PPP-C-1752C
January 29, 1987
SUPERSEDING
PPP-C-1752B
April 11, 1980

FEDERAL SPECIFICATION

CUSHIONING MATERIAL, PACKAGING, (UNICELLULAR POLYETHYLENE FOAM, FLEXIBLE)

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 unicellular, polyethylene foam cushioning materials including anti-static and fire retardant classes for use in cushioning and packaging applications.

1.2 Classification. Cushioning material covered by this specification shall be of the following types and classes as specified (see 6.2). Omission of the material grade in a specification shall be interpreted to mean grade A material.

1.2.1 Class definitions.

Class 1 - Sheet (in roll form).
Class 2 - Extruded or laminated plank (w/skins intact)
Class 3 - Fabricated shapes and planks, rounds, die cuts and specials.

1.2.2 Grade definitions.

Grade A - No special grade characteristics required.
Grade B - Static dissipative (identified)
Grade C - Fire retardant

1.2.3 Type classifications.

Type I - Density range 2.1-3.0 (lb/ft^3).

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

Type II - Density range 2.3-3.3 (lb/ft^3).

Class 1, Grades A, B, C.
Class 2, Grades A, B, C.

Type III - Density range 3.4-4.5 (lb/ft^3).

Class 2, Grades A, B.
Class 3, Grades A, B.

Type IV - Density range 5.5-7.1 (lb/ft^3).

Class 2, Grades A, B.
Class 3, Grades A, B.

Type V - Density range 8.5-10.5 (lb/ft^3).

Class 2, Grades A, B.
Class 3, Grades A, B.

Type VI - Density range 1.5-2.1 (lb/ft^3).

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

Type VII - Density range 0.9-1.2 (lb/ft^3).

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

2. APPLICABLE DOCUMENTS

2.1 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-636 - Boxes, Shippping, Fiberboard
PPP-B-640 - Boxes, Fiberboard, Corrugated, Triple-Wall
PPP-C-795 - Cushioning Material, Flexible, Cellular, Plastic Film For Packaging Applications

Federal Standards:

Federal Standard No. 101 - Test Procedures for Packaging Materials
Federal Standard No. 123 - Marking for Shipment (Civil Agencies)

(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 Seattle, 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-Packaging, Methods Of
MIL-C-26861 - Cushioning Material, Resilient Type-General

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.

American Society for Testing and Materials (ASTM) Standards

ASTM D 3575 - Flexible Cellular Materials Made from Olefin Plastics
ASTM D 3951 - Standard Practice for Commercial Packaging
ASTM D 1596 - Test Method for Shock Absorbing Characteristics of Package Cushioning Materials
ASTM D 257 - Test Methods for D-C Resistance or Conductance of Insulating Materials
ASTM D 991 - Rubber Property-Volume Resistivity of Electrically Conductive and Antistatic Products

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

F.A.R. 25.853(b) - Federal Aviation Regulations

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

EIA Interim Standard IS-5-A

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

3. REQUIREMENTS

3.1 Materials. The cushioning material supplied under this specification shall be an essentially unicellular polyethylene foam and, unless otherwise specified, shall have a useful temperature range of minus 65° F to plus 165° F(minus 54° C to plus 74° C).

3.2 Form and construction. Extruded planks (Class 2), are "as foamed" boards one inch or thicker; fabricated planks (Class 3), are single layer or laminated boards one inch or thicker which have been skived or trimmed to the required thickness tolerance; sheets are less than one inch in thickness; fabricated shapes can be made from planks or sheets; rounds are solid, extruded, cylindrical shapes.

3.2.1 Types I, III, IV, V and VI. Types I, III, IV, V and VI shall be furnished in solid or laminated planks of rectangular cross section (class 2) or fabricated planks, and shapes, rounds die cuts and specials (class 3). Laminated planks, rounds, die cuts (special), and fabricated shapes shall have a minimum strength of 80 percent of the material itself.

3.2.2 Types II and VII. Types II and VII shall be furnished in sheets of rectangular cross section (class 1) or die cuts (special) and fabricated shapes (class 3).

3.2.3 Die cuts (special) and fabricated shapes. Die cuts and fabricated shapes shall have the form and dimensions specified (see 6.2). Cut shapes may be single sheets or laminations of two or more layers of the specified material to the specified thickness. A laminated cut shape shall have a minimum strength of 80 percent of the material itself.

3.3 Dimensional tolerances

3.3.1 Types I, III, IV, V and VI.

Thickness - Thickness of extruded plank (Class 2) shall be within plus 20 and minus 5 percent of the specified thickness (see 3.2 and 6.2).

Thickness - Thickness of fabricated plank (Class 3). Unless otherwise specified, the thickness shall be within plus or minus 1/16-inch of the specified thickness.

Length - Plus 6, minus 0 percent
Width - Plus 8, minus 0 percent

3.3.2 Type II.

Thickness - Thickness shall be plus or minus 10 percent except when under 1/4-inch thickness which shall be plus or minus 20 percent of the specified thickness.

Length - Plus 6, minus 0 percent
Width - Plus 8, minus 0 percent

3.3.3 Type VII.

Thickness - The thickness of unfabricated sheet stock shall be plus or minus 20 percent of the specified thickness (see 6.2).

Length - Rolls: plus 8, minus 0 percent of the specified length.
Sheets: plus 8, minus 0 percent of the specified length.

Width - Rolls: plus 8, minus 0 percent of the specified width.
Sheets: plus 8, minus 0 percent of the specified width.

3.4 Density. Density of the material shall be as indicated in 1.2.3 or as specified (see 6.2) when tested as in 4.5.3.2.

3.5 Compression set.

3.5.1 Types I, III, IV, and V. Compression set for types I, III, IV and V material shall not be greater than 25 percent of the original thickness, when tested as specified in 4.5.3.3.

3.5.2 Types II, VI, VII. Compression set for types II, VI, VII material shall not be greater than 50 percent of the original thickness, when tested as specified as in 4.5.3.3.

3.6 Flexibility. The surface of the cushioning material shall show no cracks, tears, or separations resulting from bending around a mandrel having a diameter of four times the thickness of the cushioning material specimen, when tested in accordance with 4.5.3.4.

3.7 Creep. The average creep shall not be greater than 10 percent of the initial thickness under the following static loading at 1000 hours when tested in accordance with 4.5.3.5. This test not required for Type VII material.

Type	Static loading (psi)
I	2.0
II	0.5
III	3.0
IV	5.0
V	10.0
VI	0.5

3.8 Thermal stability. The linear shrinkage shall be not greater than 2.0 percent of the initial dimensions, when tested in accordance with 4.5.3.6.

3.9 Compression strength. Compression strength, when tested in accordance with 4.5.3.7, shall conform to the following values:

Type	Compressive strength range (psi)
I	5 - 15
II	3 - 13
III	10 - 25
IV	20 - 60
V	50 - 120
VI	2.0 - 10.0
VII	0.9 - 5.0

3.10 Water absorption. When tested as specified in 4.5.3.8, the maximum permissible water pickup shall be less than 0.1 pounds per square foot of the cut surface.

3.11 Static dissipative. Static dissipative plank material for types I, III, IV, V or VI and static dissipative sheet material for types II or VII shall have an electrostatic decay rate of two seconds maximum. Static dissipative material shall have a surface resistivity equal to or greater than 1 x 10^{5} ohms/square but less than 1 x 10^{12} ohms/square or a volume resistivity equal to or greater than 1 x 10^{4} ohms-cm but less than 1 x 10^{12} ohms-cm as specified in 4.5.3.9.

3.12 Fire-retardant (Grade C). Fire retardant materials shall conform to all tests for the specified type (Types I, II, VI and VII). In addition the material shall pass F.A.R. 25.853(b) when tested as specified in 4.5.3.10.

3.13 Dynamic cushioning. Dynamic cushioning curves for types I, III, IV, V and VI shall be run at 24 inch equivalent drop height. Average peak G values for second thru fifth drop average will be no higher than the maximum curves as seen in figures 1-5, when tested as specified in 4.5.3.11.

3.14 Contact corrosivity. The manufacturer shall conduct this test to establish that the product is noncorrosive in accordance with para. 4.5.3.12

3.15 Color. Unless otherwise specified (see 6.2), the color of the cushioning material shall be the natural color of the product.

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

4.3 Inspection of the end item.

4.3.1 Examination of the end item. The end item shall be examined in accordance with 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, dimensional, and preparation for delivery defects.

4.3.1.1 Examination for visual defects. The sample unit for this examination shall be one sheet, plank, round, die cut, fabricated shape or one linear yard of a roll, as applicable. The inspection level shall be S-3 and AQL shall be 4.0, expressed in terms of defects per hundred units.

Examine	Defects
Workmanship	Not clean, presence of foreign matter. Irregular cuts, splits, holes, cracks, or tear. Not uniform; contains large voids or inclusion.
Construction	Not planks, sheets, rounds, cut or molded shapes, or rolls as specified. Broken segments or folds.
Color	Not color of product as manufactured; or, not as specified in 6.2.
Odor	Objectionable (not odor associated with manufacture of the product).

4.3.1.2 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 shippping container fully prepared for delivery. The inspection level shall be S-3 with an AQL of 4.0 expressed in terms of defects per hundred units.

4.4 Testing of the end item. The end item shall be tested for the characteristics indicated in table I for each lot presented for inspection. The sample unit shall be a minimum of one sheet, plank, round, die cut, or manufactured part. The inspection level shall be S-1 with an AQL of 6.5, expressed in terms of defects per hundred units. All requirements are applicable to the sample unit.

TABLE I. Instructions for testing

Characteristics	Specification reference Requirements	Test methods	Pass or fail	Results reported as Numerically to nearest
Dimensional tolerances	3.3	4.5.3.1	--	as indicated
Density	3.4	4.5.3.2	--	0.1 (lb/ft^3)
Compression set 1/	3.5	4.5.3.3	X	--------
Flexibility 1/	3.6	4.5.3.4	X	--------
Constant comp. creep 1/	3.7	4.5.3.5	X	--------
Thermal stability 1/	3.8	4.5.3.6	X	--------
Compression strength	3.9	4.5.3.7	-	0.1 psi
Water absorption 1/	3.10	4.5.3.8	X	--------
Static electricity				
(Decay rate)	3.11	4.5.3.9.1	X	---------
(Resistivity)	3.11	4.5.3.9.2	-	Surface or volume resistivity to the nearest power of 10.
Fire retardancy	3.12	4.5.3.10	X	---------
Dynamic cushioning 1/	3.13	4.5.3.11	X	---------
Contact corrosivity 1/	3.14	4.5.3.12	X	---------

1/ Unless otherwise specified, a certification of compliance shall be acceptable as proof that the product being offered meets the requirements of 3.5, 3.6, 3.7, 3.8, 3.10, 3.13, and 3.14 provided the contractor furnishes actual test results acceptable to the Government, indicating that tests have been performed to substantiate the certification not less than every two years. The certificate shall state that the tests described in 4.5.3.3, 4.5.3.4, 4.5.3.5, 4.5.3.6, 4.5.3.8, 4.5.3.11, and 4.5.3.12 have been performed on products manufactured from the same material and manufacturing process of the items being offered and that any proposed changes in material or process will be promptly reported to the Government. The Government reserves the right to require additional testing and certification by the contractor when such changes are made or when otherwise deemed necessary.

4.5 Test methods.

4.5.1 Test conditions. Measurements and tests shall be made of specimens conditioned at 73.4° ± 3.6° F(23° ± 2°C) and 50 ± 5 percent RH for at least 16 hours or until the difference between two 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.

4.5.2 Test specimens. For sheets, planks, and laminated planks, test specimens shall be taken from unfabricated samples. With fabricated or die cut parts or fabricated shapes, test specimens shall be cut from samples taken prior to fabrication. Tests shall be run in triplicate, and the average value, where applicable, shall be reported.

4.5.3 Tests.

4.5.3.1 Dimensions.

4.5.3.1.2 Thickness (types I, III, IV, V and VI). Thickness of planks shall be measured in accordance with ASTM D3575, paragraphs 8.2, 8.3 and 8.4.

4.5.3.1.3 Thickness (type II and VII). Thickness of sheets shall be measured in accordance with ASTM D3575, paragraphs 8.1, 8.3 and 8.4.

4.5.3.1.4 Width. The width of planks or sheets shall be determined by one measurement across the end and one measurement across the midlength point of each sample. The width of rolls shall be determined by one measurement at the 5-ft and one measurement at the 20-ft point of the roll, these points being measured from the beginning of the roll. All measurements shall be made to 1/32 inch.

4.5.3.1.5 Length. The length of planks, sheets, or rolls shall be determined by one measurement at one edge and one measurement at the midwidth point of each sample. All measurements shall be made to 1/32 inch for planks and sheets and to the nearest inch for rolls.

4.5.3.2 Density. The density of the foam shall be determined in accordance with ASTM D3575, Suffix W.

4.5.3.3 Compression set. The compression set of the foam shall be determined in accordance with ASTM D3575, Suffix W.

4.5.3.4 Flexibility. Three specimens 2 by 6 inches shall be taken of all material types to be supplied. Where the thickness of the material is over 1/2 inch it shall be reduced to 1/2 inch. Each strip shall be bent at the center of its length over the appropriate mandrel (see 3.6), through an arc of 180 degrees, in a period of 5 seconds, and at a uniform speed of 36 degrees per second.

4.5.3.4.1 Flexibility at 73.4° ± 3.6° F(23° ± 2° C). The specimen shall be conditioned as in 4.5.1 and tested as in 4.5.3.4.

4.5.3.4.2 Flexibility at -65° F(-54° C) (types I, II, VI, and VII). The specimens shall be conditioned for 30 to 40 minutes at minus 65° F (54°C) ± 3.6° F(2°C) and tested as in 4.5.3.4 at that temperature, or, if not practical, within 5 seconds after removal from the low temperature environment.

4.5.3.5 Constant compression creep. The material shall be tested for 1000 hours in accordance with the static loading paragraph 3.7 of ASTM D3575, Suffix BB.

4.5.3.6 Thermal stability. Three 3- by 12- inch specimens shall be cut from the cushioning material. Types II and VII material thickness shall be the specified thickness of the specimen while types I, III, IV and V shall be cut to 1 inch thickness. Reference marks shall be placed 10 inches ± 1/16 inch apart along the centerline of each specimen. The distance between the marks shall be measured to the nearest 0.01 inch and recorded as L_0. The specimen shall be aged for 24 hours at 150°F(65.6° C) and then allowed to cool at 73.4° ± 3.6°F(23° ± 2° C) and 50 ± 5 percent RH for 2 hours at which time the distance between the reference marks shall be measured to the nearest 0.01 inch recorded as L_1. The linear shrinkage shall be calculated as follows:

$$\text{Percent linear shrinkage} = \frac{L_0 - L_1}{L_0} \times 100$$

Where L_c = original distance between reference marks

L_1 = distance between reference marks after aging

4.5.3.7 Compression strength. The compression strength of the foam shall be in accordance with ASTM D3575, Suffix D.

4.5.3.8 Water absorption. The test for water absorption shall be in accordance with ASTM D3575, Suffix L.

4.5.3.9 Static electricity. Electrostatic discharge protection:

4.5.3.9.1 Electrostatic decay. Select six specimens 3 x 5 inches in area from each of the material to be supplied. The material shall be cut to 1/2 inch thickness. Each specimen shall be free of defects such as holes, cracks and tears. Specimens shall be conditioned at 15 percent ± 5 percent relative humidity and at 73.4° ± 3.6°F (23° ± 2° C) for a minimum of 48 hours, then tested in the same environment. Specimens shall remain in the conditioning environment until testing is completed. The equipment used for performing the static decay test can be either as described in Federal Test Method Standard No. 101, Method 4046.1, or a commercially available system. Six test cycles shall be performed on each specimen, three cycles using a positive 5,000 volt charge and three using a negative 5,000 volt charge. The average decay time to 50 volts for each specimen shall be measured and recorded. The material shall pass if the average decay time for each specimen is less than two seconds.

4.5.3.9.2 Surface or volume resistivity. Samples shall be conditioned at 12 percent ± 3 percent relative humidity and at 73.4° ± 3.6°F(23° C ± 2° C)for a minimum of 48 hours, then tested in that same environment. Specimens shall remain in the conditioning environment until testing is completed. Resistivities shall be measured using an apparatus as described in ASTM D257, ASTM D991 or equivalent.

4.5.3.10 Fire retardancy. The material shall be cut to 1/2 inch thickness and tested in accordance with F.A.R. 25.853(b) regulations.

4.5.3.11 Dynamic cushioning. Dynamic cushioning shall be in accordance with ASTM D3575, Suffix CC following ASTM D1596 for types I, III, IV, V, and VI. The material thickness shall be 2.0 plus or minus 1/16 inch.

4.5.3.12 Contact corrosivity. Contact corrosivity shall be in accordance with PPP-C-795, paragraphs 4.6.3 thru 4.6.3.4.

PREPARATION FOR DELIVERY

5.1 Preservation and packaging. Preservation and packaging shall be level A or Commercial, as specified (see 6.2).

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

5.1.2 Commercial. The cushioning material shall be packaged to afford adequate protection against deterioration and physical damage during shipment from the supply source to the receiving activity.

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

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.

5.2.2 Commercial. The cushioning material shall be packed in fiberboard boxes to insure delivery at destination, provide for redistribution by the initial receiving activity, and shall be acceptable by common carrier under the National Motor Freight Classification and the Uniform Freight Classification.

5.3 Marking.

5.3.1 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. No. 123.

5.3.2 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 D3951, 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, contamination, and abrasion during handling and shipment.

6.2 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, form, dimensions and shape required (see 1.2 and 3.2).
(c) Whether material is to be static dissipative or volume conductive
(d) Color required (see 3.14).
(e) Selection of the level of packing (see 5.2).
(f) Marking required (see 5.3).
(g) Density, if different than range (see 1.2).
(h) The fire retardant material shall be furnished when specified.

MILITARY INTERESTS

Military Coordinating Activity

Army - GL

Custodians

Army - GL
Navy - AS
Air Force - 69

Review activities:

Army - AR, MI
Navy - OS, SA, SH

User activities:

Army - SM
Air Force - 70, 71, 80, 84

DYNAMIC CUSHIONING CURVE

PPP-C-1752C Type I, Class 2

2-5 drop average, 2" thickness, 24" drop

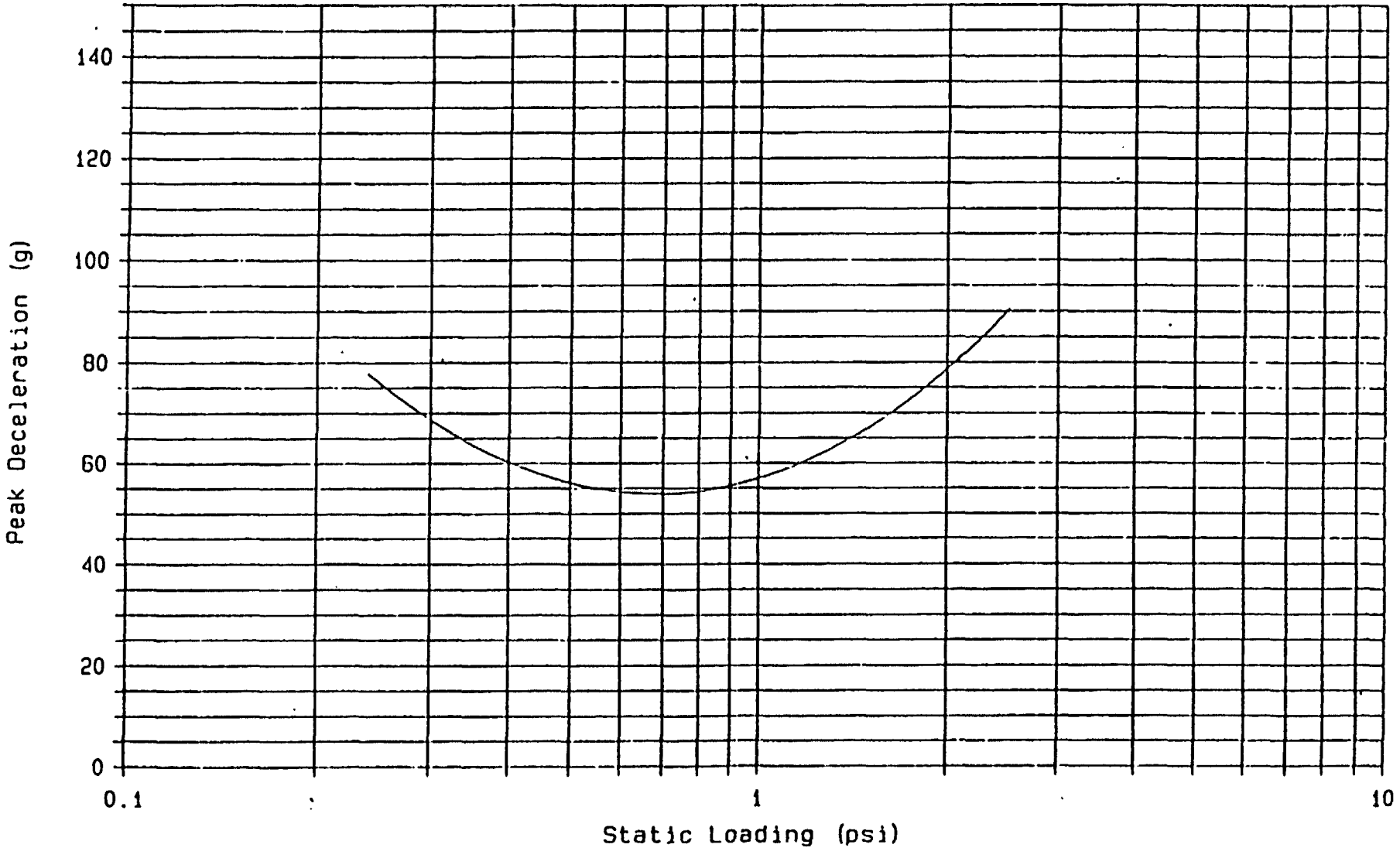

FIGURE 1.

DYNAMIC CUSHIONING CURVE

PPP-C-1752C Type III, Class 2
2-5 drop average, 2" thickness, 24" drop

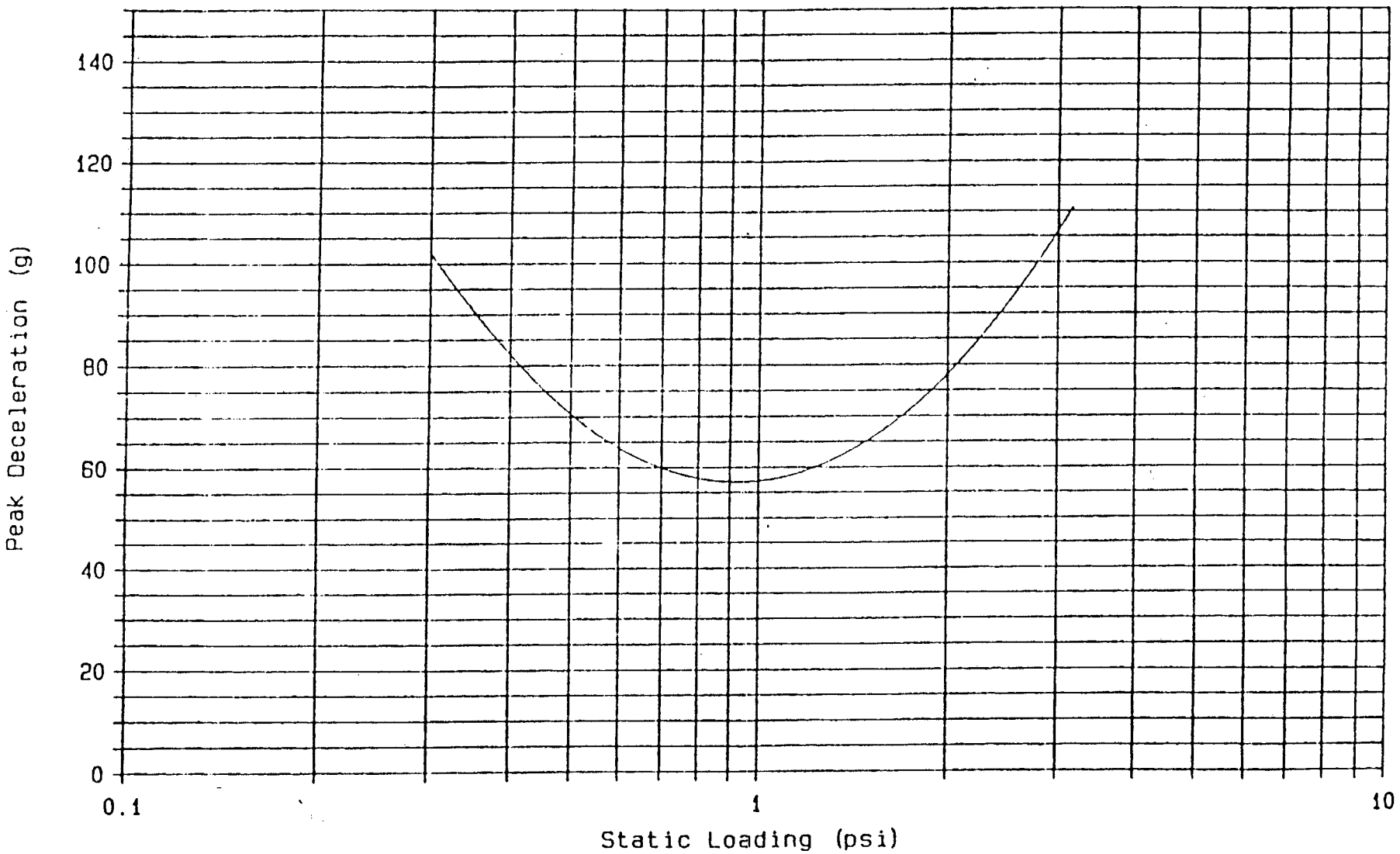

FIGURE 2.

DYNAMIC CUSHIONING CURVE

PPP-C-1752C Type IV, Class 2
2-5 drop average, 2" thickness, 24" drop

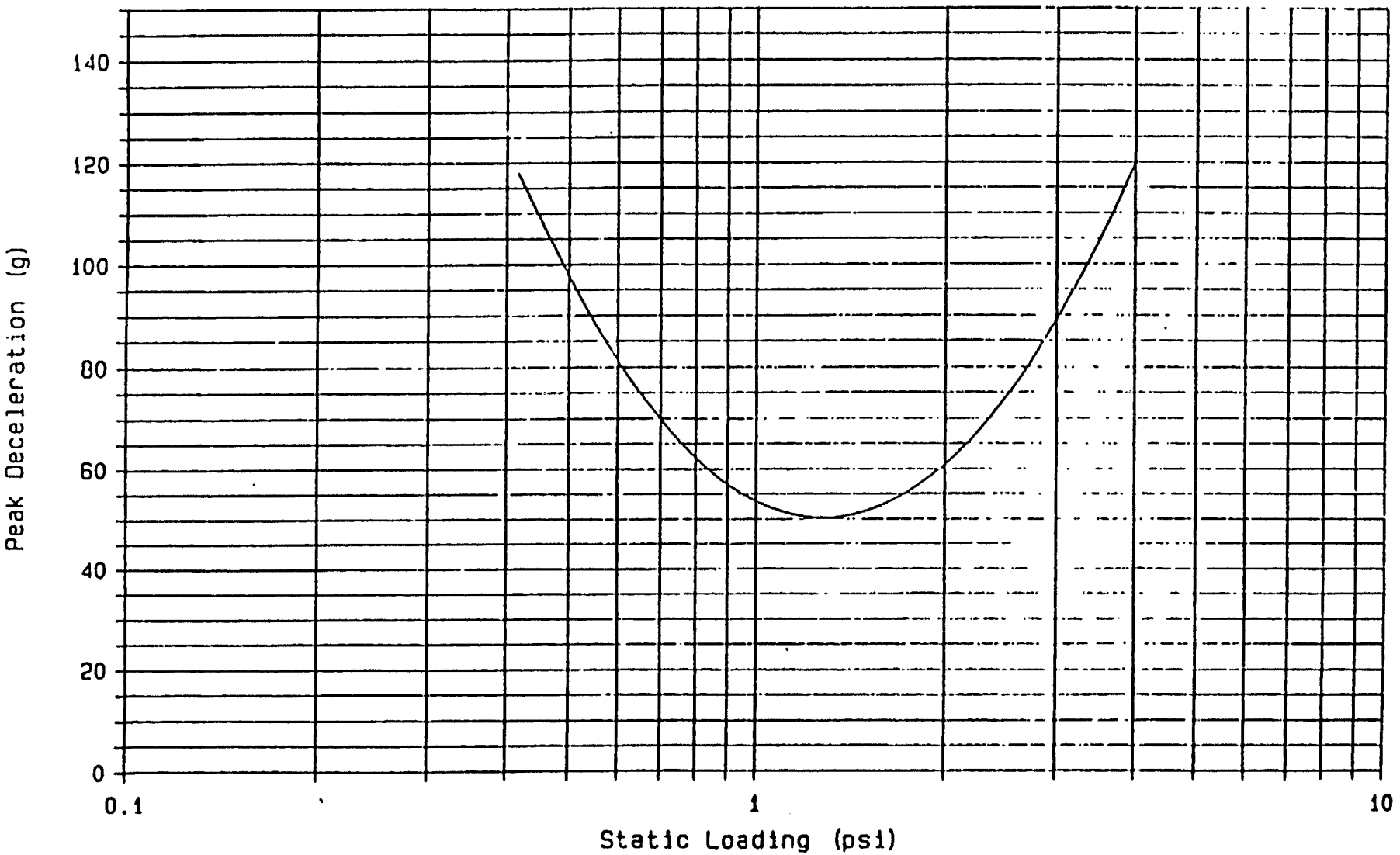

FIGURE 3.

DYNAMIC CUSHIONING CURVE

PPP-C-1752C Type V, Class 2

2-5 drop average, 2" thickness, 24" drop

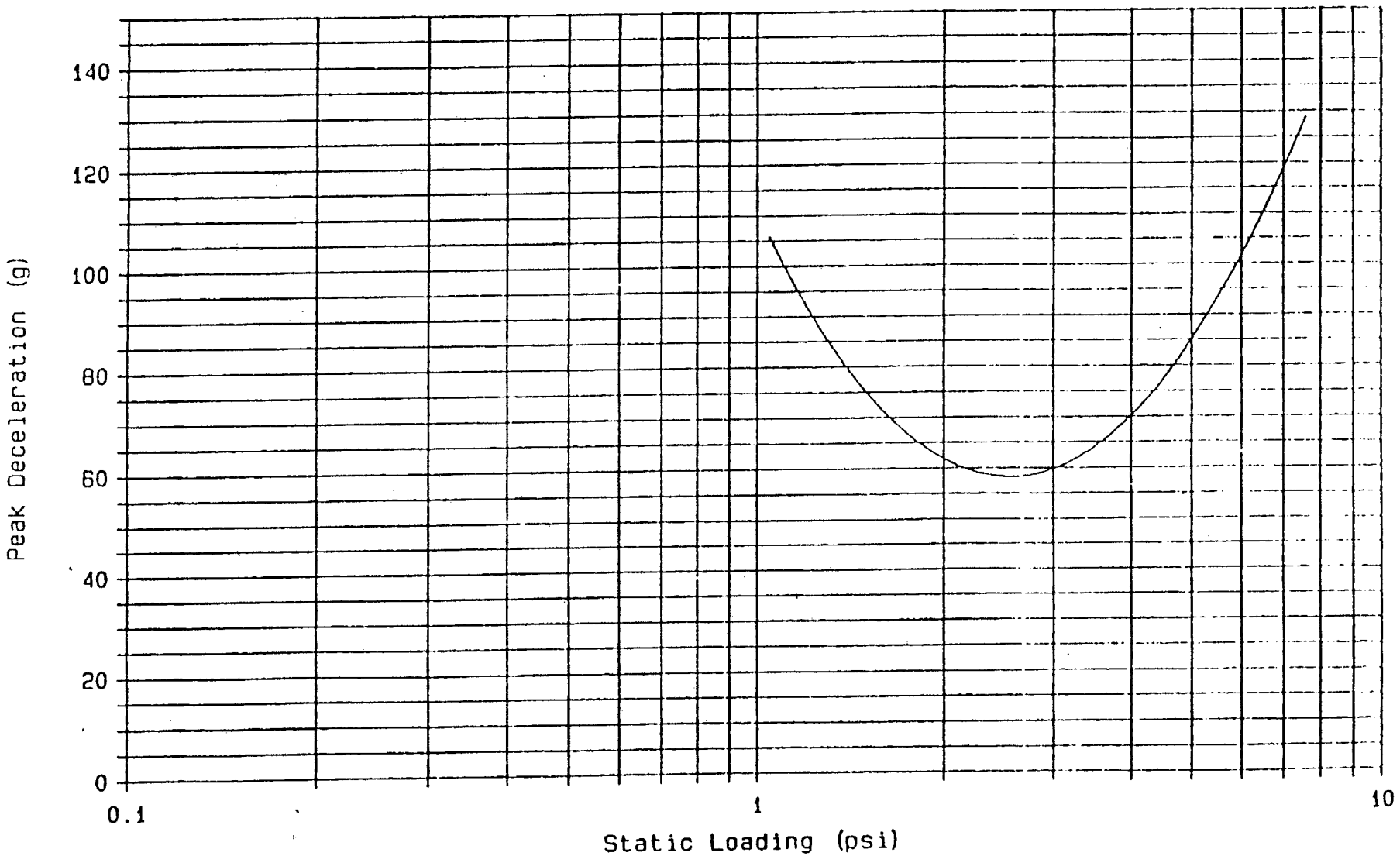

FIGURE 4.

DYNAMIC CUSHIONING CURVE

PPP-C-1752C Type VI, Class 2
2-5 drop average, 2" thickness, 24" drop

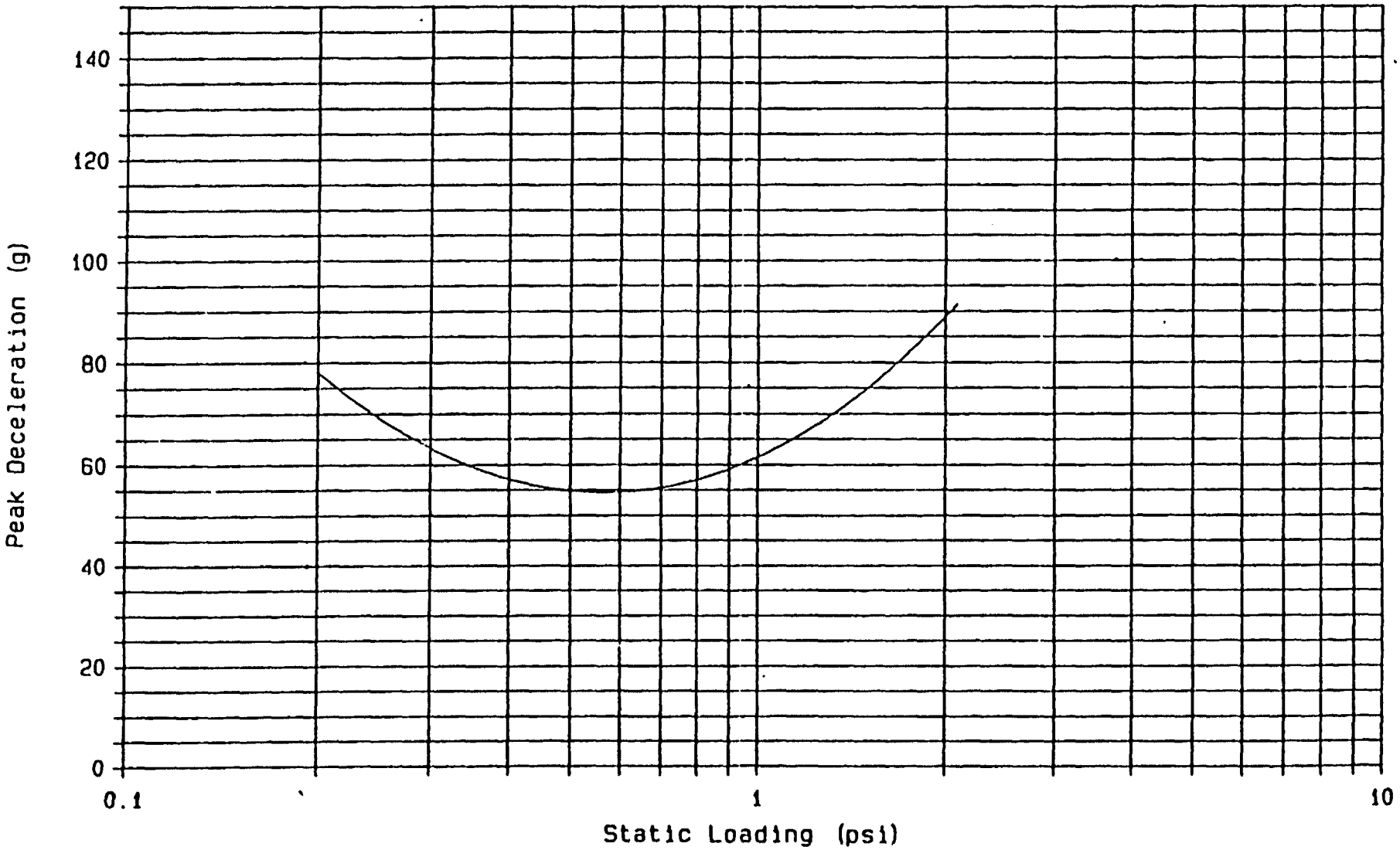

FIGURE 5.