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(SEE SECTION 6)

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 6.4):

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)

2. APPLICABLE DOCUMENTS

2.1 Government Documents.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Air Force Packaging Evaluation Agency, HQ AFLC/DSTZ, Wright-Patterson AFB OH 45433, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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* 2.1.1 Specifications and Standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

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

MILITARY

MIL-F-45216	Foam-In-Place Packaging, Procedures for
MIL-F-87075	Foam-In-Place Packaging Systems, General Specification for

STANDARDS

FEDERAL

Fed Test Method Std No. 101	Test Procedures for Packaging Materials
FED-STD-595	Colors (Requirements for Individual Color Chips)

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

(Copies of military specifications, standards, drawings and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.1.2 Other Government Documents, Drawings and Publications. The following other Government documents, drawings and publications form a part of this specification to the extent specified herein.

DEPARTMENT OF TRANSPORTATION (DOT): Title 49, Code of Federal Regulations, Parts 100-199.

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA): Occupational Safety and Health, Volume I, General Industry Standards and Interpretations, Parts 1910, Subpart Z.

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

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2.2 Other Publications. The following document(s) form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DOD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)

ASTM-C421-77	Tumbling Friability of Preformed, Block-Type Thermal Insulation, Standard Test Method for
ASTM-D471	Rubber Property - Effect of Liquids, Test Method for
ASTM-D1596-78	Shock Absorbing Characteristics of Package Cushioning Materials, Standard Test for
ASTM-D1621-73	Plastics, Rigid Cellular, Compressive Properties of Rigid Cellular Plastics, Standard Test Method for
ASTM-D1623-78	Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics
ASTM-D1638-74	Urethane Foam Isocyanate Raw Materials of Testing, DOD Adopted
ASTM-D2126-75	Response of Rigid Cellular Plastics to Thermal and Humid Aging, Standard Test Method for, DOD Adopted
ASTM-D3951-82	Standard Commercial Packaging, Practice for
ASTM-E96-80	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 specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 First Article Inspection. This specification makes provisions for first article inspection (see 4.4.3).

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 diphenyl methane diisocyanate compounds) and component B (polyol compounds) suitable for mixing in foam equipment meeting the requirements of MIL-F-87075 and using foam procedures specified in MIL-F-45216. Methylene diisocyanate (MDI) is a commonly used misnomer for diphenyl methane diisocyanate and

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methylene bisphenylisocyanate. 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.

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, and handling instructions and precautions. Also, 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.

3.2.2 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 listed as cancer suspect agents in Part 1910, Subpart Z of Volume I, General Industry Standards and Interpretations of Occupational Safety and Health. The absence of toluene diisocyanate and toluene diisocyanate derivatives shall be determined prior to the initial mixing of components for first article testing. Testing shall be in accordance with 4.5.3.13.

3.2.3.2 Airborne Isocyanate. Unless otherwise specified, the requirements of 3.2.3.2.1 shall apply to formulations procured by activities other than Navy. Navy procurements shall be in accordance with the requirements of 3.2.3.2.2.

3.2.3.2.1 Maximum Concentration. The maximum methylene diisocyanate concentration in the test chamber, when tested in accordance with 4.5.3.14.1, shall not exceed forty parts per billion.

3.2.3.2.2 Methylene Diisocyanate Determination (NAVY). For Navy procurements, the manufacturer or supplier shall:

a. Disclose the complete information of the product via material safety data (OSHA Form 20) in sufficient detail to permit an accurate appraisal of the likelihood of generation of MDI and other toxic gases, vapors, aerosols, etc., during any anticipated utilization of the product.

b. Provide specific precautionary measures to ensure safe use of the product. The specific precautionary measures shall be included in all shipments of the material, and, in addition, shall be shown as an addendum to the material safety data sheet (OSHA Form 20).

c. Forward the OSHA Form 20 to the address specified in 6.12.

TABLE I - PROPERTIES

CHARACTERISTICS	CLASS 1 (Rigid)	CLASS 2 (Flexible)		CLASS 3 (Semi-Rigid)
		GRADE A	GRADE B	
[1]Conditioning Temp. °F, Range 60 to Specified Temperature	85 (Comp A) 85 (Comp B)	90 (Comp A) 90 (Comp B)	95 (Comp A) 75 (Comp B)	75 (Comp A) 75 (Comp B)
[2]Viscosity, cps (max) @ 77°F (25°C)	1000 (Comp A) 1250 (Comp B)	1000 (Comp A) 1250 (Comp B)	1000 (Comp A) 1250 (Comp B)	1000 (Comp A) 1250 (Comp B)
Mixing Ratio (by volume)	1.0 to 1.0 ± 0.1	1.0 to 1.0 ± 0.1	1.0 to 1.0 ± 0.1	1.0 to 1.0 ± 0.1
[3]Cream Time, seconds (max)	40	5	30	5
[3]Rise Time, seconds (max)	90	30	90	20
[3]Tack Free Time, seconds (max)	120	120	120	25
[4]Reaction Temperature, °F (max)	325	300	300	275
Cure time to obtain 90% of all mechanical properties except compression set	1 hr max	4 hrs max	4 hrs max	4 hrs max
Cure time to attain compression set requirements of 3.7		24 hrs max	24 hrs max	24 hrs max

FOOTNOTES:

[1]See 3.2.1

[2]See 4.5.3.1

[3]See 6.7

[4]See 3.16 and 4.5.3.1

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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 6.5).

3.4.1 Class 1. After aging in accordance with 4.5.3.2, the minimum compressive strength at yield or 10 percent deflection, whichever is first to occur, shall not vary more than 10 percent from the values obtained prior to aging (see 4.5.3.9 and 6.4).

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 4.5.3.2.1.

3.5 Water Absorption (Class 1). Maximum water absorption by weight 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 be 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 $50^{o}F$ and $95^{o}F$) 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 homogenous and contain no knit lines.

b. Maximum allowable diameter of blow holes is 0.5 inch. The concentration of 0.5 inch diameter blow holes shall not exceed one in 16 square inches (4 inches x 4 inches).

3.11 Cold Temperature Stability (Class 1). The average linear change when tested in accordance with 4.5.3.15 shall not exceed 5 percent.

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3.12 Volume Change. The change in volume of the urethane foam after aging shall not be greater than 7 percent of the initial volume 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 test specimen shall not advance to or beyond the 5-inch gage mark specified in the test. There shall be no visual evidence of burning or melting of the specimen at or beyond the 5-inch 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 - 20psi parallel and 12psi perpendicular to the direction of foam rise.

Category 2 - 30psi parallel and 15psi perpendicular to the direction of foam rise.

When 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, 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 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 point. A minimum of three peak G-static stress points shall be required to establish conformance of the Class 3 material, one at .03psi (20.7 x 10 Pa), one at .06psi (41.4 x 10 Pa) and one at .125psi (10.3 x 10^2 Pa) (see 6.3).

3.16 Maximum Reaction Temperatures. The maximum reaction temperature shall not be greater than values listed in Table I (see 4.5.3.12).

3.17 Friability. When tested in accordance with 4.5.3.16, the cured foam product shall not have a weight loss greater than 14 percent for specimens prepared by machine dispensing equipment.

3.18 Tensile Strength (Class 1). When specified (see 6.2), the test specified in 4.5.3.17 shall be performed. The tensile strength shall be 35psi minimum on parallel specimens and 28psi minimum on perpendicular specimens.

3.19 Moisture Vapor Permeability (Class 1). When specified (see 6.2), the test specified in 4.5.3.18 shall be performed. The maximum moisture vapor permeability shall be 3 perm-inches.

3.20 Oil Resistance (Class 1). When specified (see 6.2), the test specified in 4.5.3.19 shall be performed. There shall be no softening of the oil immersed samples.

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TABLE II - FIRST ARTICLE TEST REQUIREMENTS AND METHODS

PROPERTIES	REQUIREMENTS CLASS 1	CLASS 2	CLASS 3	TEST METHOD
Toxicity (Chemicals)	3.2.3.1	3.2.3.1	3.2.3.1	4.5.3.13
Toxicity (Airborne)	3.2.3.2.1	3.2.3.2.1	3.2.3.2.1	4.5.3.14.1
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			4.5.3.15
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
Viscosity	Table I	Table I	Table I	4.5.3.11
Max. Reaction Temp.	3.16 & Table I	3.16 & Table I	3.16 & Table I	4.5.3.12
Friability	3.17	3.17	3.17	4.5.3.16
Tensile Strength (when specified by procuring activity)	3.18			4.5.3.17
Moisture Vapor Permeability (when specified by procuring activity)	3.19			4.5.3.18
Oil Resistance (when specified by procuring activity)	3.20			4.5.3.19

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4. QUALITY ASSURANCE PROVISIONS

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

4.2 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.

4.3.1 Lot. For purposes of sampling, a lot shall consist of all component A from the same batch along with an equal 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.

4.3.2 Sampling for Inspection of Filled Containers. Sampling shall 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 shall be made for fill, leakage, marking and workmanship.

4.3.2.1 Sampling for Testing. The inspector shall select at random two containers of component A from each lot (see 4.3.1). From each of the two containers, two quart samples shall 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 one to one (±10 percent) component ratio by volume (Table I) or the procuring activity's authorized component ratio shall be similarly selected, packaged and identified.

4.4 Inspection and Tests.

4.4.1 Inspection of Containers at Contractor's Plant. Each sample container specified in 4.3.2 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; and if the number of defective containers in any sample exceeds the acceptance number of the appropriate sample plan of MIL-STD-105, the lot represented by the sample shall be rejected. Rejected lots may be resubmitted for acceptance tests, provided the manufacturer has repaired or removed all nonconforming products and the following requirements are met:

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a. The government organization approves the resubmittal.

b. A new lot number is used.

c. The entire test sequence is repeated to assure that the change or modification has not altered other characteristics.

4.4.2 Waiving of First Article Inspection. The first article inspection may be waived at the prerogative of the government provided the contractor submits certified data that components of the same formulation have been recently tested and accepted under the provisions of 4.4.3 of this specification and the material will conform to the requirements of this specification.

4.4.3 First Article Inspection. First article inspection shall consist of the tests of Table II 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.

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 Acceptance Tests. Acceptance tests shall consist of the tests of Table III. Materials from 4.3.2.1 shall be used for the combustibility test and density test.

TABLE III - ACCEPTANCE TEST REQUIREMENTS

PROPERTIES	TEST METHOD PARAGRAPH
Density (when required)	4.5.3.1
Combustibility	4.5.3.8
Color Coding (drums or canisters)	Visual (5.4.4)

4.5 Testing. The tests specified in Tables II and III shall be performed to assure compliance with the requirements of section 3. No material shall be tested until the absence of TDI has been verified in accordance with 3.2.3.1 and 4.5.3.14.

4.5.1 Preparation of Test Specimens. Foams shall comply with mixing requirements of 3.2.1. Sample foam shall be poured into 12 x 12 x 12 inch or larger fiberboard containers lined with polyethylene sheet material and allowed to free rise. Sample pours shall be cured a minimum of 24 hours before preparing test specimens. The specimens material shall be taken from the center section

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of the bun and include no material within 1½ inches of the sides, bottom or top of the bun. The specimens selected shall be homogenous with no knit lines in the material or holes larger than 0.5 inch in diameter. The concentration of 0.5 inch diameter holes shall not exceed one in 16 square inches (4 inches x 4 inches).

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

4.5.1.2 Specimen Measurement Procedure. Unless otherwise specified, test specimens shall be rectangular, having dimensions of 8 inches x 8 inches x 3 inches. The length and width of the specimens shall be measured at the center lines to the nearest 0.05 inch. The specimen shall be placed on a flat, level surface and loaded with a rigid, flat plate having a weight sufficient to load the specimen to 0.025 ± 0.005 pound per square inch ($1.72 \times 10^2 \pm 34$ Pa). Thirty seconds after application of the loading plate, the vertical distance between the base surface and the bottom of the plate shall be measured to the nearest 0.01 of an inch at each of the four corners. 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.

4.5.2 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 ± 5 percent relative humidity for at least 16 hours before being tested.

4.5.3 Test Methods.

4.5.3.1 Density. Three specimens shall be prepared in accordance with 4.5.1, the thickness of each specimen determined in accordance with 4.5.1.2 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

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.

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4.5.3.2 Hydrolytic Stability. The test specimens shall be exposed for 14 days at 158°F ± 2°F (70°C ± 1.1°C) and 95 percent ± 5 percent relative humidity. After exposure, the specimens shall be subjected to 120°F ± 2°F (49°C ± 1.1°C) in a mechanically covected dry air oven for 24 hours and then to the conditions specified in 4.5.2 for a minimum of 30 minutes. After conditioning, Class 1 materials shall conform to the requirement of 3.4.1. The Classes 2 and 3 materials shall conform to the requirement of 3.4.2.

4.5.3.2.1 Load Deflection (Classes 2 and 3). Three test specimens shall be prepared in accordance with 4.5.1 and placed in a compression machine (Instron Compression Tester or equal) or a weight-increment type device. The specimens shall be preworked prior to testing. Preworking shall consist of compressing the specimens between parallel rigid plates. For Class 2 and 3 foams, compression shall be 40 percent of their original measured thickness. Compress a total of 10 times at a rate of 10 to 20 inches (25.4 to 50.8 cm) per minute. Three minutes after completion of the last compression, the thickness of the specimen shall be measured to nearest one-hundredth of an inch (0.03 cm) after preloading to 1.6 lb (0.73 kg). The thickness after prework shall be used as the zero deflection point. The specimens shall be loaded at a rate of 0.20 inch per minute. The load shall be recorded at 20 and 40 percent strains, based on the thickness at the start of loading. If a weight-increment device is used, the deflection shall be determined approximately 30 seconds after the application of an incremental change in load. Equal numbers of specimens shall be compressed both parallel and perpendicular to the direction of rise.

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 Federal Test Method Standard No. 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 ± 1/8 inches (10.16 ± 0.3 cm) square by 1 ± 1/8 inch (2.54 ± 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 ± 1 hours.

4.5.3.4 Determination of Creep (Classes 2 and 3). Three specimens, 6 inches x 6 inches x 3 inches, shall be prepared in accordance with 4.5.1 and preworked in accordance with 4.5.3.2.1. Three minutes after the last compression, the thickness of each specimen shall be measured with a 1.6 lb (0.73 kg) preload, in accordance with paragraph 4.5.1.2. The test specimens shall be loaded to 20 percent initial strain. One hour after continuous loading, the thickness shall be measured and recorded as t_i (initial thickness loaded), for the determination of creep. The specimens shall remain under constant load and thickness measurements recorded approximately every 24 hours for a total of four 24-hour increments, or until the variation between two successive measure-

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ments does not exceed 1 percent of the initial thickness (t_i). The final measurement 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)
T_f = final thickness after 4 hours in unloaded condition

The results shall not exceed the requirements of 3.7.

4.5.3.6 Pliability (Classes 2 and 3). The dimensions of each specimen shall be 6 inches x 6 inches x ½ inch (15.2 x 15.2 x 1.3 cm). The thickness tolerance shall be ± 1/16 inch (0.2 cm). The thickness shall be parallel to the direction of rise as indicated by the axes of voids which are approximately parallel to the thickness. As rapidly as possible, each of three specimens shall be bent 180° around a cylinder having a ½ inch (1.3 cm) diameter. 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 the temperature or, if not practical, within 5 seconds after removal from the low temperature environment. The specimens shall be examined for conformance with 3.8.

4.5.3.7 Volume Change. Three test specimens shall be measured and the volume calculated and recorded. They shall then be subjected to the temperature and humidity conditions only, specified in 4.5.3.2, and remeasured. The volume change shall be calculated, expressed as a percent of the initial volume and examined for conformance to 3.12. Volume for materials shall be measured after the foam is allowed to cure for 24 hours.

4.5.3.8 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 3.13. A test shall consist of determining the extent of burning of at least five foam samples. Samples shall be cut from sections at least 1½ inches from exterior surfaces. The length of each sample shall be perpendicular to the direction of rise.

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4.5.3.8.1 Apparatus.

a. Test Chamber - Any enclosure is satisfactory that is large enough to provide quiet draft-free air around the specimen during test, yet will permit normal thermal circulation of air past the specimen during burning. A hood is recommended in order to remove the sometimes noxious products of combustion. If a test chamber is used, it should be of such a design that it can be used in a hood. For referee purposes, test results with the chamber should be the same whether or not the hood exhaust is on. In cases of discrepancy, values obtained with the damper closed or the hood fan off, or both, will be considered valid. The recommended test chamber should be constructed of sheet metal or other fire-resistant material, having inside dimensions 12 inches wide, 24 inches long, 30 inches high, open at the top, with a ventilating opening approximately 1 inch high around the bottom. A viewing window of heat-resistant glass should be of sufficient size and in such a position that the entire length of the specimen under test may be observed. The chamber should be readily opened and closed to facilitate mounting and ignition of the test specimen.

b. Burner - A standard 3/8 inch outside diameter barrel Bunsen or Tirrill burner fitted with a 2 inch width wing top. The wing top may have to be opened to approximately 1/8 inch to provide the flame required in Figure 5.

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 inches x 8 inches shall have a 5/8 inch of length bent to form a right angle. This will form the specimen support as shown in Figure 4.

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 ½ inch above the top of the burner wing top, as shown in Figure 4. 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 ± 1/16 inches wide by 6 ± 1/16 inches long are needed.

b. Material thickness shall be 1/2 ± 1/16 inch.

c. Each test specimen shall be marked across its width by one line 5 inches from one end.

4.5.3.8.3 Conditioning. Specimens shall be conditioned prior to test for a minimum of 24 hours in an atmosphere having a temperature of (73.4 ± 4°F) (23 ± 2°C) and a relative humidity of 50 ± 5 percent. Tests shall be made in this atmosphere or immediately after removal therefrom.

4.5.3.8.4 Procedure. See Figures 4, 5 and 6.

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a. Clamp the wire cloth specimen support horizontally so that the bottom of the wire cloth is ½ inch above the top of the burner wing top as shown in Figure 4. 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 inches and 8 inches. 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 tests 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 inch 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 inches away from the bent-up end.

c. Adjust the burner with the wing top to provide a blue flame whose visible portion is 1½ inches high with a clearly defined inner cone ¼ inch 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, remove the burner at least 6 inches away from the test specimen. If the flame goes out before reaching the gage mark, the extent of burning is equal to 5 inches 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 inch. Note burning characteristics such as expansion as a result of heating, melting or dripping. Also record if the dropping on the foil burns. In some cases, the burning may cease in the first 60 seconds. This is 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 in any one of the five specimens, the sample shall be judged as burning. This indicates the failure of the lot.

b. If the flame front does not reach the gage mark for all 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 sample was consumed completely.)

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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 inches - 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 inch.

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 24-hour cure time, five specimens 4 inches x 4 inches x 2 inches (10.2 x 10.2 x 5.1 cm) shall be prepared from each of three 12 inch x 12 inch x 12 inch (30.5 x 30.5 x 30.5 cm) single-pour blocks of foam such that the depth dimensions of 2 inches (5.1 cm) are parallel to the direction of foam rise. Those specimens shall then be tested for compressive strength values at yield or 10 percent deflection, whichever occurs first. Additionally, five specimens 4 inches x 4 inches x 2 inches (10.2 x 10.2 x 5.1 cm) shall be cut from each of the same three sample blocks such that the depth dimensions of 2 inches (5.1 cm) are perpendicular to the direction of foam rise, then tested as with the initial fifteen specimens. Failure of the average compressive strength value, recorded for each set of five specimens, to conform to the requirement of 3.4.1 and 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 inches (61.0 cm) shall be established in accordance with ASTM-D1596 with exceptions specified herein.

4.5.3.10.2 Specimens. Specimen dimensions shall be 8 inches x 8 inches x 3 inches ± 0.125 inch (20.3 x 20.3 x 7.6 ± 0.3 cm). Three specimens shall be cut from a bun of material which has been prepared in accordance with 4.5.1. Specimen thickness will be in the direction of the foam rise and will be determined in accordance with 4.5.1.2.

4.5.3.10.3 Preworking. Each specimen shall be preworked in accordance with 4.5.3.2.1. Specimen shall be rested for at least 16 but not more than 72 hours before conducting 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 inches (7.6 cm) before starting the dynamic test procedure. Impact tests shall be so conducted on each specimen so that the dropping head compresses the specimen at an initial velocity of 136 ± 2 inches (345.4 ± 5.1 cm) per second. 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

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stress point and the drop test procedure repeated. This procedure shall be repeated until the qualifying test values have been obtained. Material samples will be replaced if the material exceeds a 10 percent set during testing or is degraded in any other manner.

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 Viscosity of Components. The viscosity of urethane foam components shall be determined in accordance with ASTM-D1638 and examined for conformance to the requirements in Table I.

4.5.3.12 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 inch x 12 inch x 12 inch (30.5 x 30.5 x 30.5 cm) corrugated fiberboard, single wall, domestic container, conforming to PPP-B-636. A 2 mil polyethylene film shall line the inside surface 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 and completely fill the container. The temperature shall be monitored for two hours, and the peak temperature recorded (see requirements in 3.16).

4.5.3.13 Toluene Diisocyanate Determination. Analyses of "as received" chemicals (component A) to determine the concentrations of TDI and TDI derivatives shall be conducted. Approved methods include the following:

a. Determination of Free Toluene Diisocyanate in Toluene Diisocyanate - Trimethylol Propane Adducts by The National Analine Division of Allied Chemical Corporation.

b. Detection of Free Isocyanate by Gas Chromotography with an Internal Standard by The Mobay Chemical Corporation.

(Copies of the above cited test methods are available upon request from the Air Force Packaging Evaluation Agency, HQ AFLC/DSTZT, Wright-Patterson Air Force Base, Ohio 45433.)

4.5.3.14 Airborne Toxicity. Methylene Diisocyanate (MDI) concentrations shall be determined by methods and procedures described in 4.5.3.14.1 through 4.5.3.14.4.

4.5.3.14.1 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 having integrating capability (see 4.5.3.14.1.2). The essentially air-tight chamber may vary in size from 27 $feet^3$ to 535 $feet^3$. 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 is 1 cubic foot per 17 seconds or 3.53 $feet^3$/minute (see 3.2.3.2.1).

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4.5.3.14.1.1 Description of Test Chamber. The test chamber shall conform to the volume limitations of 4.5.3.14.1. Although any air-tight enclosure will be acceptable for the purposes of this test, a suggested simple construction for the conducting of the test is a wood frame structure covered with clear polyethylene film of 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 inch x 4 inch port hole, with overlapping cover, to be used as a foam dispensing opening. The port hole should be centered 18 inches 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 inches 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 inch 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 6.11.

4.5.3.14.1.2 Instrumentation for MDI Determination. The diisocyanates monitor with integration/recording capability 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 4.5.3.14.1. A continuous diisocyanates monitor with a range of 0 to 80 ppb MDI shall be used. Audio and visual alarms are activated when MDI concentrations exceed a preset level. Concentrations in ppb are visually displayed and are also recorded. Capability is provided for integration of the concentration data. Technical information is available from the manufacturer, MDA Scientific, Inc., 1815 Elmdale Avenue, Glenview, Illinois 60025.

4.5.3.14.1.3 Pretest Operations. At least 24 hours prior to testing foam in accordance with 4.5.3.14.1.4, dispense foam at the nominal production rate and determine dynamic cushioning characteristics in accordance with 3.15 and 4.5.3.10. Dispensing rates and settings during production and testing sequences shall be identical. Dispense adequate foam in properly ventilated area to determine that the foam dispensing unit is operating properly. Prior to positioning the monitor in the test chamber, calibrate the monitor by removing tape cassette and using the calibration card per manufacturer's instructions. A properly functioning monitor will indicate zero concentration in an isocyanate free atmosphere.

4.5.3.14.1.4 Test Procedure. To protect instrumentation, place in a clear plastic bag providing openings for the monitor's inlet and outlet tubes. 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. Turn on monitor at least 20 minutes before test sequence. Position 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 edges of the 4 inch x 4 inch cover for the foam dispensing opening. Start the circulating fan. Mark the integrator chart to identify point at which test was initiated and record time when the test begins. Dispense a predetermined amount of foam chemicals, as prescribed in 4.5.3.14.1, into the polyethylene lined box, taking care to distribute the foam evenly over the bottom surface of the box.

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If required, seal visible leaks in test chamber with tape. Mark chart to indicate end of test 12 minutes after start of test. Open chamber. Record the maximum charted concentration that occurred during the test period. Prior to running another sample, be certain that the vapors from previous test have been dispersed. To ensure that proper foaming action has occurred, determine dynamic cushioning characteristics of the test bun in accordance with 3.15 and 4.5.3.10.

4.5.3.15 Cold Temperature Stability (Class 1). Five samples, having thicknesses perpendicular to the direction of foam rise, shall be tested and examined for conformance to the requirements of 3.11. Cold temperature stability shall be determined in accordance with procedure "E" of ASTM-D2126-75 at a test temperature of -40 ± 6°F (-40 ± 3°C).

4.5.3.16 Friability. Twelve samples shall be tested and examined for conformance to 3.17. Friability shall be determined in accordance with the tumbling technique of ASTM-C421-77 with the following modification: The drying temperature of ASTM-C421, paragraph 5.3, shall be 220 to 235°F.

4.5.3.17 Tensile Strength (Class 1). When tensile strength has been specified by the procuring activity, three samples shall be prepared for parallel tests and an equal number for perpendicular tests. The applicable requirements are in 3.18. Tests shall be conducted in accordance with ASTM-D1623-78. Type A or Type B test specimens shall be used.

4.5.3.18 Moisture Vapor Permeability (Class 1). Three, 3-inch thick test specimens, from which the skins have been removed, shall be tested. Thickness shall be parallel to the direction of rise. Tests shall be performed in accordance with ASTM-E96-80, Procedure A of XI with the following exceptions:

a. The thickness of the test sample shall be 3 ± 1/8 inches.

b. The specimen holder shall have a diameter of 5 3/4 inches ± 1/4 inch 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.

4.5.3.19 Oil Resistance.

4.5.3.19.1 Sample Preparation. A foam bun having minimum dimensions of 12 inches x 12 inches x 12 inches shall be poured. The bun shall be trimmed by removing at least 2 inches of material from all sides and 3 inches of material from the top and bottom. A circular die having an inside diameter of 1 1/8 inch shall be used for cutting five specimens having a thickness of one inch. These 1 inch x 1/18 inch diameter test samples shall be conditioned for at least 24 hours at 73.4 ± 1.8°F and 50 ± 5 percent relative humidity (R.H.).

4.5.3.19.2 Test Procedure. Four specimens prepared and conditioned in 4.5.3.19.1 shall be immersed in No. 2 reference oil of ASTM-D471 at 73.4 ± 1.8°F. The test room or chamber shall be maintained at 50 ± 5 percent R.H. After 70 ± 1 hours, the specimens shall be removed, lightly blotted and compared with the specimen conditioned in 4.5.3.19.1 which has not been immersed in the oil. Evidence of softening or degradation shall constitute failure of the sample(s) representing the lot.

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4.6 Inspection of Packaging.

4.6.1 Quality Performance Inspection.

4.6.1.1 Unit of Product. Filled and sealed drums 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. AQL shall be 2.5 percent defective.

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

102. Size of drums not as specified.

103. Containers not blanketed with dry nitrogen as specified.

104. Marking missing, incorrect, illegible.

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

5. PACKAGING

5.1 Preservation. Not applicable.

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

5.2.1 Level A. The liquid components A and B shall be separately packed in closed head drums conforming to DOT specification 17C, 5B or canisters conforming to DOT 39 of Title 49 of the Code of Federal Regulations. The capacity shall be as specified (see 6.2). The containerized chemicals shall be blanketed with dry nitrogen conforming to BB-N-41, not to exceed 3psi (20.7×10^3 Pa).

5.2.2 Industrial. Industrial packing shall be in accordance with ASTM-D3951-82.

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

5.4 Marking.

5.4.1 Level A. 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.

5.4.2 Industrial. Industrial marking shall be in accordance with the requirements of ASTM-D3951-82. In addition, weight and cube data shall be marked on each shipping container.

5.4.3 Labels. Each container shall be marked on the sides, using waterproof labels, with the following information:

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a. Gross and net tare weight (pounds).

b. Manufacturer's name and address.

c. Classification (class and grade).

d. Handling precautions: Each container of isocyanate shall have the following label:

CAUTION: HARMFUL IF INHALED, MAY CAUSE ALLERGIC RESPIRATORY REACTION, SKIN IRRITATION. Use appropriate protection as designated by responsible industrial hygiene personnel.

Do not get in eyes, on skin, on clothing.
Do not breath vapors.
Keep container closed.
Use with adequate ventilation.
Avoid water contamination.

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

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

g. Mixing ratio by weight and volume.

h. Manufacturer's batch or lot number.

i. Operation and storage temperature ranges.

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

k. The following notation: "FLAME RESISTANT".

l. 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."

5.4.4 Color Coding. All containers shall be color coded on the top and sides as follows:

a. "A" component: Red or Yellow.

b. "B" component: Blue.

6. NOTES

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 therein from damage by shocks or impacts incurred during shipment and handling.

6.2 Ordering Data. The following ordering data shall be specified:

a. Title, number and date of this specification.

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b. Class, grade and category (see 1.2).

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

d. Hydrolytic stability - state if not required (see 3.4 and 6.5).

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

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

g. Pliability - state if not required (see 3.8) (Classes 2 and 3).

h. Minimum compressive strength, if other than as specified in 3.14 (Class 1 - see 6.4).

i. Tensile strength - specify if required (see 3.18) (Class 1).

j. Moisture vapor permeability - specify if required (see 3.19) (Class 1).

k. Oil resistance - specify if required (see 3.20) (Class 1).

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

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

n. Indicate level of packing (see 5.2).

o. Indicate capacity of container (see 5.2.1).

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

q. Indicate marking requirements (see 5.4).

6.3 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. The three foams are not based on specific material densities. Formulations and differences in component ratios and sizes of open and closed cells have been found to be more significant than density.

6.4 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 kg/m^3). If a different density material is specified, the compressive strengths should also be specified. For MIL-F-45216, Technique VII encapsulated pack, the 2 pounds per cubic foot (2pcf) Category 2 foam is required. It possesses the higher minimum compressive strengths of 30psi parallel to the direction of rise and 15psi perpendicular to the direction of rise.

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6.5 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 ether formulations. Procuring activities may waive the hydrolytic stability requirements of 3.4.

6.6 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 lbs/cu ft is being procured, the maximum reaction temperature should be specified by the procuring activity.

6.7 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 semi-cured foam may be touched lightly without stickiness.

6.8 Storage Information. The minimum acceptable shelf life of the foam chemicals is one year when the storage temperature remains in the 50 to 95°F conditioning temperature range. The nominal freezing points of isocyanates are approximately 20°F. Some materials have been usable following prolonged storage in the -10 to +10°F range. As a guide, prolonged exposure to 20°F above the 95°F maximum normally halves the shelf life. Exposure to temperatures 20°F below 50°F, the 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 to 95°F conditioning range.

6.9 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 5.4.3.

6.10 Maximum Isocyanate Concentration. The forty parts per billion value cited in this specification is based on correlation of test results with simulated production operations. The National Institute for Occupational Safety and Health (NIOSH) recommendations for maximum methylene diisocyanate (MDI) concentrations were adhered to during the simulated production tests. The applicable US Department of Health and Human Services document is The Summary of NIOSH Recommendations for Occupational Health Standards, October 1978. The NIOSH recommended threshold limit value ceiling (TLV-C) for isocyanates is 20 parts per billion. It is a maximum concentration that should never be exceeded in production operations. Of equal importance is the Time Weighted Average (TWA) for the same chemicals. The TWA is the nominal safe exposure limit based on an eight hour day, 40 hour week. NIOSH considers the TWA and lower concentrations of isocyanates acceptable working environments. The TWA for isocyanates is 5 parts per billion. During the correlation tests, an approved foam was dispensed in an acceptable foam-in-place installation and the TWA for isocyanates did not exceed 3 parts per billion. The TWA is 5 parts per billion. During these foam-

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ing operations, a constant face velocity of 157 feet per minute was maintained. The foaming rate was 5.3 pounds per minute.

6.11 Materials for Test Chamber. Following are some of the materials and equipment suitable for use in the test method of 4.5.3.14.

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

b. Plastic sheeting, polyethylene, .002 inch x 72 inches x 1700 inches, NSN 8135-01-040-3749.

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

d. Fan, circulating floor, FSN 4140-203-3807.

6.12 Foam-in-Place Operations (NAVY). Evaluation of workers' exposures to toxic chemicals released during FIP operations shall be performed at each work place utilizing NIOSH sampling and analysis techniques and shall be accomplished by persons and/or agencies having recognized competence and expertise in industrial hygiene, sampling and analysis. Inquiries concerning this requirement should be directed to the Commanding Officer, Naval Environmental Health Center, Building X 353, Naval Station, Norfolk VA 23511.

6.13 Supersession. This specification supersedes MIL-P-21929B dated 22 June 1970 and the Type II requirements for foam-in-place contained in MIL-P-26514E dated 10 May 1978.

Custodians:

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

Review Activities:

Navy - AS, EC, SH
Army - AL, AT, CR, EA, MD, ME, MI
Air Force - 11, 43, 82, 99
DLA - GS, ES

User Activities:

Navy - EC, MD, SA, YD
Army - AV, ER, MR, MT

Preparing Activity:

Air Force - 69

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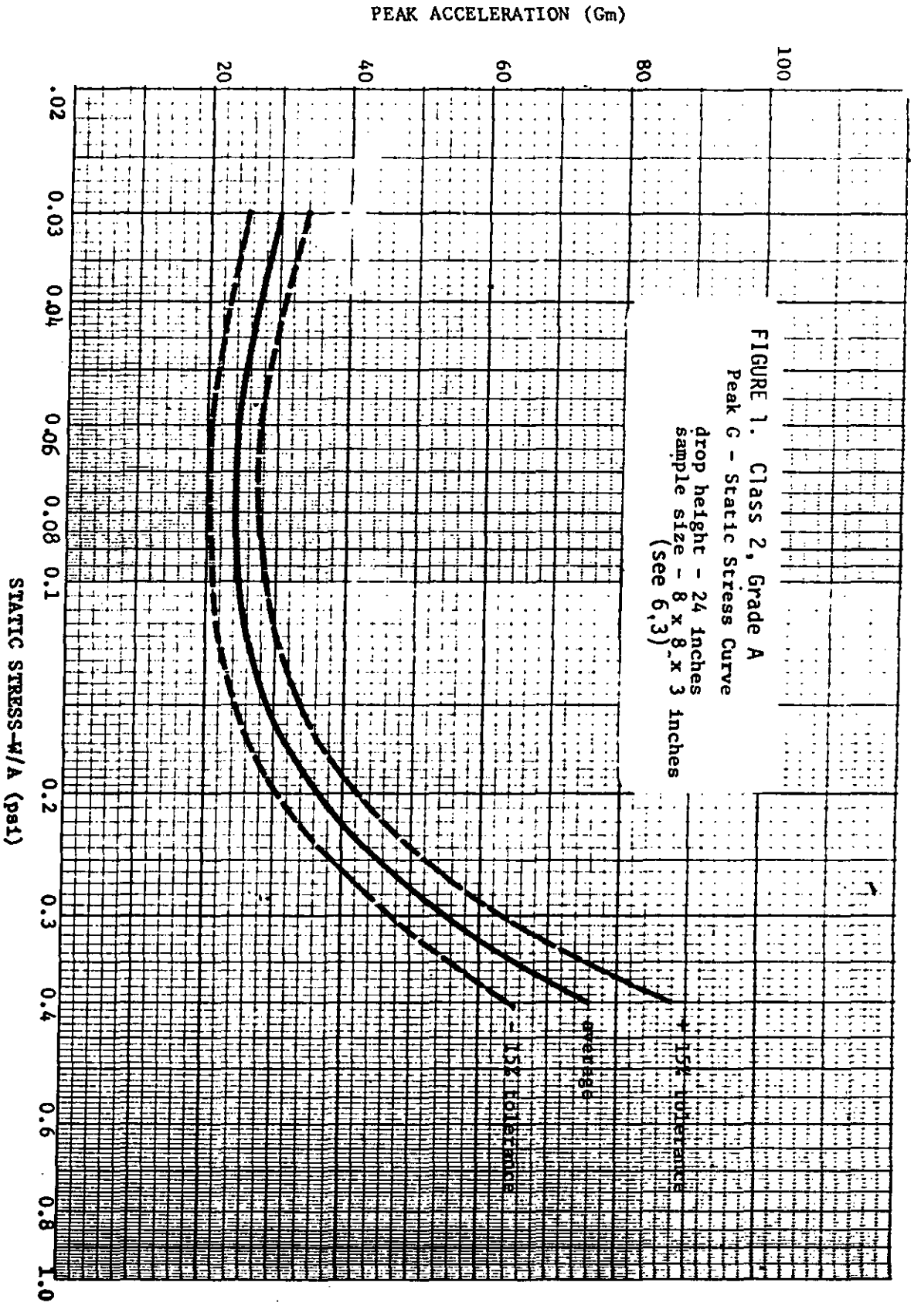

FIGURE 1. Class 2, Grade A
Peak G - Static Stress Curve
drop height - 24 inches
sample size - 8 x 8 x 3 inches
(see 6.3)

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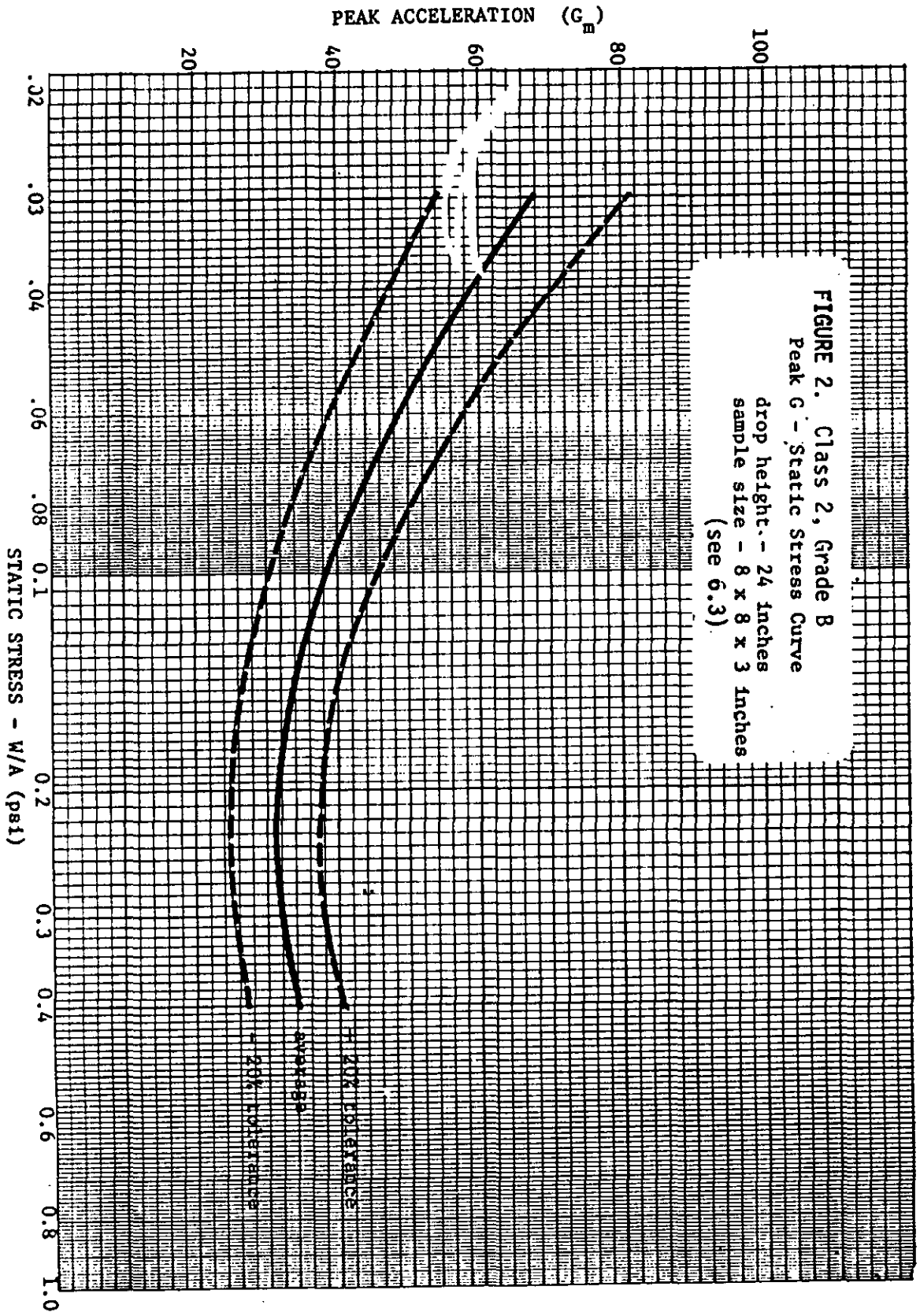

FIGURE 2. Class 2, Grade B
Peak G - Static Stress Curve
drop height - 24 inches
sample size - 8 x 8 x 3 inches
(see 6.3)

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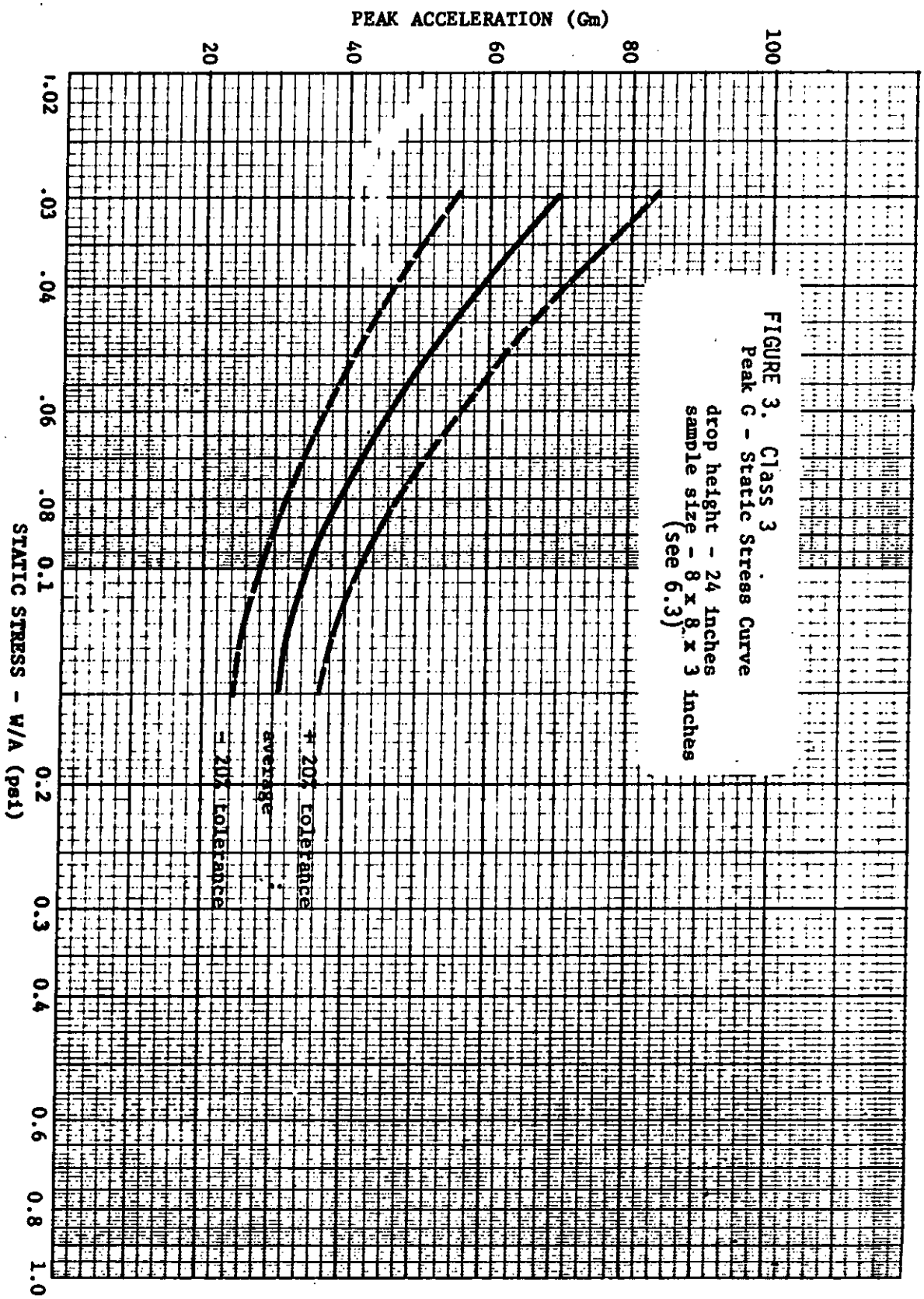

FIGURE 3. Class 3
Peak G - Static Stress Curve

drop height - 24 inches
sample size - 8 x 8 x 3 inches
(see 6.3)

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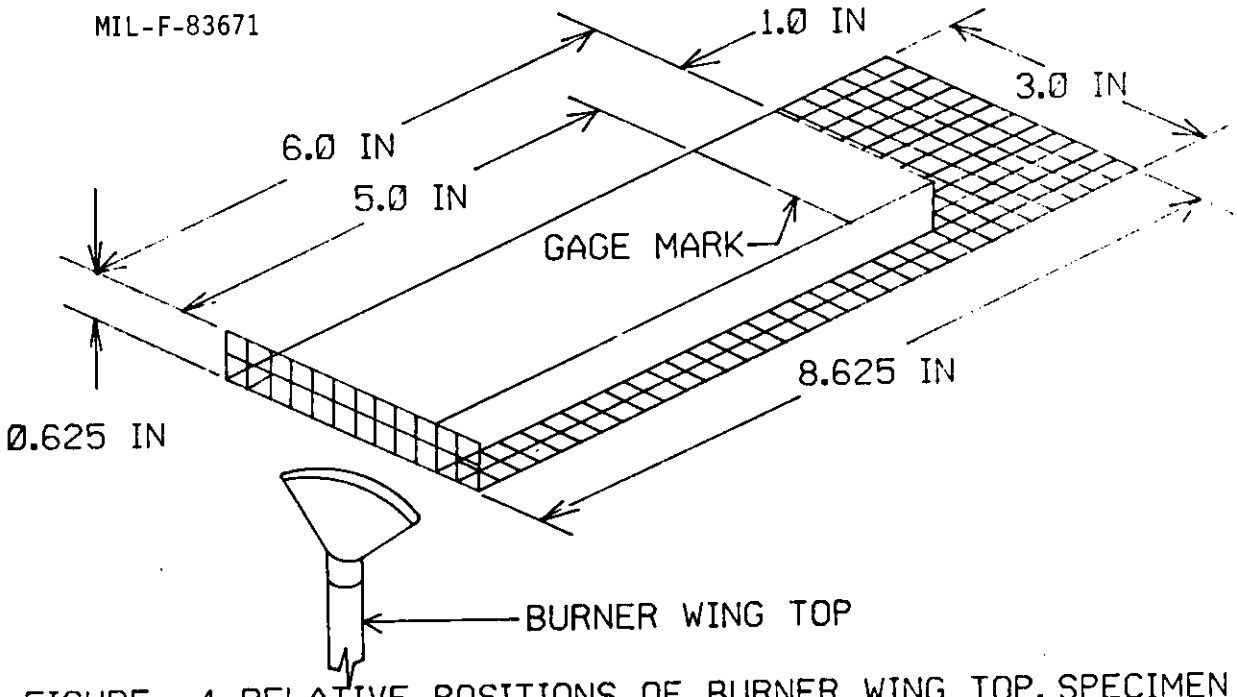

FIGURE 4. RELATIVE POSITIONS OF BURNER WING TOP, SPECIMEN AND SPECIMEN SUPPORT

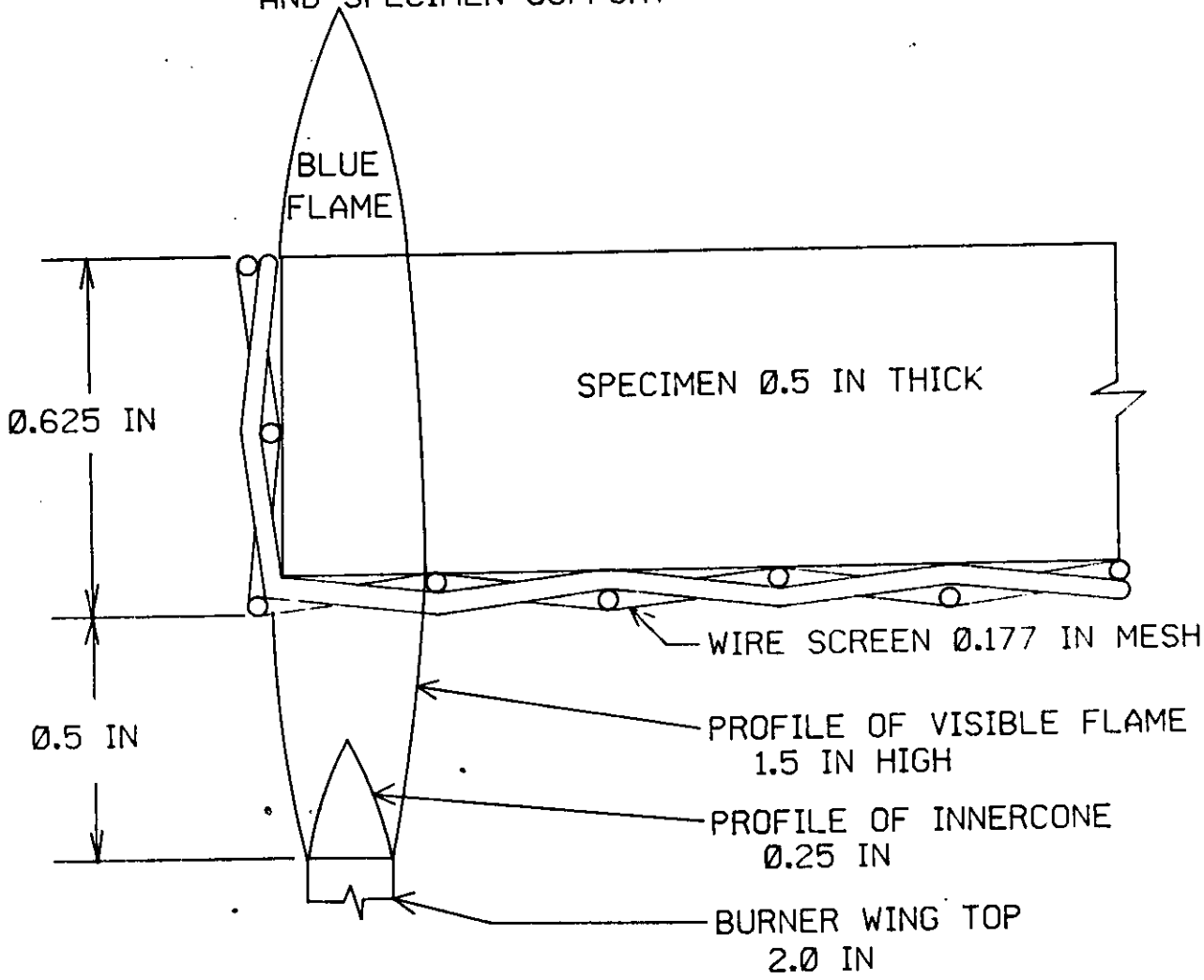

FIGURE 5. RELATIVE POSITIONS OF BURNER WING TOP, FLAME, SPECIMEN AND SPECIMEN SUPPORT.

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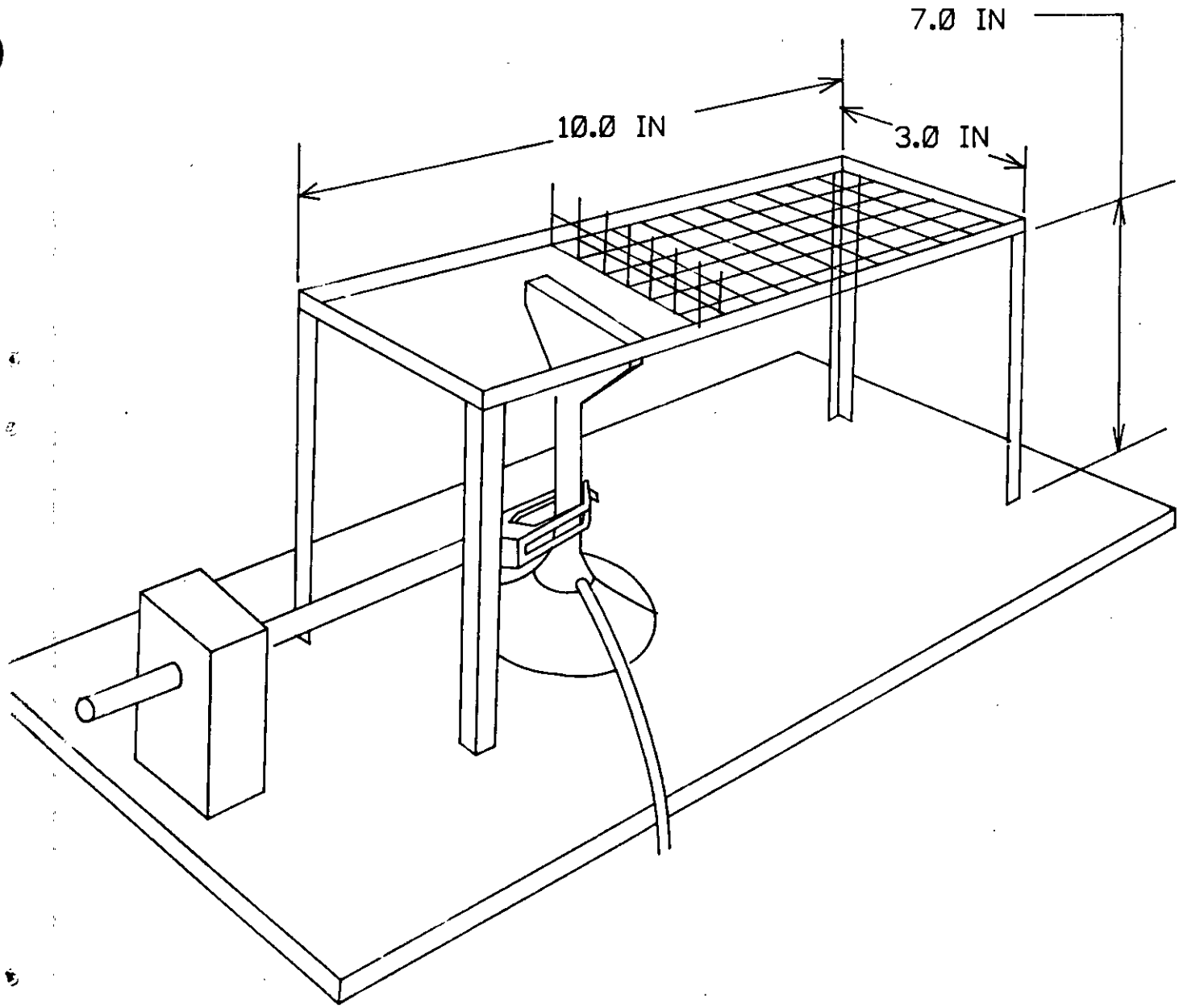

FIGURE 6. APPARATUS FOR SUPPORT OF SPECIMEN.

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1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-F-83671	Foam-In-Place Packaging Materials, General Specification For

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
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c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
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