 2 in. (10.2 cm x 10.2 cm x 5.1 cm) shall be cut from each of the same three sample blocks such that the depth dimension of 2 in. (5.1 cm) 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 3.14 shall be cause for rejection.

4.5.3.10 Dynamic cushioning properties (classes 2 and 3).

4.5.3.10.1 Peak acceleration versus static stress data. The data to plot the peak acceleration in multiples of g versus static stress in pounds per square inch, from a drop height of 24 in. (61.0 cm), shall be established in accordance with ASTM-D1596 with exceptions specified herein.

4.5.3.10.2 Specimens. Three specimens, 8 in. x 8 in. x 3 in. ± 0.125 in. (20.3 cm x 20.3 cm x 7.6 cm ± 0.3 cm) with parallel orientation shall be prepared as specified in 4.5.1 (see table 4.)

4.5.3.10.3 Preworking. Each specimen shall be compressed to 60 percent of its original thickness in accordance with 4.5.1.6. A specimen shall be rested for at least 16 hours, but not more than 72 hours, before conducting the dynamic test procedure.

4.5.3.10.4 Dynamic test procedure. All test samples shall be measured to determine that samples are within 10 percent of the required thickness of 3 in. (7.6 cm) 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 136 in. ± 2 in. (345.4 cm ± 5.1 cm) per second. This corresponds to a nominal initial free-fall drop height of 24 in. (70.0 cm). 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 weights 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.

4.5.3.10.5 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 3.15.

4.5.3.11 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 12 in. x 12 in. x 12 in. (30.5 cm x 30.5 cm x 30.5 cm) corrugated fiberboard container, conforming to PPP-B-636. 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 10°F (5.5°C).

4.5.3.12 Airborne toxicity (Navy). For Navy procurements, methylene bisphenyl isocyanate (MDI) concentrations shall be determined by methods and procedures described in 4.5.3.12.1 through 4.5.3.12.1.4.

4.5.3.12.1 MDI determination sealed chamber test. Determination of airborne methylene diisocyanate concentrations will involve the foaming of chemicals into an essentially air-tight chamber. MDI generated will be measured with an organic diisocyanate monitor (see 4.5.3.12.1.2). The essentially air-tight chamber may vary in size from 27 ft^3 to 535 ft^3 (0.76 m^3 x 15.15 m^3). The ratio of the volume of the enclosed chamber to the volume of the dispensed foam shall be 27 to 1. The minimum acceptable foam dispensing rate shall be 1 cubic foot per 30 seconds (0.03 cubic meters per 30 seconds) or 2.00 ft^3/minute (0.06 m^3/minute) (see 3.2.3.2.1).

4.5.3.12.1.1 Description of test chamber. The test chamber shall conform to the volume limitations of 4.5.3.12.1. Although any air-tight enclosure will be acceptable for the purpose of this test, a suggested simple construction is a wood frame structure covered with clear polyethylene film of a minimum 4 mils thickness. The plastic sheets can be overlapped and secured carefully to the frame with staples or other fasteners. One side panel of the test chamber should be hinged along one edge to provide an access door. Provide a 4 in. x 4 in. (10.2 cm x 10.2 cm) porthole with an overlapping cover to be used as a foam dispensing opening. The porthole should be centered 18 in. (45.7 cm) above the floor of the test chamber. Tape should be used to seal all chamber

seams and openings to provide a leakproof enclosure. A fiberboard box, open at the top, with a height of 12 in. (30.5 cm) and an overall volume sufficient to contain the dispensed foam without overflow, shall be placed in the chamber. Place a polyethylene film liner in the box. A 12 in. (30.5 cm) diameter fan that operates at approximately 1350 rpm shall be placed in the test chamber and connected to an external power source. Optional materials and accessories for the test chamber are listed in 6.13.

4.5.3.12.1.2 Instrumentation for MDI determination. The MDI monitor described in this section shall be used to detect and record peak and time-weighted-average (TWA) concentrations of MDI in accordance with procedures in 4.5.3.12.1. A continuous sampling diisocyanate monitor, capable of detecting within a range of 0 to 40 ppb MDI, shall be used. Concentrations in ppb are recorded. Both the peak and the TWA values are recorded. Methodology for the sampling may employ continuous recording instruments with display or may use multiple sampling procedures as outlined in OSHA method 47. Technical information is available from the manufacturer, MDA Scientific, Inc., 1815 Elmdale Avenue, Glenview, IL 60025, or from GMD Systems Inc., Old Route 519, Hendersonville, PA 15339. Instruments capable of providing equivalent information may be used. The Navy can require identification of instruments deemed capable of providing equivalent information. For more information, contact the Navy Environmental Health Center, 2510 Walmer Ave, Norfolk, VA 23513-2617.

4.5.3.12.1.3 Pretest operations. Prior to testing foam in accordance with 4.5.3.12.1.4, dispense foam at the nominal production rate and appropriate ratio in an adequately ventilated area to determine that the foam dispensing unit is operating properly. Determine the reactivity characteristics of cream time, rise time, and tack free time on this foam per table 1 to ensure that these characteristics are typical. Determine the density and relative combustibility as per the acceptance test criteria of 4.5.3.1 and 4.5.3.8, respectively. Dispensing ratio and settings during production and testing sequences shall be identical. Prior to positioning the monitor in the test chamber, verify the proper operation of the monitoring equipment selected according to the manufacturer's or supplier's instructions or the methods/procedures.

4.5.3.12.1.4 Test procedure. To protect instrumentation, place in a clear plastic bag and provide openings for the monitor's inlet and outlet tubes as appropriate. One-half inch of the monitor's inlet tube shall protrude through the side wall of the test chamber. The tube will be at the level of the container top. Position the polyethylene-lined box in the right front corner of the chamber and close the door. If required, use tape to seal the door chamber interface. Place tape around the edges of the 4 in.

x 4 in. (10.2 cm x 10.2 cm) cover for the foam dispensing opening. Start the circulation fan. Identify the point at which the test was initiated if a chart is used, and record the time when the test begins. Dispense a predetermined amount of foam chemicals, as prescribed in 4.5.3.12.1, into the polyethylene lined box, taking care to distribute the foam evenly over the bottom surface of the box. The minimum box size shall be 12 in. x 12 in. x 12 in. (30.5 cm x 30.5 cm x 30.5 cm) [L x W x H]. If required, seal visible leaks in test chamber with tape. Mark the chart, if used, to indicate the end of test at 12 minutes after start of test. If other sampling techniques are used, record the time for each sample and the time the sampling was completed. Open the chamber to allow venting. Record the maximum concentration that occurred during the test period. Prior to running another sample, be certain that the vapors from the previous test have been dispersed. To ensure that proper foaming action has occurred, determine density and combustibility characteristics of the test bun in accordance with 4.5.3.1 and 4.5.3.8 and compare these results with the reference sample prepared in 4.5.3.12.1.3 during pretest. Density measurements for the two samples should be within ± 10 percent and combustibility values of both should meet the requirements of 3.13. If these conditions are not met, the procedures of 4.5.3.12.1.3 and 4.5.3.12.1.4 should be repeated.

4.5.3.13 Cold temperature stability (class 1). Five samples, measuring 4 in. x 4 in. x 1 in. (10.2 cm x 10.2 cm x 2.5 cm) [L x W x H], with perpendicular orientation, shall be prepared as specified in 4.5.1. Specimens shall be tested in accordance with ASTM D2126 at a test temperature of -40°F ± 6°F (-40°C ± 3°C) and examined for conformance to the requirements of 3.11.

4.5.3.14 Friability. Twelve samples shall be prepared as specified in 4.5.1. 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 220°F to 235°F (104.4°C to 112.8°C). Samples shall be examined for conformance to the requirements of 3.17.

4.5.3.15 Tensile strength (class 1). Testing and sample preparation will 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 3.18.

4.5.3.16 Moisture vapor permeability (class 1). Three test specimens, from which the skins have been removed, shall be tested. Specimen thicknesses 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 3 in. ± 0.06 in. (7.6 cm ± 0.16 cm).

b. The specimen holder shall have a diameter of 5.75 in. ± 0.25 in. (14.6 cm ± 0.64 cm), 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.

4.5.3.17 Oil resistance.

4.5.3.17.1 Sample preparation. A foam bun having minimum dimensions of 12 in. x 12 in. x 12 in. (30.5 cm x 30.5 cm x 30.5 cm) shall be poured. The bun shall be trimmed by removing at least 1.5 in. (3.8 cm) of material from all four sides, the top, and bottom of the bun. The bun shall be cut into two pieces at a point 4 in. (10.2 cm) down from the top; this will result in a piece 9 in. x 9 in. x 5 in. (22.9 cm x 22.9 cm x 12.7 cm). From the top of this piece, a slice measuring 9 in. x 9 in. x 1 in. (22.9 cm x 22.9 cm x 2.5 cm) shall be cut. A circular die having an inside diameter of 1.125 in. (2.9 cm) shall be used for cutting five specimens from the 1 in. (2.5 cm) thick slice of foam. These 1.125 in. (2.9 cm) diameter, 1 in. (2.5 cm) high samples shall be conditioned for at least 24 hours at 73.4°F ± 1.8°F (23°C ± -16.8°C) and 50 percent RH ± 5 percent RH.

4.5.3.17.2 Test procedure. Four specimens prepared and conditioned in accordance with 4.5.3.17.1 shall be immersed in No. 2 reference oil of ASTM-D471 at 73.4°F ± 1.8°F (23°C ± -16.8°C). The fifth specimen shall remain unused in accordance with the conditions specified in 4.5.3.17.1. The test room or chamber shall be maintained at 50 percent RH ± 5 percent RH. After 70 hours ± 1 hour, the specimens shall be removed, lightly blotted and compared with the unused specimen. Evidence of softening or degradation shall constitute failure of the samples representing the lot.

4.6 Inspection of packaging.

4.6.1 Quality conformance inspection.

4.6.1.1 Unit of product. Filled and sealed containers ready for shipment shall be the unit of product.

4.6.1.2 Sampling. Sampling shall be in accordance with MIL-STD-105.

4.6.1.3 Examination. Samples selected in accordance with 4.6.1.2 shall be examined for the following major defects.

101. Containers for components A and B not of type specified for level A.

102. Size of containers not as specified.

103. Containers not blanketed with dry air or dry nitrogen as specified.

104. Marking missing, incorrect, or illegible.

105. Containers not palletized, when required, as specified.

5. PACKAGING

5.1 Preservation. Not applicable.

5.2 Packing. Packing shall be level A or commercial as specified (see 6.2).

5.2.1 Level A. The liquid components A and B shall be separately packed in 1A1, 1H1, 3H1, or containers conforming to Title 49 of the Code of Federal Regulations to carry the intended product. The capacity shall be as specified (see 6.2). The containerized chemicals shall be blanketed with dry nitrogen conforming to BB-N-411, not to exceed 3 psi (20.7×10^3 Pa).

5.2.2 Commercial. Commercial packaging shall be in accordance with ASTM-D3951.

5.3 Unitized loads. When specified (see 6.2), the drums shall be palletized in accordance with MIL-STD-147. When commercial packaging is designated, standard commercial pallets may be used.

5.4 Marking.

5.4.1 Military. In addition to any special or other identification marking required by this specification or the contract, containers and unitized loads shall be marked in accordance with MIL-STD-129 and 49 CFR Part 178, subpart L.

5.4.2 Labels. Labels attached to each container shall comply with the OSHA Hazard Communication Standard 29 CFR 1910.1200. Each container shall be marked on the sides, using waterproof labels, with the following information:

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

b. Specification classification (class and grade).

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

> CAUTION: 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 breath 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: "FLAME RESISTANT".

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

5.4.3 Color Coding. All containers shall be color coded on the top and sides with 300 $in.^2$ (1935.5 cm^2) minimum on sides and 150 $in.^2$ (967.7 cm^2) minimum on top as follows:

a. "A" component: red or yellow.

b. "B" component: blue.

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. Density (optional - see 3.3) - express in pounds per cubic foot.

e. Hydrolytic stability - specify if not required (see 6.7).

f. Maximum allowable percentage creep, if other than as specified in 3.6 (classes 2 and 3).

g. Maximum allowable percentage set, if other than as specified in 3.7 (classes 2 and 3).

h. Pliability (classes 2 and 3) - state if not required (see 3.8).

i. Minimum compressive strength, if other than as specified in 3.14 (class 1 - see 6.6).

j. Tensile strength (class 1) - specify if required (see 3.18).

k. Moisture vapor permeability (class 1) - specify if required (see 3.19).

l. Oil resistance (class 1) - specify if required (see 3.20).

m. Indicate whether first article inspection is waived (see 4.4.2).

n. Indicate where first article test report should be sent (see 4.4.3.1).

o. Indicate level of packing (see 5.2).

p. Indicate capacity of container (see 5.2.1).

q. Indicate whether containers should be palletized (see 5.3).

r. Indicate marking requirements (see 5.4).

s. After 1 Oct 93, provide certified statement that the product does not contain CFCs and/or HCFCs.

t. Indicate guaranteed conformance to minimum shelf life requirements of paragraph 3.9.

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 4.4.3. 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 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 Sampling procedures.

6.4.1 Sampling for inspection of filled containers. Sampling should be in accordance with MIL-STD-105, inspection level I, and with an AQL of 2.5 percent defective. Visual examination of the sample containers and contents should be made for fill, leakage, marking, and workmanship.

6.4.1.1 Sampling for testing. The inspector should select at random two containers of component A from each lot (see 4.3). From each of the two containers, two quart samples should be taken, placed in separate clean, dry metal containers, then sealed

and identified with permanent marking ink. Samples of component B, in quantities necessary to provide the appropriate component ratio by volume (table I), should be similarly selected, packaged, and identified.

6.5 Dynamic cushioning. The requirements of 3.15 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.

6.6 Compressive strength (class 1). The compressive strength requirements of 3.14 were developed from test data obtained on materials with nominal densities of 2.0 lb/ft^3 (32.0 kg/m^3). If a different density material is specified, the compressive strengths should also be specified. For MIL-STD-1191, technique VII encapsulated pack, the 2 lb/ft^3 (32. kg/m^3) category 2 foam is required. It possesses the higher minimum compressive strengths of 30 psi (20.7 x $10a^4$ Pa) parallel to the direction of rise and 15 psi (10.3 x 10^4 Pa) perpendicular to the direction of rise.

6.7 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 3.4.

6.8 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 2 lb/ft^3 (32.0 kg/m^3) is being procured, the maximum reaction temperature should be specified by the procuring activity.

6.9 Definitions. The following terms listed in table I have these definitions:

a. Cream time - period between "pour mixing" 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 pouring and period when semicured foam may be touched lightly without stickiness.

6.10 Storage information. The minimum acceptable shelf life of the foam chemical is one year when the storage temperature remains in the 50°F to 95°F (10°C to 35°C) conditioning temperature range. The nominal freezing point of isocyanates is approximately 20°F (-6.7°C). Some materials have been usable following prolonged storage in the -10°F to +10°F (-23.3°C to -12.2°C) range. As a guide, prolonged exposure to 20°F (-6.7°C) above the 95°F (35°C) maximum normally halves the shelf life. Exposure to temperatures 20°F (-6.7°C) below the 50°F (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 50°F (10°C) to 95°F (35°C) conditioning range.

6.11 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) may be procured directly from the original supplier by furnishing the applicable information specified in 5.4.2.

6.12 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.

6.13 Materials for test chamber. Following are some of the materials and equipment suitable for use in the test method of 4.5.3.12.

a. Polyester sheeting, 100 ft. x 6 ft. x 6 mils, NSN 8135-00-579-6489.

b. Plastic sheeting, polyethylene, 0.002 in. x 72 in. x 1700 in., NSN 8135-01-039-4030.

c. Sealing compound, NSN 8030-00-965-2438.

d. Fan, circulating floor, NSN 4140-00-203-3807.

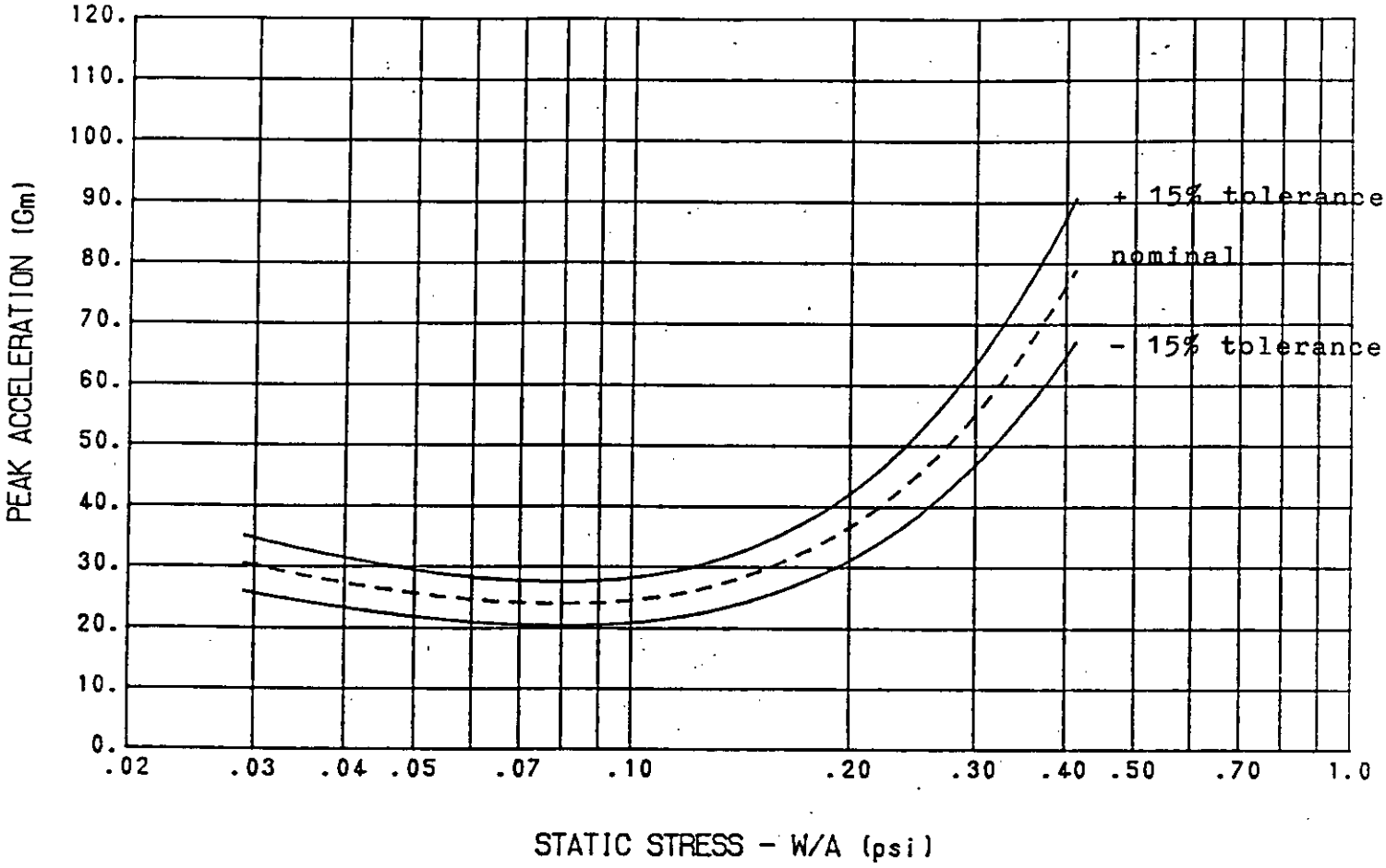
6.14 Approval of dynamic compression testing apparatus. Information regarding dynamic compression testing apparatus approval can be obtained by contacting HQ AFMC/LGTP, 5215 Thurlow St, Wright-Patterson Air Force Base, OH 45433-5540.

6.15 Subject term (key word) listing.

Polyurethane foam
Cushioning
Flame-resistant foam
FIP
Foam

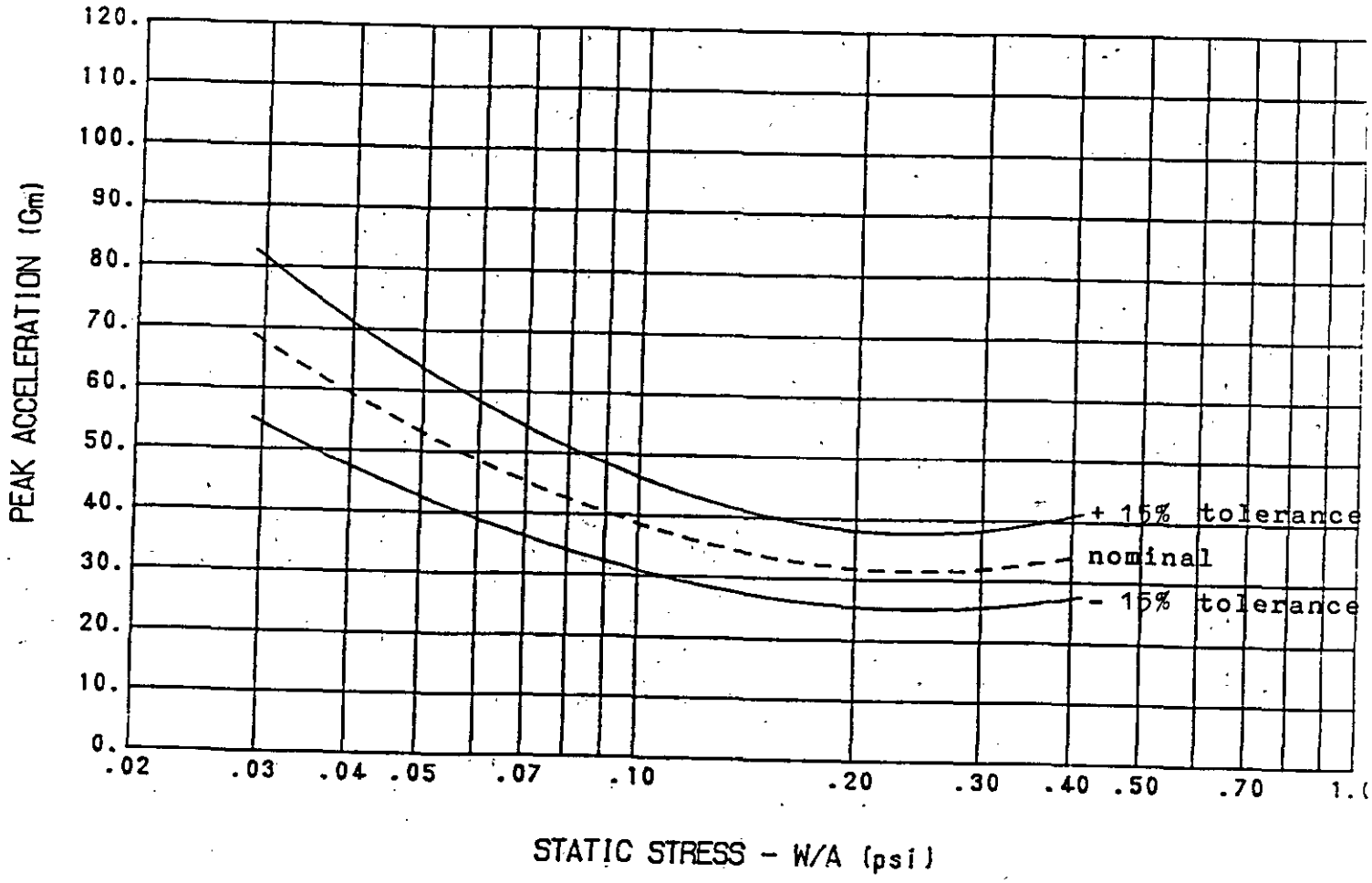
6.16 Foam-in-place operations (Navy). An evaluation of a worker's exposure to toxic chemicals released during foam-in-place operations shall be performed at each work place, utilizing National Institute for Occupational Safety and Health (NIOSH) recommended sampling and analysis techniques. These determinations 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 Department, Code 33), Navy Environmental Health Center, 2510 Walmer Avenue, Norfolk, VA 23513-2617.

6.17 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.



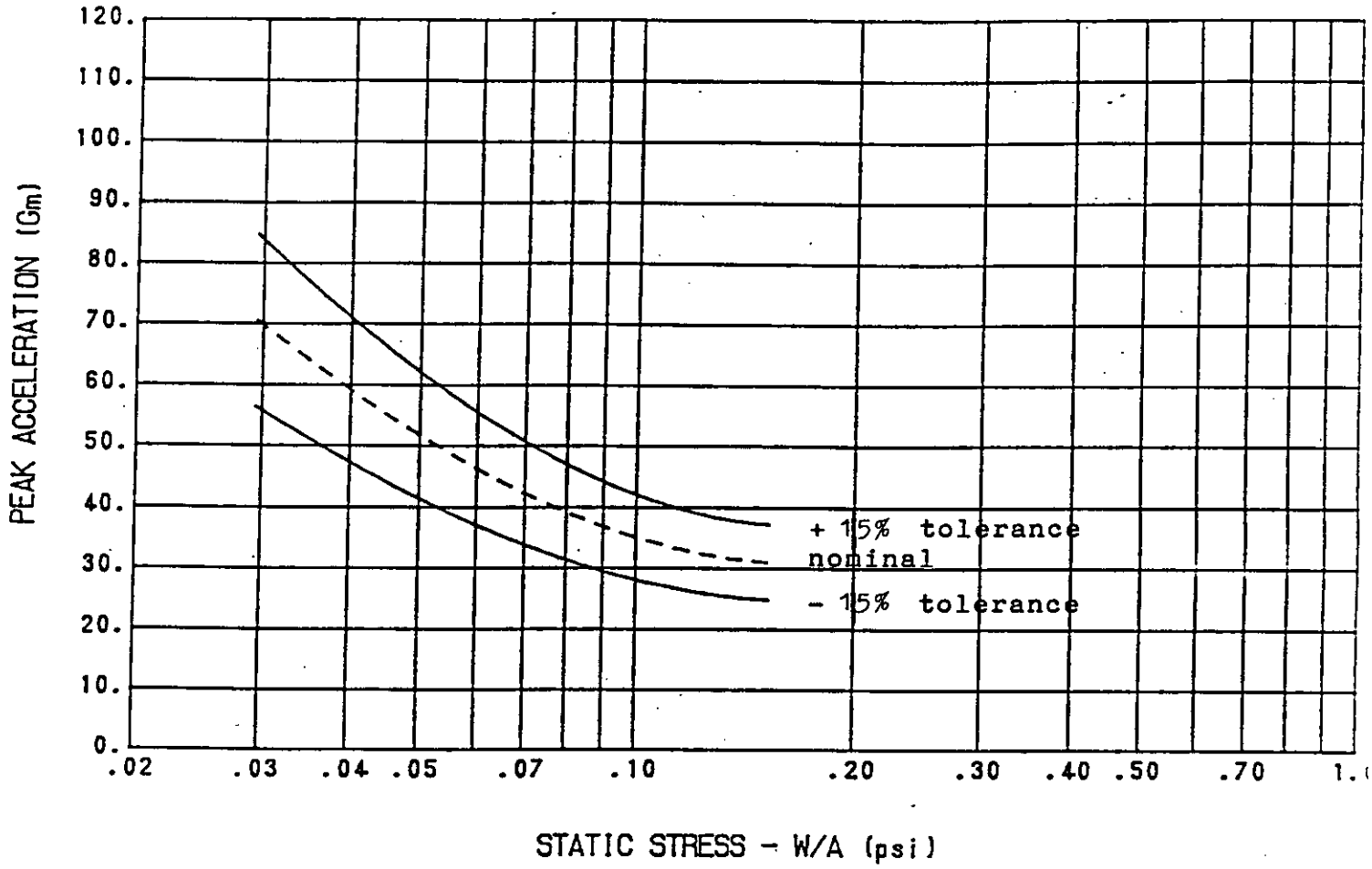
Peak G - Static Stress Curve
drop height - 24 inches (61 cm)
sample size - 8 x 8 x 3 inches (20.3 cm x 20.3 cm x 7.6 cm)
(see 6.5)

FIGURE 1. Class 2, grade A.



Peak G - Static Stress Curve
drop height - 24 inches (61 cm)
sample size - 8 x 8 x 3 inches (20.3 cm x 20.3 cm x 7.6 cm)
(see 6.5)

FIGURE 2. Class 2, grade B.



Peak G - Static Stress Curve
drop height - 24 inches (61 cm)
sample size - 8 x 8 x 3 inches (20.3 cm x 20.3 cm x 7.6 cm)
(see 6.5)

FIGURE 3. Class 3.

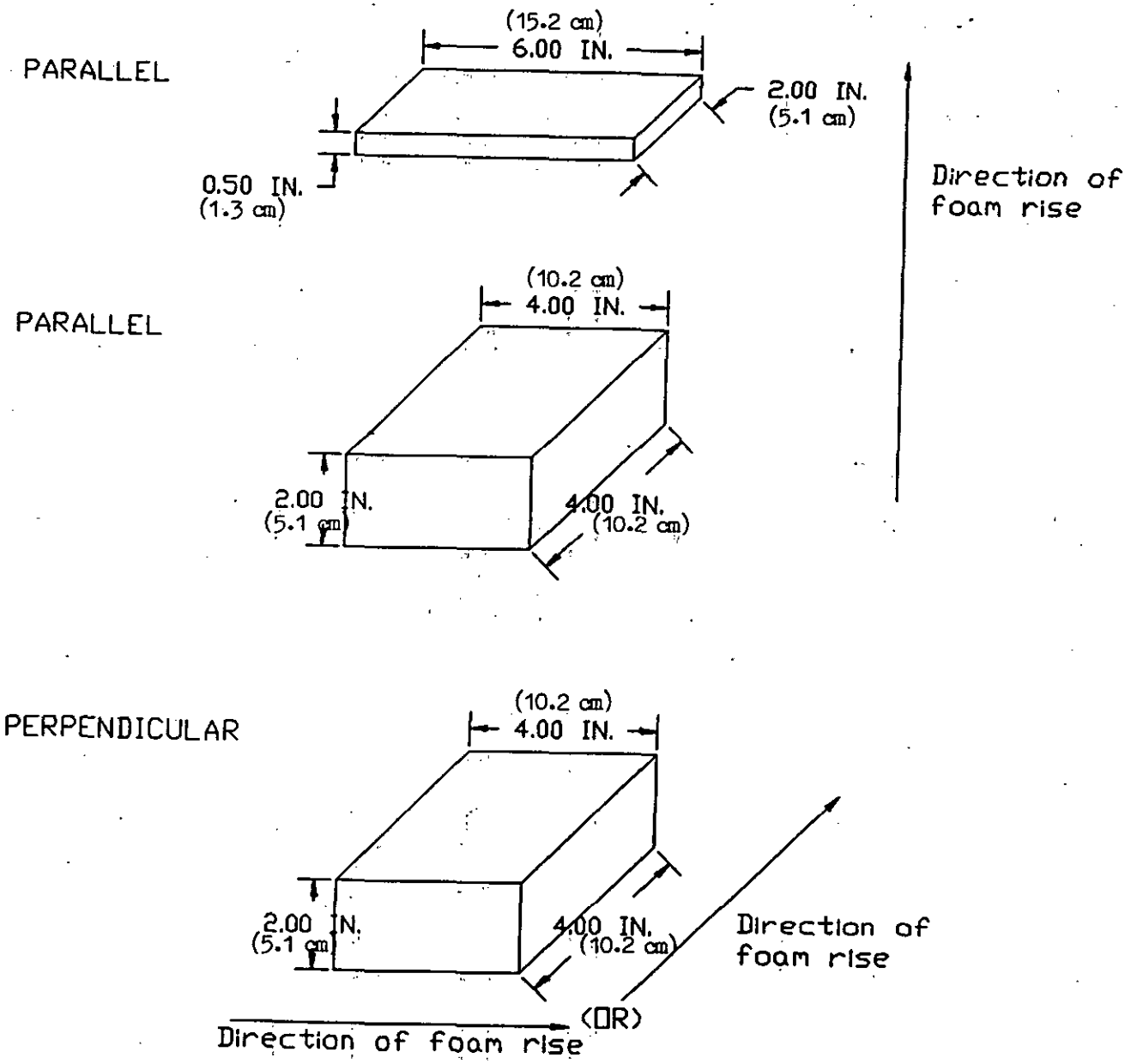
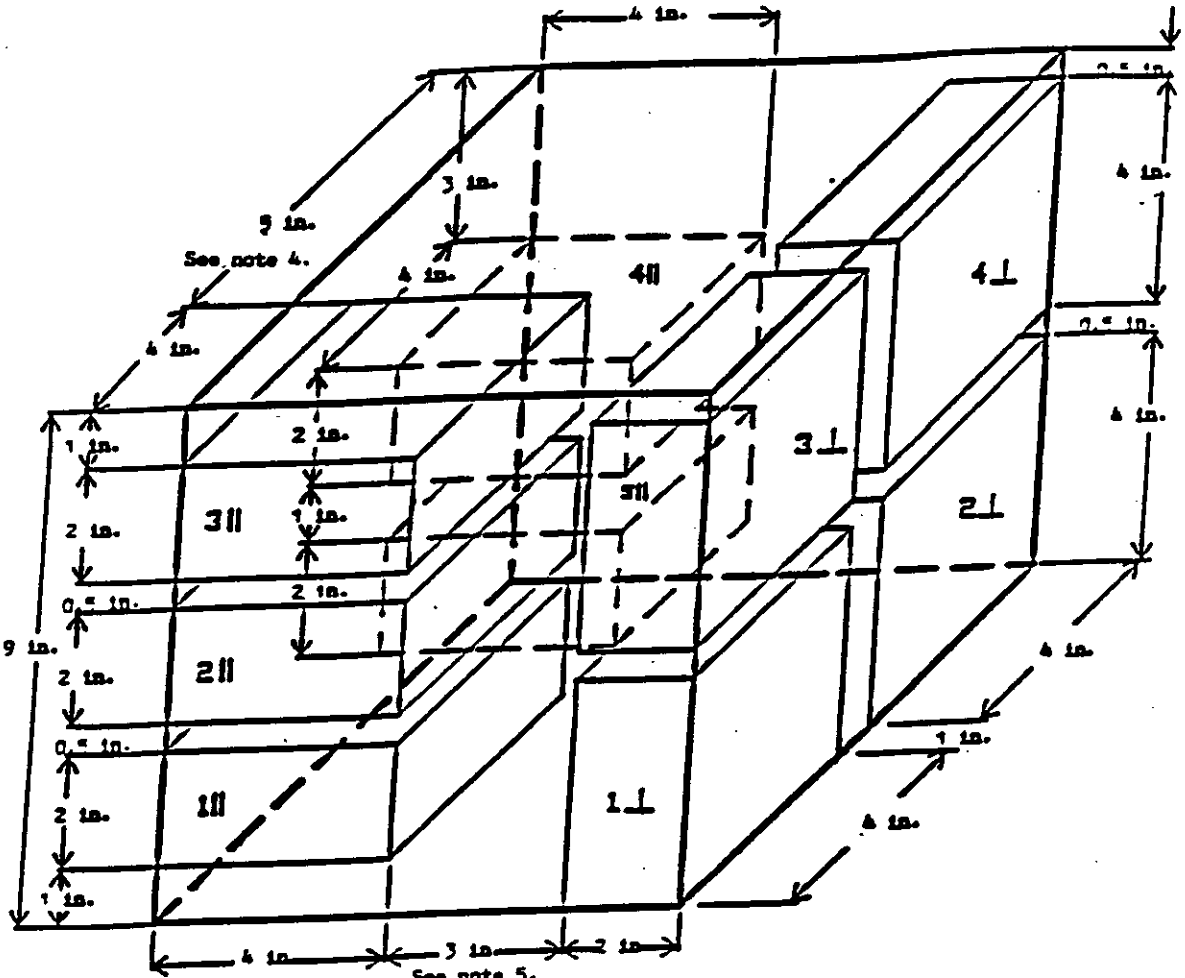


FIGURE 4. Example of orientation of foam samples.



NOTES:

1. This is a suggested method only for cutting class 1 samples.

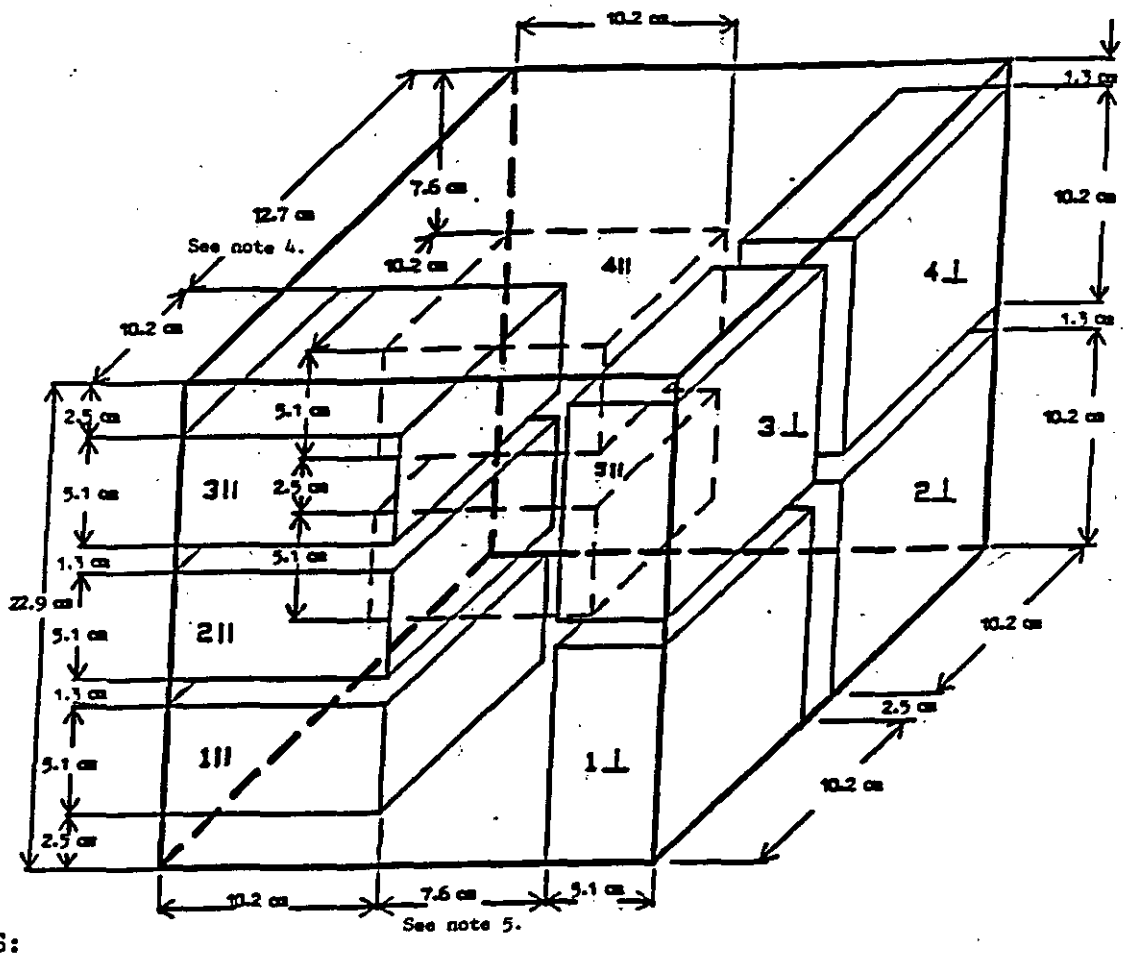
2. 12 in. x 12 in. x 12 in. less 1.5 in. off each face.

3. Use 9 in. x 9 in. x 9 in. trimmed block for density measurement.

4. This section is 5 in. x 4 in. x 3 in. (L x W x H). Friability, water absorption, and oil resistance samples are taken from here.

5. This section is 9 in. x 3 in. x 9 in. (L x W x H). The 5th perpendicular compression set sample and combustibility samples are taken from here.

FIGURE 5. Class 1, 12 in. x 12 in. x 12 in. individual pour block trimmed to 9 in. x 9 in. x 9 in.



NOTES:

1. This is a suggested way only for cutting class 1 samples.
2. 30.5 cm x 30.5 cm x 30.5 cm less 3.8 cm off each face.
3. Use 22.9 cm x 22.9 cm x 22.9 cm trimmed block for density measurement.
4. This section is 12.7 cm x 10.2 cm x 7.6 cm (L x W x H). Friability, water absorption, and oil resistance samples are taken from here.
5. This section is 22.9 cm x 7.6 cm x 22.9 cm (L x W x H). The 5th perpendicular compression set sample and combustibility samples are taken from here.

FIGURE 5. Class 1, 30.5 cm x 30.5 cm x 30.5 cm individual pour block trimmed to 22.9 cm x 22.9 cm x 22.9 cm - Continued.

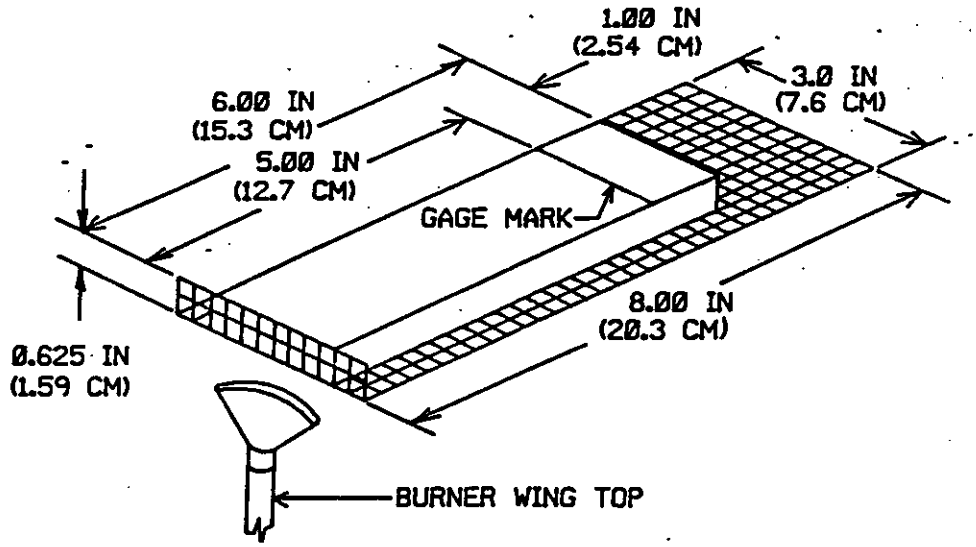


FIGURE 6. RELATIVE POSITIONS OF BURNER WING TOP, SPECIMEN AND SPECIMEN SUPPORT

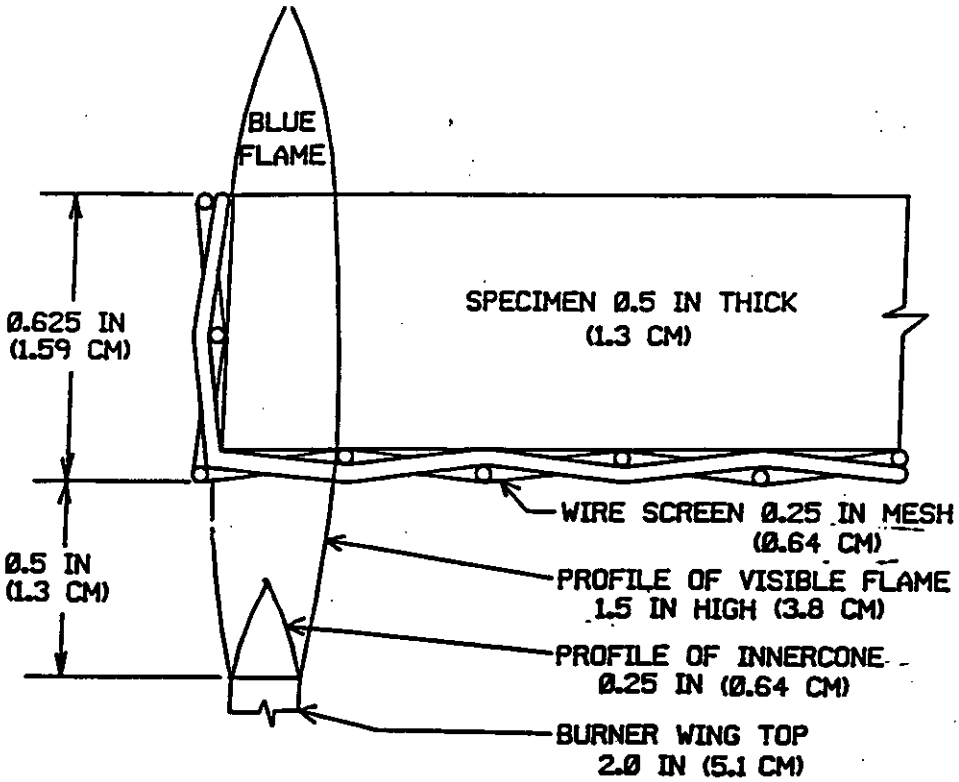


FIGURE 7. RELATIVE POSITIONS OF BURNER WING TOP, FLAME, SPECIMEN AND SPECIMEN SUPPORT.

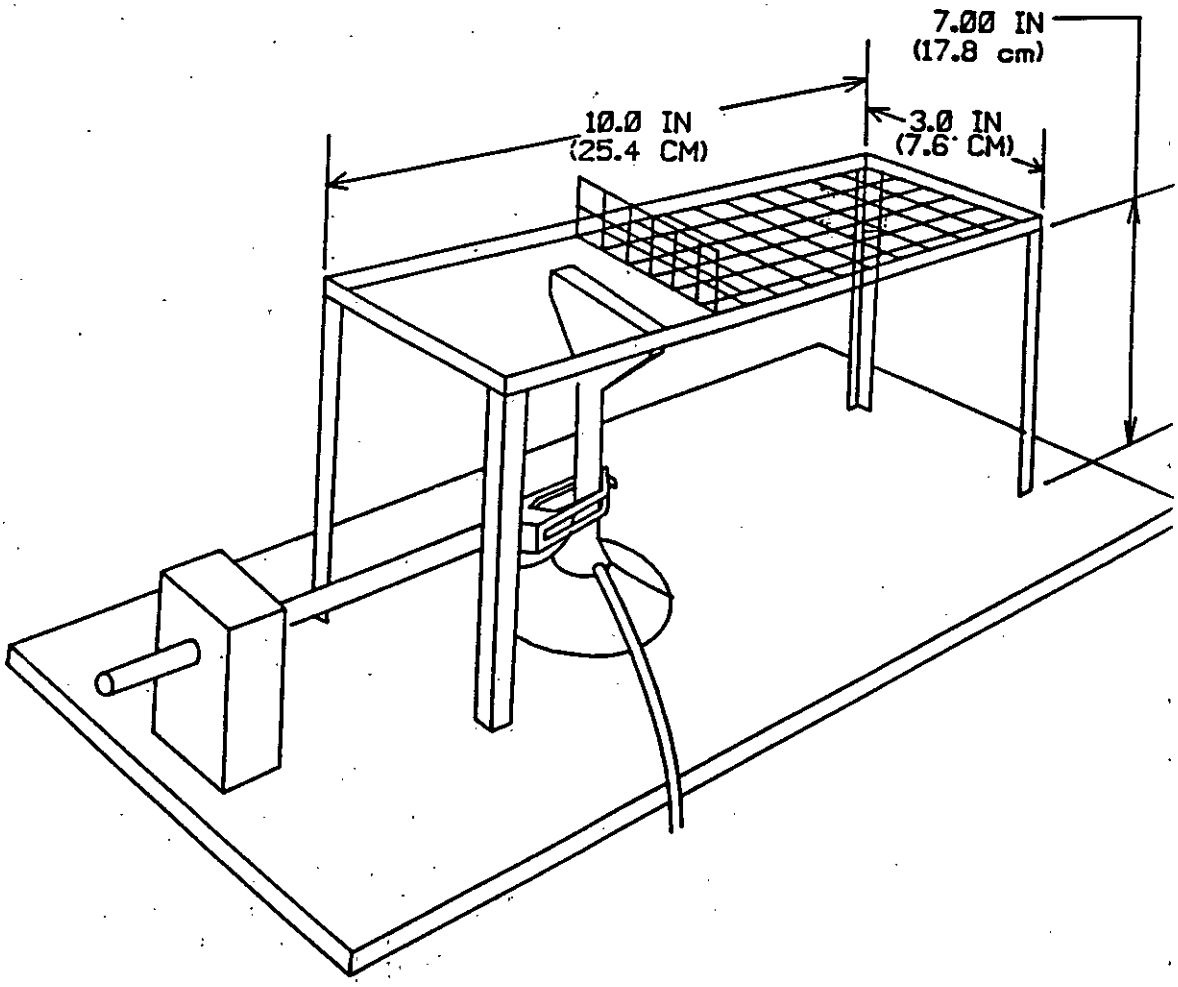


FIGURE 8. APPARATUS FOR SUPPORT OF SPECIMEN.

Custodians:
Army – SM
Navy – SA
Air Force – 69
DLA - DH

Review activities:
Army - AL, AT, EA, MD, ME, MI
Navy - AS, EC, SH
Air Force - 11, 71, 82, 84, 99
DLA - GS, ES

User activities:
Army – AV, CR, ER, MR, MT
Navy – YD

Preparing activity:

Air Force - 69

(Project 8135-0651)

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 contractiual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD)
	MIL-F-83671A	93/09/15

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	b. TELEPHONE (Include Area Code)	
SUSAN J. MISRA, Materials Engineer	(1) Commercial 513-257-4519	(2) AUTOVON 787-4519
c. ADDRESS (Include Zip Code) HQ AFMC/LGTPM 5215 THURLOW ST BLDG 70 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	