

PPP-C-1752D
December 26, 1989
SUPERSEDING
PPP-C-1752C
January 29, 1987

FEDERAL SPECIFICATION

CUSHIONING MATERIAL, PACKAGING, POLYETHYLENE FOAM

This specification is approved by the Commissioner,
Federal Supply Service, General Services Administration,
for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1. Scope. This specification establishes requirements for polyethylene foam packaging and cushioning materials, including static dissipative and fire retardant grades.

1.2 Classification. Polyethylene foam shall be of the following types, classes, and grades as specified (see 6.2 and 6.3). Unless otherwise specified, grade A material shall be furnished.

1.2.1 Class definitions.

Class 1 - General purpose sheet material
Class 2 - General purpose plank material
Class 3 - Special purpose sheets, special purpose planks,
and special shapes

1.2.2 Grade definitions.

Grade A - Standard
Grade B - Static dissipative
Grade C - Fire retardant
Grade D - Static dissipative and fire retardant

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1.2.3 Type classifications.

Type I, Cushioning material, stress range 0.2 - 2.0 psi

Class 1, Grades A, B, C, D
Class 2, Grades A, B, C, D
Class 3, Grades A, B, C, D

Type III, Cushioning material, stress range 1 - 3 psi

Class 2, Grades A, B, C, D
Class 3, Grades A, B, C, D

Type IV, Cushioning material, stress range 2 - 5 psi

Class 2, Grades A, B, C, D
Class 3, Grades A, B, C, D

Type V, Cushioning material, stress range 4 - 10 psi

Class 2, Grades A, B, C, D
Class 3, Grades A, B, C, D

Type VII, Packaging material

Class 1, Grades A, B, C, D
Class 3, Grades A, B, C, D

2. APPLICABLE DOCUMENTS

2.1 Government publications. The following documents, of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

Federal Specifications

PPP-B-601 - Boxes, Wood, Cleated-plywood
PPP-B-621 - Boxes, Wood, Nailed and Lock-corner

Federal Standards

FED-STD-101 - Test Procedures for Packaging Materials
FED-STD-123 - Marking for Shipment (Civil Agencies)

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(Activities outside the Federal Government may obtain copies of Federal specifications, standards, and commercial item descriptions as outlined under General Information in the Index of Federal Specifications, Standards and Commercial Item Descriptions. The Index, which includes cumulative bimonthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

(Single copies of this specification, and other Federal specifications and commercial item descriptions required by activities outside the Federal Government for bidding purposes are available without charge from General Services Administration Business Service Centers in Boston, MA; New York, NY; Philadelphia, PA; Washington, DC; Atlanta, GA; Chicago, IL; Kansas City, MO; Fort Worth, TX; Houston, TX; Denver, CO; San Francisco, CA; Los Angeles, CA; and Auburn, WA.)

(Federal Government Activities may obtain copies of Federal standardization documents and the Index of Federal Specifications, Standards and Commercial Item Descriptions from established distribution points in their agencies.)

Military Specifications

MIL-P-116 - Preservation, Methods of

Military Standards

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

MIL-STD-129 - Marking for Shipment and Storage

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

Electronics Industries Association Recommended Standard

541 - Packaging Material Standards for ESD Sensitive Items

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(Applications for copies should be addressed to Electronics Industries Association, Engineering Department, 2001 Eye Street, NW, Washington, DC 20006)

American Society for Testing and Materials Standards

- D 3575 - Standard Test Methods for Flexible Cellular Materials Made from Olefin Polymers
- D 3951 - Standard Practice for Commercial Packaging
- D 1596 - Standard Test Method for Shock Absorbing Characteristics of Package Cushioning Materials
- D 3330 - Standard Test Methods for Peel Adhesion of Pressure Sensitive Tape at 180 Degree Angle
- E 162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source
- E 662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials

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

3. REQUIREMENTS

3.1 Material. The material supplied under this specification shall be a polyethylene foam suitable to protect items from hazards encountered during handling and shipping at temperatures between -65°F (-54°C) and 158°F (70°C).

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3.2 Form. Class 1 (general purpose sheet material) shall consist of sheets of material which meet the dimensional tolerances of 3.3.1. Sheets are defined as pieces of material which have a rectangular horizontal cross section and a nominal thickness of 1/2 inch or less. When specified, Class 1 material shall be furnished in roll form (see 6.3). Class 2 (general purpose plank material) shall consist of planks of material which meet the dimensional tolerances of 3.3.2. Planks are defined as pieces of material which have a rectangular horizontal cross section and a nominal thickness of more than 1/2 inch. Class 3 material (special purpose sheets, special purpose planks, and special shapes) shall consist of sheets which meet the dimensional tolerances of 3.3.3.1; planks which meet the dimensional tolerances of 3.3.3.2; and special shapes. Special shapes consist of extruded shapes, fabricated shapes, molded shapes, rounds, die cuts, and all other pieces of polyethylene foam which meet the dimensional tolerances of 3.3.3.1. Die cuts may consist of a single layer or of several layers of cushioning material laminated together to reach the specified thickness. The form and dimensions of Class 3 material shall be as specified (see 6.3).

3.2.1 Type I. Type I cushioning material shall be furnished in sheets, in planks, and in special shapes.

3.2.2 Types III, IV and V. Types III, IV and V cushioning material shall be furnished in planks and in special shapes.

3.2.3 Type VII. Type VII cushioning material shall be furnished in sheets and in special shapes.

3.3 Dimensional tolerances

3.3.1 Class 1 - General purpose sheet

Length - plus 6, minus 0 percent of the specified length.
 Width - plus 8, minus 0 percent of the specified width.
 Thickness - plus or minus 15 percent of the specified thickness.

3.3.2 Class 2 - General purpose plank

Length - plus 6, minus 0 percent of specified length.
 Width - plus 8; minus 0 percent of specified width.
 Thickness - plus 20 or minus 5 percent of the specified thickness.

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3.3.3 Class 3 - Special purpose sheets, special purpose planks, and special shapes

3.3.3.1 Dimensional tolerances for special purpose sheets and shapes. Dimensional tolerances for special purpose sheets and shapes shall be as specified (see 6.3).

3.3.3.2 Dimensional tolerances for special purpose planks.

Length - plus 6, minus 0 percent of specified length, unless otherwise specified (see 6.3).
 Width - plus 8, minus 0 percent of specified width, unless otherwise specified (see 6.3).
 Thickness - plus or minus 1/16 inch, unless otherwise specified (see 6.3).

3.4 Compression set. Compression set shall be not greater than 25 percent of the original thickness, when tested as specified in 4.3.3.2.

3.5 Flexibility (Types I and III, Class 2). The cushioning material shall show no cracks, tears, or separations resulting from bending through an arc of 180 degrees around a mandrel having a diameter of 2 inches when tested as specified in 4.3.3.3.

3.6 Constant compression creep (Types I, III, IV, V). The average creep shall be not greater than 10 percent of the initial thickness after testing for 1000 hours as specified in 4.3.3.4 using the applicable static loads, as follows:

Type	Static load, (psi)
I	2.0
III	3.0
IV	5.0
V	10.0

3.7 Thermal stability. The dimensional changes shall be not greater than 2 percent in any dimension when tested as specified in 4.3.3.5.

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3.8 Compressive strength. The compressive strength, when tested as specified in 4.3.3.6, shall be as follows:

Type	Compressive strength range, (psi)
I	4 - 12
III	13 - 20
IV	21 - 50
V	51 - 100
VII	0.8 - 4.0

3.9 Water absorption. When tested as specified in 4.3.3.7, the maximum permissible water pickup shall be not greater than 0.1 pound per square foot of the cut surface.

3.10 Static dissipative cushioning material (Grades B and D). Static dissipative cushioning material shall conform to all requirements for the specified type. In addition, static dissipative cushioning material shall meet the requirements of 3.10.1 and 3.10.2.

3.10.1 Electrostatic decay time. The average decay time shall be not greater than 2.0 seconds when tested as specified in 4.3.3.8.1.

3.10.2 Resistivity. For surface conductive material, the surface resistivity, expressed to 3 significant figures, shall be not less than 1.00×10^5 ohms per square and not more than 1.00×10^{12} ohms per square when tested as specified in 4.3.3.8.2. For volume conductive material, the volume resistivity, expressed to 3 significant figures, shall be not less than 1.00×10^4 ohm centimeters and not more than 1.00×10^{11} ohm centimeters when tested as specified in 4.3.3.8.2.

3.11 Fire-retardant cushioning material (Grades C and D). Fire retardant cushioning material shall conform to all the requirements for the specified type and class. In addition, fire retardant cushioning material shall meet the requirements of 3.11.1 and 3.11.2.

3.11.1 Flame spread index. The flame spread index shall be not more than 25 when tested as specified in 4.3.3.9.1.

3.11.2 Specific optical density. The maximum specific optical density shall be not more than 100 when tested in 4.3.3.9.2.

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3.12 Dynamic cushioning properties (Types I, III, IV and V, Classes 1 and 2). The dynamic cushioning curve shall lie entirely between the upper and lower limit curves of the applicable figure (see Figures 1-4) when tested as specified in 4.3.3.10.

3.13 Contact corrosivity. The cushioning material shall not induce corrosion on the aluminum panel when tested as specified in 4.3.3.11.

3.14 Density. Unless otherwise specified (see 6.2), the density of the cushioning material shall be at the option of the supplier. If density is specified, it shall be tested as required in 4.3.3.12.

3.15 Color. Grade B cushioning material shall be pink. Unless otherwise specified (see 6.3). The color of the Grades A, C, and D cushioning material shall be at the option of the supplier.

3.16 Workmanship. The cushioning material shall be uniform and shall be free from dirt, cracks, tears, holes, large voids, inclusions or other defects adversely affecting serviceability.

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 Quality conformance inspection. Sampling for inspection shall be performed in accordance with MIL-STD-105.

4.2.1 Examination of the end item. The end item shall be examined for the defects set forth in the applicable subparagraphs at the inspection levels and acceptable quality levels (AQLs) specified. Random samples shall be drawn from each lot of the end items for examination of visual defects and preparation for delivery defects.

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4.2.1.1. Examination for visual defects. The sample unit for this examination shall be one square yard of a sheet, one plank, one extruded, fabricated, or molded shape, one round, one die cut, or one special shape, as applicable. The inspection level shall be S-2 and AQL shall be 2.5, expressed in terms of percent defective.

<u>Examine</u>	<u>Defects</u>
Workmanship	Dirty, presence of foreign matter. Irregular cuts, splits, holes, cracks, or tears. Not uniform; contains large voids or inclusions.
Construction	Not sheets, planks, extruded shapes, fabricated shapes, molded shapes, rounds, die cuts, specials, or rolls, as specified. Broken segments or folds.
Color	Not pink (Grade B), or not as specified in 6.3.
Odor	Objectionable (odor not normally associated with manufacture of the product).

4.2.1.2 Examination of preparation for delivery. An examination shall be made to determine that the packaging, packing, and marking comply with section 5. The sample unit shall be one shipping container fully prepared for delivery. The inspection level shall be S-2 with an AQL of 2.5 expressed in terms of percent defective.

4.3 Test methods. The end item shall be tested for the characteristics indicated in table I for each lot presented for inspection. The sample unit shall be one plank, fabricated shape, molded shape, round, die cut, or special shape, or one square yard of a sheet, as applicable. The inspection level shall be S-1 with an AQL of 2.5 expressed in terms of percent defective. All requirements are applicable to the sample unit.

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TABLE I. Instructions for testing .

<u>Characteristic</u>	<u>Requirement</u>	<u>Test Method</u>	Results reported as	
			<u>Pass or fail</u>	<u>Numerically to nearest</u>
Dimensional tolerances	3.3	4.3.3.1	--	As indicated
Compression set 1/	3.4	4.3.3.2	--	1 percent
Flexibility 1/ Constant compression	3.5	4.3.3.3	X	-----
creep 1/ Thermal stability 1/ Compressive strength	3.6	4.3.3.4	--	1 percent
Water absorption 1/ Static dissipative properties	3.7	4.3.3.5	--	1 percent
Electrostatic decay time	3.8	4.3.3.6	--	0.1 psi
Resistivity	3.9	4.3.3.7	--	0.01 lb
Fire retardancy				
Flame spread index	3.10.1	4.3.3.8.1	--	0.1 second
Specific optical density	3.10.2	4.3.3.8.2	--	Numerically to 3 significant figures
Dynamic cushioning properties 1/ Contact	3.11.1	4.3.3.9.1	--	1 unit
corrosivity 1/ Density (when specified)	3.11.2	4.3.3.9.2	--	1 unit
	3.12	4.3.3.10	X	-----
	3.13	4.3.3.11	X	-----
	3.14	4.3.3.12		0.1 lb/ft ³

Footnote to TABLE I. Instructions for testing

1/ Unless otherwise specified, a certification of compliance shall be acceptable as proof that the product being offered meets the requirements of 3.4, 3.5, 3.6, 3.7, 3.9, 3.12 and 3.13, provided the contractor furnishes actual test results acceptable to the Government, indicating that tests have been performed within the 2 years prior to presentation of the lot of material. The certificate shall state that the tests described in 4.3.3.2, 4.3.3.3, 4.3.3.4, 4.3.3.5, 4.3.3.7, 4.3.3.10, and 4.3.3.11 have been performed on products manufactured from the same material and manufacturing process as the items being offered and that any proposed changes in material or process will be promptly reported to the Government representative. The Government reserves the right to require additional testing and certification by the contractor when such changes are made, or when otherwise deemed necessary.

4.3.1 Test conditions. Dimensions shall be measured at ambient temperature and humidity. All other measurements and tests shall be made on specimens conditioned at $73.4^{\circ} \pm 3.6^{\circ}\text{F}$ ($23^{\circ} \pm 2^{\circ}\text{C}$) and 50 ± 5 percent relative humidity for at least 16 hours, or until the difference between 2 successive weighings conducted at 1 hour intervals is less than 1 percent of the average weight. Unless otherwise specified in the test method, tests shall be conducted in this environment.

4.3.2. Test specimens. Test specimens shall be taken from the end item whenever possible. If test specimens cannot be prepared from the end item, they shall be prepared from the same lot of polyethylene foam used to make the end item.

4.3.3 Tests.

4.3.3.1 Dimensions. Dimensions shall be measured in accordance with ASTM D 3575.

4.3.3.2 Compression set. The compression set of the cushioning material shall be determined in accordance with ASTM D 3575, Suffix B.

4.3.3.3 Flexibility. Six specimens, each 2 x 6 x 1/2 inches shall be taken from each sample unit. Each specimen shall be bent at the center of its length over a 2 inch diameter mandrel, at a uniform rate such that it takes 5 ± 1 seconds to bend the cushioning material through an arc of 180 degrees.

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4.3.3.3.1 Flexibility at 73.4°F (23°C). Three specimens shall be conditioned as in 4.3.1 and tested as specified in 4.5.3.4.

4.3.3.3.2 Flexibility at -65°F (-54°C). Three specimens shall be conditioned for 30 to 40 minutes at $-65^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$ ($-54^{\circ} \pm 2^{\circ}\text{C}$) and tested as specified in 4.5.3.4, either at that temperature, or at ambient temperature within 5 seconds after removal from the low temperature environment.

4.3.3.4 Constant compression creep. The creep properties of the cushioning material shall be determined in accordance with ASTM D 3575, suffix BB, using the static load specified in 3.6.

4.3.3.5 Thermal stability. The thermal stability of the cushioning material shall be determined in accordance with ASTM D 3575, Suffix S.

4.3.3.6 Compressive strength. The compressive strength of the cushioning material shall be determined in accordance with ASTM D 3575, Suffix D.

4.3.3.7 Water absorption. The water absorption of the cushioning material shall be determined in accordance with ASTM D 3575, Suffix L.

4.3.3.8 Static dissipative properties.

4.3.3.8.1 Electrostatic decay time. The electrostatic decay time of the cushioning material shall be determined in accordance with EIA Standard 541, appendix F.

4.3.3.8.2 Resistivity. The surface resistivity or the volume resistivity of the cushioning material shall be determined in accordance with EIA Standard 541, section 4.3.

4.3.3.9 Fire retardancy.

4.3.3.9.1 Flame spread index. The flame spread index of the cushioning material shall be determined in accordance with ASTM E 162.

4.3.3.9.2 Specific optical density. The specific optical density shall be determined in accordance with ASTM E 662.

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4.3.3.10 Dynamic cushioning. Dynamic cushioning shall be determined in accordance with ASTM D 1596, except that the test specimens shall be $2 \pm 1/16$ inches thick. Cushioning material which is less than 2 inches thick shall be plied up without the use of adhesive to produce a total thickness of $2 \pm 1/16$ inches. Cushioning material more than 2 inches thick shall be cut and planed to a uniform thickness of 2 inches. The impact velocity shall be 136 ± 3 inches per second. Not less than 5 specimens of cushioning material shall be tested, each at a different static stress. Record the average peak G of drops 2 through 5 as the average peak G value for the static stress applied. Plot a best fit dynamic cushioning curve throughout the range covered by the applicable upper and lower limit curves of Figures 1-4 using a french curve, drawing spline, or by use of a mathematical curve fitting analysis.

4.3.3.11 Contact corrosivity. Contact corrosivity shall be determined on aluminum panels as specified by method 3005 of FED-STD-101. The cleaning procedure specified by ASTM D 3330 may be used to clean the panels after finishing with abrasives instead of the cleaning procedure specified by paragraph 3.8.2 of Method 3005.

4.3.3.12 Density. (see 3.14). The density of the cushioning material shall be determined in accordance with ASTM D 3575, Suffix D, Method B.

5. PACKAGING

5.1 Preservation. Preservation shall be level A or Commercial, as specified (see 6.3).

5.1.1 Level A. Cushioning material shall be preserved in accordance with method III of MIL-P-116.

5.1.2 Commercial. Each unit of issue of cushioning material shall be preserved in accordance with normal commercial practice.

5.2 Packing. Packing shall be level A or Commercial, as specified (see 6.3).

5.2.1 Level A. Cushioning material of one description only, shall be packed in wood boxes conforming to PPP-B-601, overseas style A, B, or I; or PPP-B-621, style 4. Containers shall be closed in accordance with the appendix of the applicable specifications.

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5.2.2 Commercial. Cushioning material shall be packed to assure acceptance by common carrier and to provide product protection against loss or damage during multiple shipments, handling, and storage. The shipping container shall be in compliance with the National Motor Freight Classification and the Uniform Freight Classification.

5.3 Marking.

5.3.1 For delivery to civil agencies. In addition to any special marking required by the contract or order, interior packages and shipping containers shall be marked in accordance with FED-STD-123.

5.3.2 For delivery to military agencies. In addition to any special marking required by the contract or order, interior packages and shipping containers shall be marked in accordance with MIL-STD-129 or ASTM D 3951; and, for delivery to the Army only, MIL-STD-1190, as applicable.

6. NOTES

6.1 Intended use. The cushioning material covered by this specification is intended primarily for use in cushioning and packaging applications to protect items from environmental hazards such as shock, vibration, concentrated forces, and abrasion during handling and shipping. Grade B and Grade D cushioning material also protect items from the buildup or retention of electrostatic potential. Grade C and Grade D cushioning materials have been treated to retard their burning rate. Figures 1-4 define the dynamic cushioning properties provided by 2 inches of class 1 or class 2 material. Increasing the thickness of the cushioning material will provide additional protection. Type VII cushioning material is not required to have specific dynamic cushioning properties. It is intended as a wrapping material or for use in areas of a package not subject to shock and vibration forces.

6.2 Density. Density is not closely related to the performance characteristics of this cushioning material. Manufacturing processes are available to increase the rigidity of lower density polyethylene foam and make it suitable for use at higher loads. Specifying density may result in higher costs and decreased competition among suppliers. Density should be specified only when it affects the performance of the item, for example, when the cushioning material is intended for use in flotation devices (see 6.3).

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6.3 Ordering data. Purchasers should select the preferred options permitted herein, and include the following information in procurement documents:

- (a) Title, number, and date of this specification.
- (b) Type, class, grade, dimensions, and shape required (see 1.2 and 3.2).
- (c) Dimensional tolerances for special purpose sheets and shapes (see 3.3.3.1).
- (d) Dimensional tolerances for special purpose planks (see 3.3.3.2).
- (e) Roll form, if required for Class 1 material (see 3.2).
- (f) Density, if required (see 3.14).
- (g) Color, if required (see 3.15).
- (h) Level of preservation required (see 5.1).
- (i) Unit of issue, when commercial packaging is specified (see 5.1.2).
- (j) Level of packing required (see 5.2).

6.4 Supersession data. This revision of PPP-C-1752 supersedes PPP-C-1752C which has been in effect since January 26, 1987. All documents and drawings referencing PPP-C-1752 should be reviewed to determine what type, class, and grade of PPP-C-1752D is applicable. The principal changes from PPP-C-1752C are:

- (a) The distinction between Class 2 planks and Class 3 planks is now based on the dimensional tolerances allowed (see 3.3.2 and 3.3.3.2).
- (b) Types II and VI have been incorporated into Type I.
- (c) Grade D cushioning material, which is both static dissipative and fire retardant, has been added.

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Compressive strength range

Type I	5 - 15 psi
Type II	3 - 13 psi
Type III	10 - 25 psi
Type IV	20 - 60 psi
Type V	50 - 120 psi
Type VI	2 - 10 psi
Type VII	0.9 - 5.0 psi

Compressive strength range

Type I	4 - 12 psi
Type I	4 - 12 psi
Type III	13 - 25 psi
Type IV	26 - 50 psi
Type V	51 - 100 psi
Type I	4 - 12 psi
Type VII	0.8 - 4.0 psi

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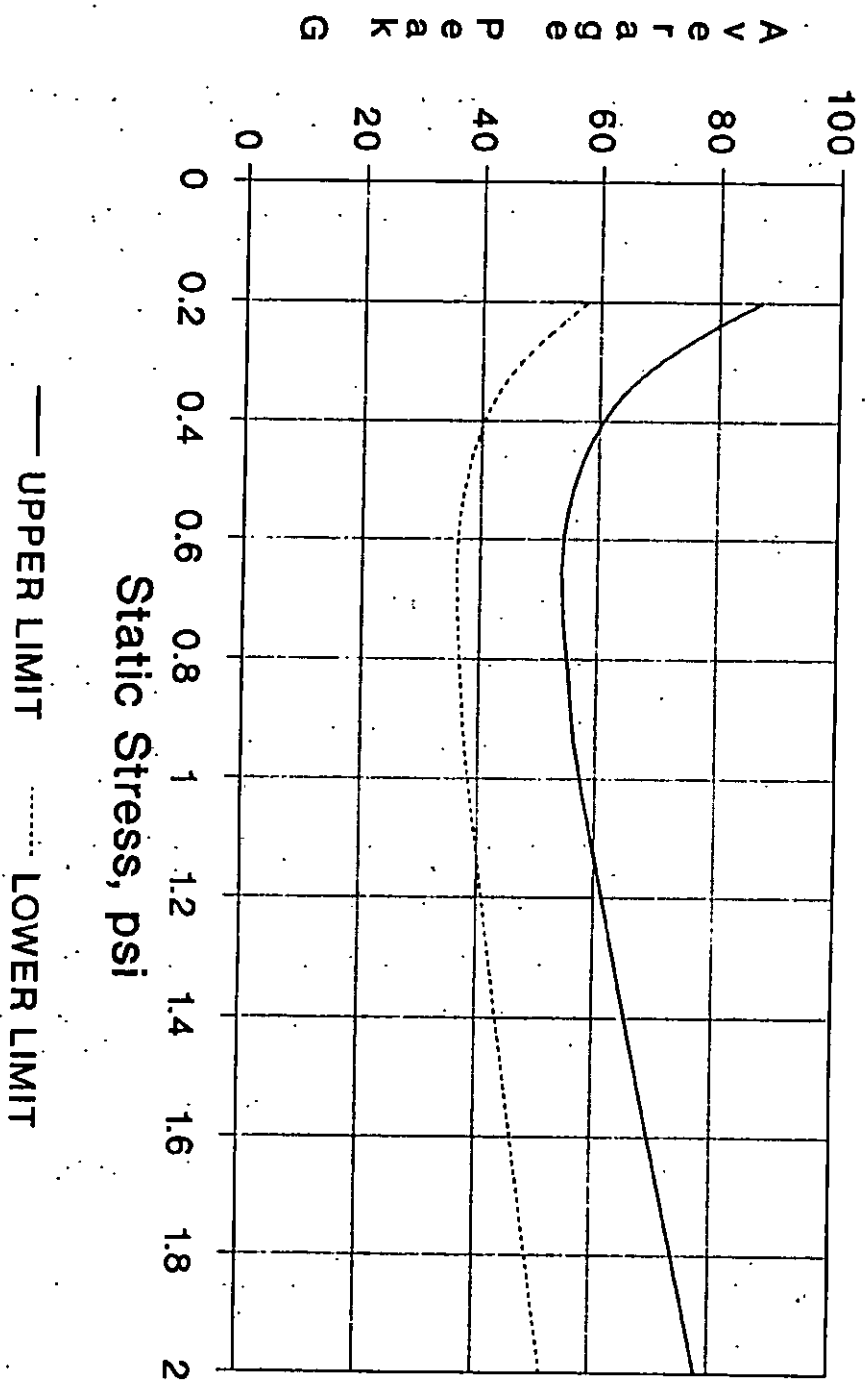
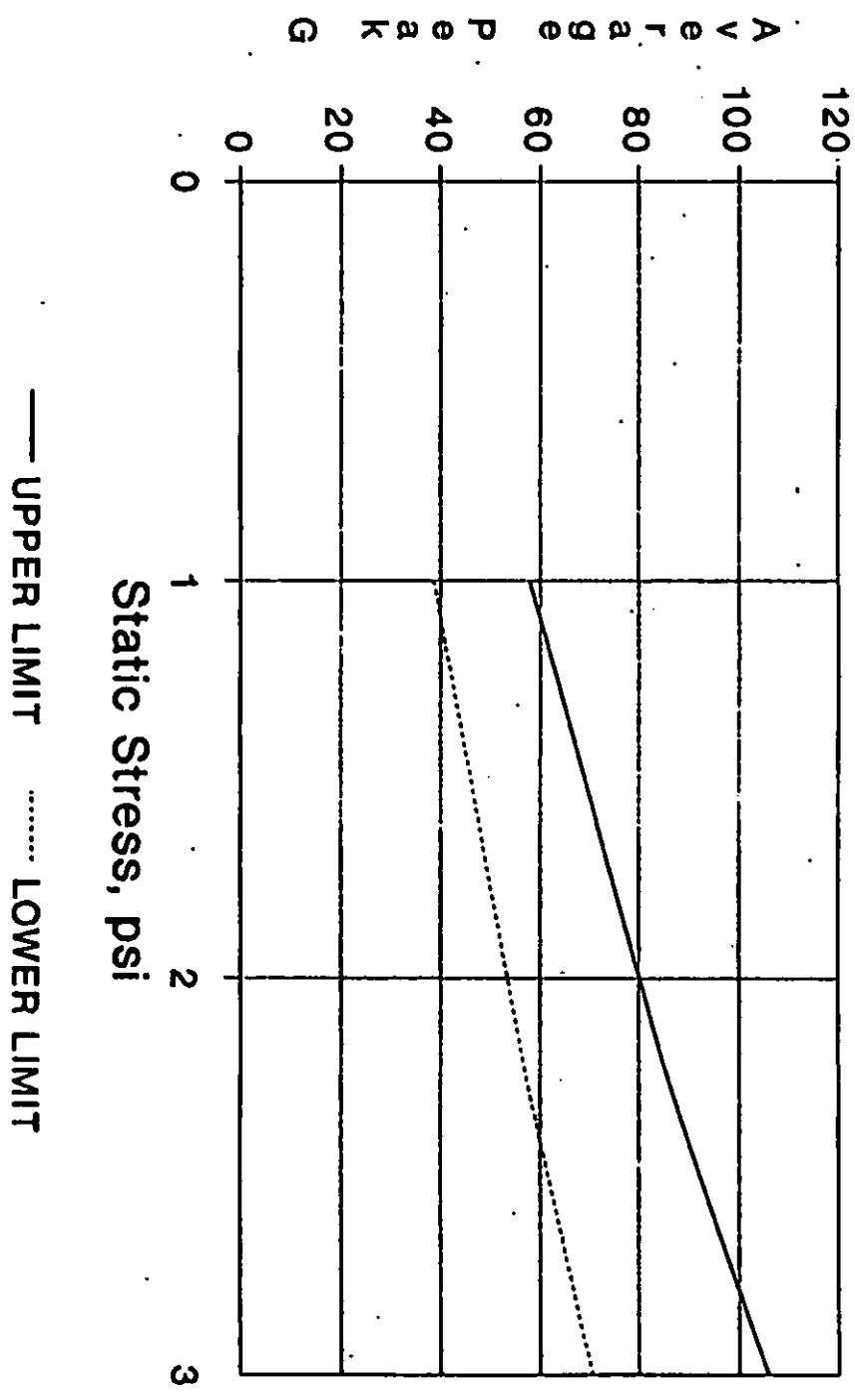


Figure 1. Type I, Class 1 and Class 2
DYNAMIC CUSHIONING CURVES
2 inches thick, Drops 2-5

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Figure 2. Type III, Class 2
DYNAMIC CUSHIONING CURVES
2 inches thick, Drops 2-5



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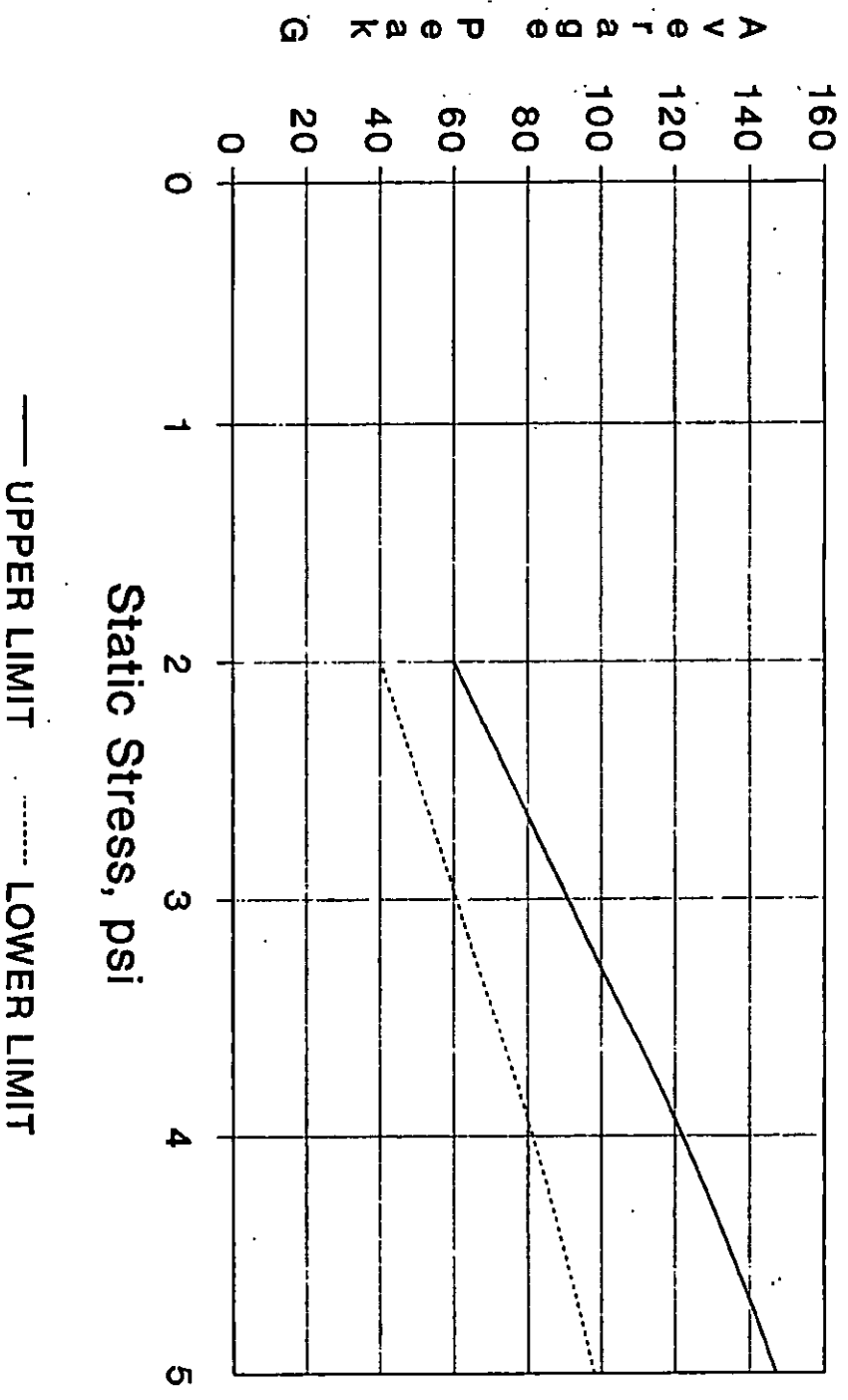
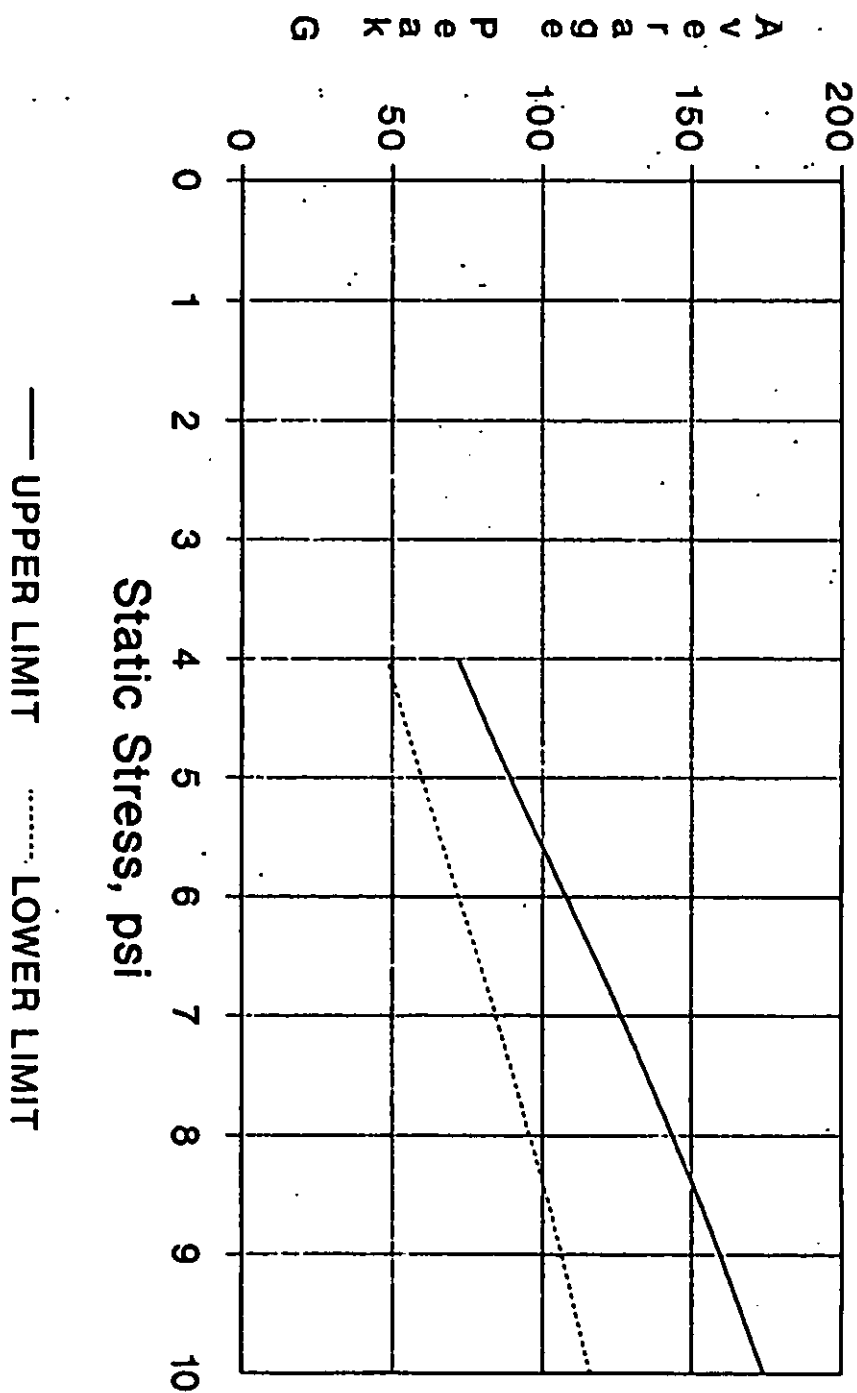


Figure 3. Type IV, Class 2
DYNAMIC CUSHIONING CURVES
2 inches thick, Drops 2-5

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Figure 4. Type V, Class 2
DYNAMIC CUSHIONING CURVES
2 inches thick, Drops 2-5



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MILITARY INTERESTS:

CIVIL AGENCY COORDINATING ACTIVITY

Military Coordinating Activity

GSA - FSS

Air Force - 69

Custodians

PREPARING ACTIVITY:

Army - GL

GSA - FSS

Navy - AS

Air Force - 69

DLA - ES

Review activities

Army - AR, MI

Navy - OS, SA, SH

User activities

Army - SM

Air Force - 70, 71, 80, 84