MIL-STD-1186 – Cushioning, Anchoring, Bracing, Blocking and Vaperproofing with Appropriate Test Methods

Subject/Scope:

This standard covers common packing requirements which may be omitted from detailed specifications for items or categories of items when this standard is referenced in the detail specification. It does not contain requirements for shipping containers themselves or for preservations of items both of which may also provide physical protection. Tests for determining the adequacy of the protective measures to prevent damage to the items or materials (barriers) are included in Appendix A. Quality Assurance provisions are given in Appendix B and forms a mandatory part of this standard. Appendix C is for general information only.

Keywords:

Bracing, container, blocking, material, wood, cushioning, water, bolt, fiberboard, test, strapping, load, requirement, nail, document, damage, inspection, protection, weight, document, corrugated, anchor, corner, direction, packaging, flute, shipping, prevent, member, method, standard, proof, wrap, case, barrier, liner, class, drop, tiedown, surface, member, plywood, nail, bolt, packing, specification, design, method, clearance, army, proposal, military, shipment, bursting, barrier, dangerous

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Text in blue boxes such as this one is instructional and is intended to assist you in understanding the document.

Text in red boxes such as this explains changes made to the document by The Wooden Crates Organization.

Red text has been added to the document or modifies the document since its final version was officially published.

Soft Conversion of Imperial to Metric

Conversions, when made, consider materials that are available in metric or imperial sizes rather than converting sizes exactly. For example: Panelboard (plywood) in the US is typically 4 feet X 8 feet (1220 x 2440 mm) while panelboard in metric countries is typically 1200 X 2400 mm. Since the standard was developed based on readily available materials these variations in material sizes could not have been practically considered.

The content of the document below has not been modified.

MIL-STD-1186A
12 March 1981
SUPERSEDING
MIL-STD-1186
28 October 1963

MILITARY STANDARD

CUSHIONING, ANCHORING, BRACING, BLOCKING AND WATERPROOFING; WITH APPROPPIATE TEST METHODS

FSC PACK

DEPARTMENT OF DEFENSE

Washington, D.C. 20301

Cushioning, Anchoring, Bracing, Blocking and Waterproofing; with Appropriate Test Methods

MIL-STD-1186A

1. This Military Standard is approved for use by all Departments and Agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: US Army Mobility Equipment Research and Development Command, ATTN: DRDME-DS, Fort Belvoir, VA 22060 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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1. SCOPE

1.1 Scope. This standard covers common packing requirements which may be omitted from detailed specifications for items or categories of items when this standard is referenced in the detail specification. It does not contain requirements for shipping containers themselves or for preservations of items both of which may also provide physical protection. Tests for determining the adequacy of the protective measures to prevent damage to the items or materials (barriers) are included in Appendix A. Quality Assurance provisions are given in Appendix B and forms a mandatory part of this standard. Appendix C is for general information only.

1.2 Application. The requirements contained herein are confined to the protective measures applied to items in their shipping configuration and when applicable, this document should be specified in the packing section of procurement documents.

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

FEDERAL

L-P-378	- Plastic Sheet and Strip, Thin Gauge, Polyolefin.
FF-B-584	- Bolts, Finned Neck, Key Head, Machine, Ribbed Neck, Square Neck, Tee Head.
FF-N-105	- Nail, Brads, Straples and Spikes, Wire, Cut and Wrought.
FF-W-92	- Washer, Metal, Flat (Plain).
NN-P-530	- Plywood, Flat Panel.
QQ-S-781	- Strapping, Steel and Seals.
TT-I-1795	- Ink, Marking, Stencil Opaque (Porous and Nonporous Surfaces).
UU-T-81	- Tag, Shipping and Stocks.
MMM-A-260	- Adhesive, Water Resistant, (For Sealing Waterproof Paper).
PPP-B-1055	- Barrier Material, Waterproofed, Flexible.
PPP-C-843	- Cushioning Material, Cellulosic.
PPP-C-850	- Cushioning Material, Polystyrene Expanded, Resident (For Packaging Uses).
PPP-C-1120	- Cushioning Material, Uncompressed Bound Fiber for Packaging.
PPP-F-320	- Fiberboard, Corrugated and Solid, Sheet Stock (Container Grade), and Cut Shapes.

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MIL-P-116	- Preservation-Packaging, Methods of.
MIL-L-10547	- Liner, Case, and Sheet, Overwrap, Water Vaporproof or Waterproof, Flexible.
MIL-P-19644	- Plastic Molding Material (Polystyrene Foam, Expanded Bead).
MIL-P-21929	- Plastic Material, Cellular Polyurethane, Foam-in-Place, Rigid 2 and 4 Pounds per Cubic Foot.
MIL-B-22191	- Barrier Material, Transparent, Flexible, Heat Sealable.
MIL-P-24249	- Plastic Material, Cellular Polyurethane, Rigid, Void Filler, Pour-in-Place, Large Scale and Installation of.
MIL-P-26514	- Polyurethane Foam, Rigid or Flexible, for Packaging.
MIL-F-26862	- Fiberboard, Solid, Non-Corrosive, Fungi-Resistant for Interior Blocking Applications.

STANDARDS

FEDERAL

FED-STD-101	- Preservation, Packaging and Packing Materials, Test Procedures.

MILITARY

MIL-STD-731	- Quality of Wood Members for Containers and Pallets.

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

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

TM 38-250 (AFR 71-4, NAVSUP PUB 505, MCOP4030.19, DSAM 4145.3) - Packaging and Handling of Dangerous Materials for Transportation by Military Aircraft.

U.S. Department of Agriculture, Forest Products Laboratory, Agriculture Handbook No. 72, Wood Handbook, Wood as an Engineering Material.

3. DEFINITIONS

3.1 Anchoring. The securing of an item to its shipping container so as to prevent any movement of the item within the container.

3.2 Blocking and bracing. A means used to immobilize an item during shipment and storage.

3.3 Cushioning. A means used to absorb the energy of shocks and vibrations through a gradual but increasing resistance to the movement of the item.

3.4 Fragility. The inherent physical properties of an item that limit its ability to withstand shock or vibration without damage.

3.5 Packaging. The processes and procedures used to protect material from deterioration and damage, including appropriate cleaning, drying, preserving, packing, marking and unitization.

3.6 Packing. Assembling of items into a unit, intermediate or exterior pack with necessary blocking, bracing, cushioning, anchoring weatherproofing, reinforcement and marking.

3.7 Preservation. Application of protective measures, including cleaning, drying, preservative materials, barrier materials, cushioning, and containers when necessary.

4. GENERAL REQUIREMENTS

4.1 Material. Material shall be as specified herein. Materials not definitely specified herein shall be as specified by the item specification, contract or order.

4.1.1 Recycled material. It is encouraged that recycled material be used when practical as long as it meets the requirements of the specification.

4.2 Dangerous articles. The packaging of commodities in accordance with this standard which come within the scope of the Interstate Commerce Commission Rules and Regulations for the Transportation of Explosives or other dangerous articles, 49CFR-100-199, and other applicable documents, shall conform to the regulations in all respects without exception. In addition, packaging of dangerous materials for air shipment shall be in accordance with the joint Air Force, Army, Navy Manual, TM 38-250, Packaging and Handling of Dangerous Materials for Transportation by Military Aircraft (AFR 71-4, TM 38-250, NAVSUP PUB 505, MCOP4030.19, DSAM 41453).

4.3 Weight limitations. Whenever design considerations limit the gross weight of individual shipping containers, a maximum gross weight limit shall be stated in the specification, contract, or order.

4.4 Performance. When packs prepared for shipment in accordance with the detailed requirements of this standard are tested for any rough handling

required by the specification, contract, or order, there shall be nc settlement or shifting of the packed item. Further, the testing shall cause no damage to the item and shall not loosen, break, or displace the anchoring, blocking, or bracing. The testing shall not render the interior containers, wraps, liners, barriers, or cushioning ineffectual in providing continued adequate protection to the contents.

5. DETAILED REQUIREMENTS

5.1 Arrangement of contents. The contents of a pack shall be arranged to provide the smallest practical cubage, convenient handling, suitability for unitization while permitting a container to be fabricated in the most economical method. The contents shall completely fill the container or be secured therein with suitable clearance (see 5.5) to prevent damage.

5.1.1 Disassembled parts. When practical, items shall be disassembled to afford protection of components, attachments, and accessories against damage and pilferage and to reduce cubage. Disassembled parts shall be preserved, anchored, braced, blocked, and cushioned to prevent damage. Disassembled parts shall be clearly and legibly marked as to identity and proper location on the assembled item. All fasteners removed during disassembly shall be secured in one of the mating parts. A part shall not be removed from an assembly unless it can be reassembled readily in the field without special tools.

5.1.1.1 Matchmarking. Disassembled parts shall be matchmarked when necessary to facilitate reassembly. Removed parts and mating parts on the item shall be matchmarked by stenciling on the part or by the use of tags. Tags shall conform to UU-T-81, type A or D. Stencil ink shall conform to TT-I-1795 and tags shall be printed or typed with waterproof ink.

5.1.2 Moveable parts and projecting parts. Articles with moving external parts or projecting parts that might become damaged by shock or vibration encountered in shipment shall have these parts made secure against movement by means of blocking, bracing, tiedown, or other adequate provisions; or shall be disassembled, if practicable.

5.1.3 Segregation of packaged contents. So far as practicable, contents of shipping containers shall be segregated in the following order: (a) the order on the packing list; (b) items of the same contract; (c) items of the same National Stock Numbers; and (d) items of the same Federal Supply Class.

5.1.4 Conversion of type 3 load. Where practicable, type 3 loads shall be converted to type 1 or type 2 loads.

5.1.5 Surface corrosion. Only wrapping, cushioning and dunnage materials meeting requirements of FED-STD-101, method 3005 shall be used in contact with unprotected surfaces susceptible to damage from corrosion or deterioration.

5.2 Cushioning. Where applicable, cushioning shall be used in one or more of the following ways to provide necessary physical protection. Cushioning materials containing asphalt shall not be permitted to come in direct contact with highly finished, varnished, or lacquered surfaces. Materials shall be as clean and dry as practicable.

5.2.1 Flotation or suspension. Delicate or fragile items shall be protected against shock and vibration by flotation or suspension within the shipping container by suitable cushioning materials. These materials may be in sheet form applied to give support at top, bottom, sides, and ends of the item. For items in sturdy cabinets, cases, consoles, or packed in an inner box, the cushioning material may be in the form of prefabricated corner pads. Materials shall be bound fiber conforming to PPP-C-1120, fiberboard conforming to MIL-F-26862; cellulosic material conforming to specification PPP-C-843 (see 5.2.4) expanded polystyrene conforming to PPP-C-850; polyurethane foam conforming to MIL-P-26514; or such other materials meeting the requirements specified herein or as specified in the procurement documents.

5.2.2 Abrasion protection. Protection against abrasion shall be provided for highly finished or easily marred surfaces by wrapping or covering with a cushioning material, which is nonabrasive and meets the requirements of 5.1.5.

5.2.3 Coatings and barriers. Protection shall be provided for strippable compound coatings and for grease-proof, water-proof, or water vapor-proof barriers at points of contact with blocking, bracing, or projecting members of containers. Cushioning materials shall be applied to reduce the static pressure at points of contact to 30 pounds or less per square inch.

5.2.4 Moisture resistance. Unless otherwise specified in the product specification, cushioning material conforming to PPP-C-843 shall be of the water-resistant type.

5.2.5 Dusting. Cushioning materials that are not dust producing shall be used for packing items that are adversely affected by dust, unless a dustproof barrier is used to prevent dust from reaching the item.

5.3 Blocking and bracing. Items which do not completely fill the shipping container shall be blocked, braced, anchored, or otherwise immobilized within the container. Items or moveable parts of items mounted on springs or other flexible supports shall be braced securely to prevent movement, except where such mounting is part of the package cushioning or is designed to protect against shock and vibration during shipment. The materials selected for all blocking and bracing and the design and application of the blocking and bracing shall be compatible with the load to be supported and the size, shape, and strength of bearing areas of the item.

5.3.1 Surface abrasion and corrosion. When the surface of the item in contact with the blocking and bracing can be damaged by relative motion between the contacting surfaces or could become corroded as a result of such contact, the contacting surfaces shall be separated by a barrier material meeting requirements of 5.1.5.

5.3.2 Corrugated fiberboard forms. Corrugated fiberboard used for blocking and bracing shall conform to PPP-F-320, class weather resistant or domestic. In certain instances where the levels of moisture and humidity are expected to have a detrimental effect on the integrity of the blocking and bracing, weather resistant fiberboard shall be specified. Blocking and bracing forms shall be loaded in the direction parallel to the flutes wherever possible. The cutting, slotting, scoring, and folding of fiberboard blanks to make blocking and bracing supports or forms shall be such as to assure proper fitting and distribution of load.

5.3.2.1 Open-end cells and trays. Open-end cells and trays, as shown in figures 1 and 2, shall be used for blocking and bracing deep recesses; bridging long projections; providing spaces for disassembled parts, accessories, and desiccants; and providing clearance between item and container. Bracing supports shall bear directly on the article. Allowable loads for bracing supports of open-end cells loaded in the flute direction shall be in accordance with table I. If flute direction is at right angles to the direction of the load, the allowable loads shall be 50 percent of the values of table I. Trays shall be scored and folded parallel to the flute direction and shall not exceed 4 inches in height.

TABLE I. Allowable loads for corrugated fiberboard columns loaded in the flute direction.

Material	Allowable loads per lineal inch of bracing support or column 1/	
	Height up to 4 inches	Height over 4 inches
	Pounds	Pounds
Double-faced fiberboard:		
200-pound bursting strenght	2	1
275-pound bursting strength	2.5	1.5
350-pound bursting strength	3	2
Double-wall fiberboard:		
275-pound bursting strength	2.5	1.5
350-pound bursting strength	3	2
500-pound bursting strength	4	2.5
Triple-wall fiberboard:		
1,100-pound puncture resistance	5	4

1/ Note: When a greater load is imposed than that permitted by the table, use wood blocking and bracing.

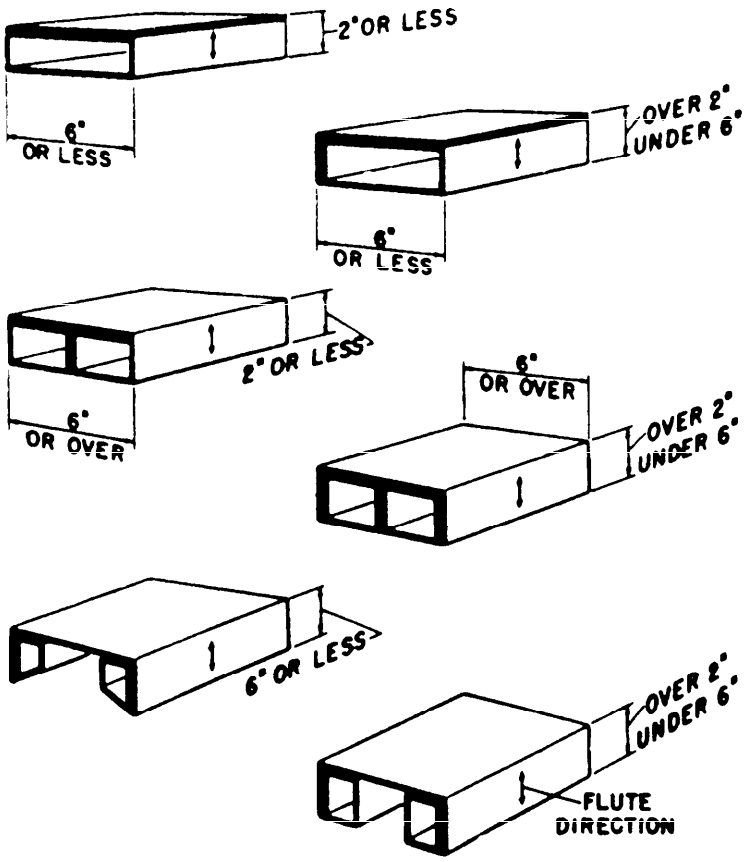

FIGURE 1. Trays and open end cells.

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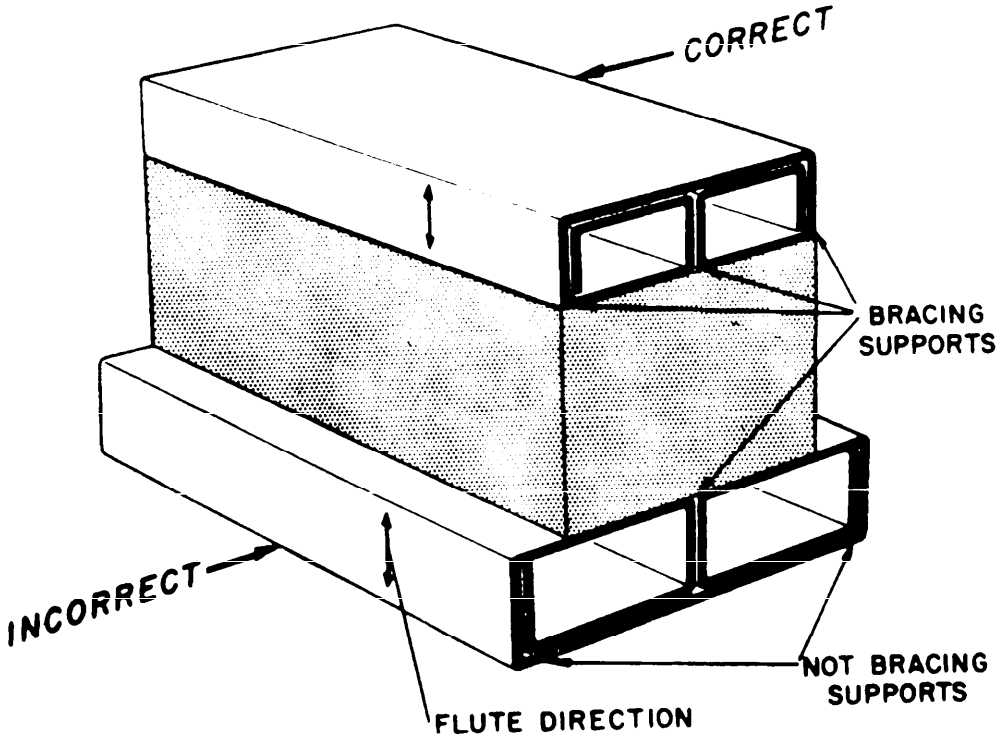

FIGURE 2. Bracing supports shall bear directly on the article.

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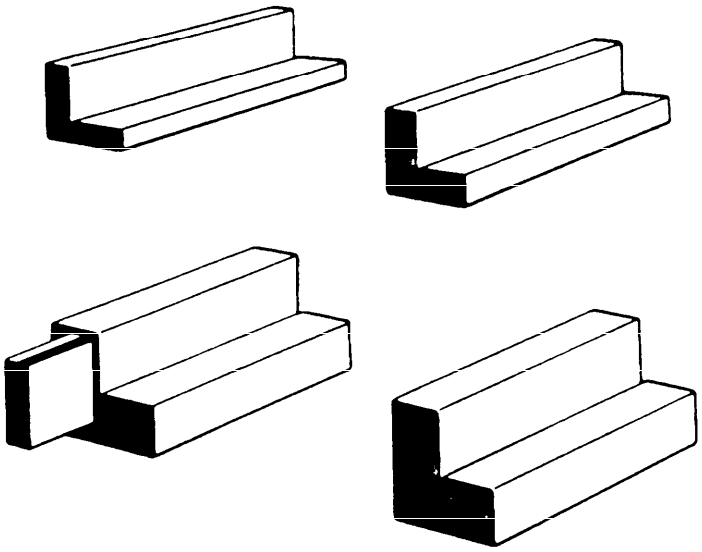
5.3.2.2 Folded pads. Folded pads of corrugated fiberboard as shown in figure 3 may be used for blocking greater loads than are feasible to support with cells and trays. The pads shall be designed to fit against a flat surface (flat pads) or along an edge (corner pads). Connecting webs between flat pads shall always contact the container and not the item. All scores and folds shall be made at right angles to the flute direction. Flat pads shall be a minimum of 2 inches wide. Portions of folded pads in direct contact with the item are bearing areas. The maximum loads for these bearing areas shall be in accordance with table II.

TABLE II. Allowable loads for folded corner and flat pads of corrugated fiberboard.

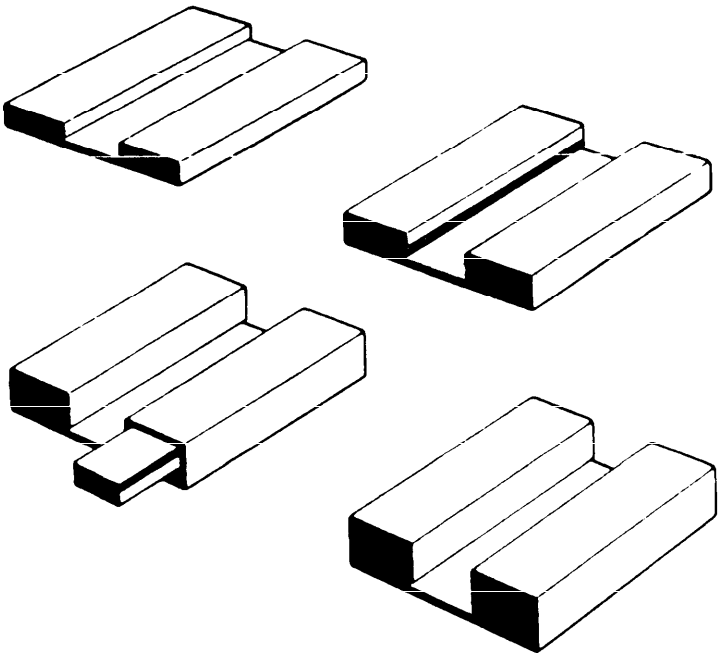
Flute design	Maximum allowable load for bearing areas 1/ Pounds per square inch
A-flute (36 ± 3 corrugations per foot)	2.0
B-flute (50 ± 3 corrugations per foot)	3.0
C-flute (42 ± 3 corrugations per foot)	2.5

1/ Note: The flat crush resistance of the corrugations shall determine the load that may be carried in flat loading of corrugated fiberboard. This shall not be construed to mean the bursting strenght of the material.

5.3.2.3 Flat pads. Flat pads of corrguated fiberboard may be used to block very shallow projections, such as hinges or slight offsets on surfaces; to level off projecting screw heads; to fill in the space between ends of inner flaps of slotted fiberboard boxes; to provide additional protection to contents at top and bottom of boxes; and to separate items within a container. Allowable loads shall be in accordance with table II.



CORNER PADS



FLAT PADS

FIGURE 3. Corrugated fiberboard accordion folded pads.

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5.3.2.4 Corner pads. The use of corner pads made of multiple layers of corrugated fiberboard, as shown in figure 4, shall comply with the load requirements of table II. The pads shall provide required clearances (see 5.5) and support for rectangular shaped items or for an inner box in which items are packed.

5.3.2.5 Tubes. Fiberboard tubes shall be used as blocking when items mounted on an auxiliary base are packed in fiberboard boxes. The bottom of the tube shall contact the top of the auxiliary base and the top of the tube shall contact the top inside surface of the container. The flutes shall be oriented in the top-to-bottom direction of the tube. The weight of the item plus auxiliary base, in pounds, divided by the perimeter of the tube, in inches, shall not exceed the appropriate values given in table I for column heights over 4 inches.

5.3.2.6 Corner posts. Fiberboard corner posts shall be used to reinforce the shipping container and provide blocking for platform-mounted equipment. The flutes shall be oriented in the top-to-bottom direction. The bottom end of the corner post shall bear on the inner flap of the container or top member of a crate.

5.3.3 Other rigid, low-density materials. Other rigid, low-density materials, such as solid fiberboard conforming to PPP-F-320 and MIL-F-26862, and rigid foam or cellular plastics conforming to MIL-P-19644, MIL-P-24249 or MIL-P-21929, cut, foamed in place, molded, or otherwise formed as required, may be used for appropriate blocking and bracing applications.

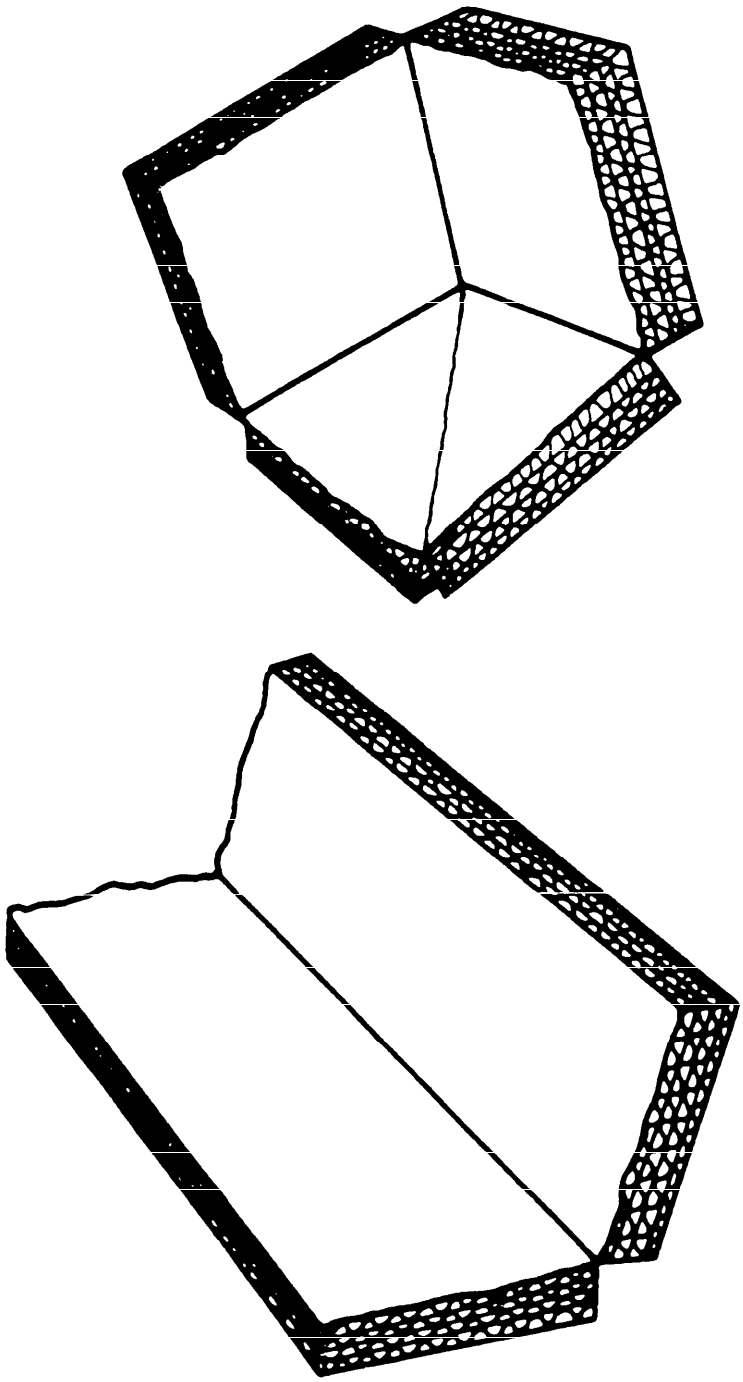

FIGURE 4. Multiple - layer corrugated fiberboard corner pads.

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5.3.4 Wood and plywood. Wood or plywood may be used alone or in combination for blocking and bracing. Wood or plywood blocking and bracing members shall bear against only those parts of the packed item capable of withstanding the applied dynamic forces or shall bear against blocking pads or pressure strips that adequately distribute these forces. Wood or plywood blocking and bracing shall be designed to permit easy removal without damage to the item. Strengths of wood and plywood members may be calculated from information given in USDA Agriculture Handbook No. 72.

5.3.4.1 Wood. Wood used for blocking and bracing shall conform to MIL-STD-731. One wood member of each size and type used in the blocking and bracing shall be tested for moisture content. Structural members (those subject to critical bending stresses) shall conform to class 1 of MIL-STD-731. All other blocking and bracing members shall conform to class 3. Whenever possible, wood blocks or braces shall be placed so that the load is applied against the end grain of the member. Ends of braces shall be socketed or fitted and secured into appropriate notches in load-bearing members.

5.3.4.2 Plywood. Plywood used for blocking and bracing shall conform to NN-P-530, group A, (grade 3-4, type II) or group B, (C-D, interior with exterior glue).

5.3.5 Nails and nailing. Nails shall conform to the requirements of specification FF-N-105. All nails that are not clinched shall be cement coated, etched, or mechanically deformed (helically or annularly threaded). Unclinched nails shall be as long as practicable without splitting the material, but not shorter than three times the thickness of the member holding the nailhead for ten penny nails and smaller, or not shorter than the thickness of the same member plus 1-1/2 inches for twelve penny nails and larger. Nails loaded in shear blocking and bracing joints need not be clinched. End grain nailing in solid wood or edge nailing in polywood shall not be permitted. Nails shall be driven through the thinner member into the thicker member wherever possible. Nails shall not be subject to withdrawal stresses. Nails shall be driven no closer to the end of a piece of lumber than the thickness of the piece and not closer to its side than one-half its thickness. There shall be at least two nails in each joint. Lateral loading of nails for blocking and bracing shall be in accordance with table III. Ends of blocks and braces shall not be fastened to a wood container by end-grain nailing, toe nailing, or similar methods but shall be fastened to a sturdy part of the container or held in place by parallel cleats or other side-grain nailing methods. Blocking and bracing shall be applied against areas of the item(s) that are of sufficient strength and rigidity to resist damage.

5.3.6 Bolt application. Bolts shall be used as fastenings for wood or plywood blocking and bracing where necessary to facilitate disassembly for removal of container contents. Bolts shall also be used for fastening, blocking and bracing members that are too thick for proper fastening with nails. Boltholes in wood or plywood shall be of the same diameter as the bolts. A flat washer of proper size shall be used under the nut of each bolt. Bolts, nuts, and washers shall conform to the requirements of 5.4.1.

5.4 Anchoring. Anchoring of heavy items shall be accomplished by securing the item to a base by tension devices, either by bolts through mounting boltholes on the item (bolting down); or by metal strapping, cables, tie rods, chains, wire, or other tension devices attached to, or applied over, the item (tiedown and holddown); or by both. The same washer requirement as specified for bolts (see 5.4.1) of equal diameter shall apply to tie rods.

TABLE III. Allowable loads for unclinched cement-coated or etched common wire nails when used for blocking or bracing

	Load, pounds per nail								
Species of Wood 1/	4d	6d	8d	10d	12d	16d	20d	30d	40d
White pine, ponderosa pine, spruce, and other group I woods.	14	17	21	25	26	29	38	42	48
Southern yellow pine, Douglas fir, western larch, and other group II woods.	21	26	32	39	40	45	58	65	73
Oak, maple, birch, beech, ash, and other group III and IV woods.	26	32	40	48	49	55	71	80	90

1/ Group classification of species not specifically named shall be in accordance with MIL-STD-731.

5.4.1 Anchor bolts. Carriage or step bolts conforming to FF-B-584, type I, class 1, style A or C shall be used. Articles having mounting holes in areas that can withstand rough handling without breakage shall be bolted to either the base of the container or an auxiliary base. The bolt heads of anchor bolts (those holding the item to the container base or the auxiliary base) shall be on the outside of the container when an item is bolted to the base of the container, otherwise on the underside of the auxiliary base. The heads of all anchor bolts shall bear against a wide washer conforming to FF-W-92, type A or B, grade 1, class A except that the minimum diameter or minimum size of square shall be as specified in table IV when bolt head is against a wood member. Bolts through mounting boltholes shall form a snug fit, except that precision holes shall be bushed to prevent damage by anchor bolts. In a crate where the item is bolted to a skid-type base, the anchor bolts shall pass through the skids or through load-bearing members that are bolted to the skids. Boltholes in wood shall be of the same diameter as the bolts. The maximum allowable load for anchor bolts required and the minimum size of wood-bearing washers shall be as specified in table IV. When the weight of the item exceeds that which can be anchored adequately using allowable loads shown in table IV and all of the available mounting boltholes on the item, the excess weight shall be taken care of by tiedown provisions specified herein. Loosening of the installed nuts shall be

prevented by either nicking the exposed threads of the bolt; applying paint, asphaltum or P-1 of MIL-P-116; using lock nuts; or using cotter pins. The required size and quantity of bolts used as tie rods or for anchoring the ends of the tiedown tension members shall be in accordance with table IV. Lag bolts (screws) shall not be used for anchoring.

TABLE IV. Maximum allowable loads and minimum sizes of wood-bearing washers for anchor or tiedown bolts.

Wood-bearing washers			Maximum allowable load per bolt		
Diameter of bolt	Minimum diameter of round	Minimum size of square	Items weighing 200 pounds and less	Items weighing 200 to 3,000 pounds	Items weighing over 3,000 pounds
Inch	Inch	Inch	Pounds	Pounds	Pounds
1/4	1.35	1.00	10	--	--
5/16	1.75	1.25	30	--	--
3/8	2.10	1.50	50	75	--
1/2	2.85	2.10	100	150	300
5/8	3.60	2.65	150	225	450
3/4	4.70	3.25	--	375	750

5.4.2 Metal strapping. Metal strapping used to tiedown an item to the base or other face of the container or to an auxiliary base shall conform to QQ-S-781 class 1, type I or IV or class 2, type V or VI. Tiedown strapping shall be securely attached to or looped over the item. It shall be anchored to the container or auxiliary base either by looping around a load-bearing member or by utilizing steel slotted anchor plates for flat strapping or drivescrews and staples for round strapping. Padding material or suitable edge protectors, as applicable, shall be used under the straps to prevent damage to the item. Whenever possible, all strands holding down an item shall be of approximately the same length. All tiedown strappings shall be tensioned and sealed securely. Strapping shall be finish B when exposed to the weather and finish A when used in a protected environment such as a covered crate, etc.

5.4.2.1 Minimum lenght of straps. The minimum total length of strapping of a given cross section area required for securing a given load can be calculated from the following formulas:

for flat strapping

$$L = \frac{P}{300\ Wt} \quad \text{and}$$

for round strapping

$$L = \frac{4P}{300\ TT\ D^2}$$

where P = load

W = width of flat strapping
t = thickness of flat strapping
D = diameter of round strapping
L = total lenght of strapping required
TT = 3.14

The calculated length of strapping required does not include that portion of material used to make secure fastenings at the ends of each strand but is the sum of and does include all lengths of material between such fastenings. Overall lengths of each strand shall be adequate to permit fastening as specified in 5.4.2. The load capacity of steel strapping is based on available energy of 8640 inch-pounds per cubic inch of strap in tension at a drop height of 30 inches. The above formulas are applied on the basis of 300 pounds of load per cubic inch of strap in tension.

5.5 Clearance. When an item is blocked, braced, anchored, or tiedown to the inside of one face of a container or to an auxiliary base which, in turn, is so secured, a clearance of not less than 1 inch shall be provided between the item and all members of the remaining faces of the container. A minimum clearance of 2 inches shall be provided around fragile parts of the item that might be damaged due to slight distortion of the container. A minimum 2-inch clearance shall also be provided between items within floating bag barriers and ajacent members of the container.

5.6 Waterproofing. Except as provided herein, water-proof liners, wraps, shrouds, or other suitable means shall be provided in shipping containers as necessary to prevent the entry of water. Such protection, however, is not necessary when items, dunnage, exterior cushioning, and interior packages are water-resistant or otherwise water-proofed. Water-proof liners, wraps, shrouds, or other similar protection shall also be required where such protection against the entry of dust, dirt, and other foreign matter is necessary. All seams shall be completely and continuously sealed to provide water resistance equivalent to that provided by the barrier material itself. Barrier materials and sealants constructed with asphaltum shall not be used in the presence of moth-proofing chemcials such as paradichlorobenzene and napthalene. Barrier materials and sealants constructed with asphaltum shall not be used to protect items subject to stain or other damage by asphalt, unless such items are initially protected to exclude asphalt. All sharp points of contact between an item and barrier material shall be cushioned to prevent rupture or chafing of the barrier.

5.6.1 Liners and linings (see 30.2).

5.6.1.1 Case liners. Case liners shall be fabricated and closed in accordance with MIl-L-10547, type and grade as applicable for specific requirements.

5.6.1.2 Linings for drums, kegs, barrels, and bags. Linings shall be provided for drums, kegs, barrels, or bags when their contents require protection not otherwise provided by the containers against sifting, contamination or free water. The lining material shall conform to specification PPP-B-1055 or MIL-F-22191. Fabrication and closure seams shall be heat-sealed or sealed with adhesive conforming to MMM-A-260 as applicable.

5.6.2 Water-proof and water-vaporproof wraps. Water-proof and water-vaporproof wraps shall be fabricated and sealed in accordance with MIL-L-10547.

5.6.2.1 Unsealed water-proof wraps. Unsealed water-proof wraps shall be applied to shed water while permitting breathing and circulation of air.

5.6.3 Shrouds. Shrouds shall be fabricated from material conforming to specification L-P-378, or PPP-B-1055 of a class as specified for shrouds. Seams shall be made using adhesive conforming to MMM-A-260 or by heat sealing, as applicable. There shall be no constricting external ties binding the shroud to upper parts of the item, but the sides and ends of the shroud shall hang or be drawn down as straight as is feasible and secured to the base of the item or container. The fastening at bottom shall prevent tearing or loosening of the shroud by storms. There shall be no snagging of the applied shroud that will form catchment areas to trap and hold water. Bottom openings to permit breathing and drainage shall be provided.

Custodian:
Army - ME
Navy - SA
Air Force - 69

Preparing activity:
Army - ME

Review activities:
Army - MI, MT, SM, EA
Navy - EC, YD
Air Force - 99
DLA - GS

Project: PACK-0507

APPENDIX A

TEST METHODS

10. GENERAL

10.1 Scope. This appendix covers requirements for the testing of packs prepared for shipment. While this appendix does not cover the complete realm of tests available to assure pack integrity, it does include the more commonly used test procedures for assuring the packs capability to withstand rough handling.

20. APPLICABLE DOCUMENTS

20.1 Issues of documents. The following document, of the issue in effect on date of invitation for bids or request for proposal forms a part of this specification to the extent specified herein:

FED-STD-101 - Preservation, Packaging, and Packing Materials.

30. REQUIREMENTS

30.1 Failure criteria. At the conclusion of the tests or at any time during the tests as deemed necessary by the Government, the pack shall be examined. Any shifting of contents, loosening or breaking of holdowns, ties, stays, blocking or bracing, any visible damage to the contents, or any other discernible damage which would render the pack useless for its intended use shall constitute failure of this test.

30.2 Drop tests. The free fall drop test shall only apply to containers having no one dimension over 60 inches and a gross weight of 200 pounds or less. The cornerwise-drop test and edgewise-drop test shall only apply to larger containers over 200 pounds gross weight or with any dimension exceeding 60 inches.

30.2.1 Free fall drop test. The container shall be drop tested in accordance with FED-STD-101, method 5007, procedure B and procedure E.

30.2.2 Cornerwise-drop test. The container shall be tested as specified in FED-STD-101, method 5005.

30.2.3 Edgewise-drop test. The container shall be tested in accordance with FED-STD-101, method 5008.

30.3 Vibration test. The container shall be vibration tested in accordance with FED-STD-101, method 5019 or 5020 as specified.

30.4 Impact tests.

30.4.1 Pendulum-impact test. The container shall be tested in accordance with FED-STD-101, method 5012.

30.4.2 Incline-impact test. The container shall be tested in accordance with FED-STD-101, method 5023.

30.4.3 Rail-impact test. The packed item, in its normal shipping configuration, shall be adequately blocked and secured to the floor of the test rail car to prevent any longitudinal, vertical or lateral movement. Loading and tiedowns shall be in accordance with applicable practices of the Association of American Railroads. The test car shall be impacted into two to five buffer cars. The buffer cars shall be located on a level section of track with the air and hand brakes set and draft gear extended. The total weight of the buffer cars shall be 250,000 pounds minimum. All cars shall be equipped with standard draft gear and conventional under frame. Three impacts shall take place at 4, 6, and 8 miles per hour (MPH) in one direction and one impact at 8 mph in the opposite direction. The velocities given are minimum values and should not be exceeded by more than is necessary to insure that these values are met.

APPENDIX B

QUALITY ASSURANCE

10. SCOPE

10.1 Scope. This appendix established the inspection methods and procedures necessary to achieve the desired quality assurance. This appendix is a mandatory part of this standard.

20. APPLICABLE DOCUMENTS

20.1 Issues of documents. The following documents, of the issue in effect on date of invitation for bids or request for proposal forms a part of this specification to the extent specified herein:

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

30. QUALITY ASSURANCE PROVISIONS

30.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements specified herein. The contractor may utilize 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 standard where such inspection are deemed necessary to assure supplies and services conform to prescribed requirements.

30.2 Material inspection. The contractor is responsible for insuring that materials used are manufactured, examined, and tested in accordance with referenced documents or as specified herein.

40. QUALITY CONFORMANCE INSPECTION

40.1 Unit of product. For the purpose of inspection, a completed pack prepared for shipment shall be considered a unit of product.

40.2 Inspection lot. When an inspection lot is required for the specific inspection plan being used, the inspection lot shall consist of identical items on the same contract or order prepared for shipment in the same manner and presented for inspection at the same time and place.

40.3 Sampling. Samples for inspection shall be selected at random from each inspection lot in accordance with procedures prescribed in MIL-STD-105.

40.4 Examination. Samples selected in accordance with 40.3 shall be examined for the defects listed below. These defects shall form a part of the quality assurance provisions of the procuring document. The Acceptance Quality Level (AQL) shall be 4.0 percent defective unless otherwise specified in the procuring document.

101. Materials not as specified.
102. Contents not arranged to provide smallest practical cubage.
103. Disassembled parts not matchmarked as specified.
104. Arrangement of contents in container not as specified.
105. Materials in contact with surfaces susceptable to damage from corrosion or deterioration not as specified.
106. Protection against abrasion for highly finished or easily marred surfaces not provided as specified.
107. Strippable coatings and barrier wraps not protected at points of contact with blocking, bracing and container projections.
108. Contents of shipping containers not immobilized as specified.
109. Allowable loads imposed on fiberboard forms exceeds the values specified herein.
110. Nails and nailing not as specified.
111. Application of bolts not as specified.
112. Application of strapping not as specified.
113. Minimum clearance between contents and container faces not as specified.
114. Water-proofing of containers not as specified.

APPENDIX C

NOTES

10. SCOPE

10.1 Scope. This appendix is intended only for information and is not a mandatory part of this standard.

20. APPLICABLE DOCUMENTS

20.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal forms a part of this specification to the extent specified herein:

MIL-HDBK-304 - Package Cushioning Design.
TM 38-230-1 - Preservation and Packaging.
(DSAM 4145.2, NAVSUP Pub 502, AFP 71-15,MCO 4030.31A)
TM 38-203-2 - Packaging.
(NAVSUP Pub 503, AFP 71-16, MCO 4030.21B)

30. NOTES

30.1 Factors influencing cushioning selection and use. Shock resulting from rough handling and shipping container is the usual cause of mechanical damage of the contents. The purpose of cushioning is to reduce the intensity of the shock reaching the packed item to a level which the item can safely withstand. Factors influencing cushion design are the fragility and weight of the item, the load-bearing area of the cushion, the dynamic force-deformation characteristics of the cushioning material, and the height of drop for which protection is desired, Among these, the fragility and weight of the item are fixed values for any particular item. The load-bearing area of the cushion can be altered by design or by packing the item in an inner container, if desired. Cushioning design curves relating fragility value of item to weight per unit of bearing area (or compressive stress due to the weight of the item) are available from cushioning material manufacturers. MIL-HDBK-304 provides design procedures for the solution of cushioning problems. There are also a number of commercial textbooks available relating to cushion design.

30.2 Disadvantages of case liners made from barrier materials other than water-vaporproof materials. Experience has shown that under some conditions, especially when contents do not fill the case liner completely, case liners do more harm than good by trapping and holding water rather than preventing its entry. It is not essential that there be openings in a sealed case liner for this to happen. If the case liner material has low resistance to water-vapor transfer (a common occurrence) water can enter in the form of vapor and condense

on contents within the liner. That this can be largely a one-way process has been proven when, at the end of an extended outdoor exposure period, sealed case liners have been opened and found partially filled with liquid water. When packed items need protection against water, it is preferable to incorporate the protection in the individual unit packages in lieu of case liners.

30.3. Supplemental information. Supplemental information on packaging may be found in the Technical Manuals on Preservation, Packaging, and Packing of Military Supplies and Equipment: Volume I, Preservation and Packaging (TM 38-230-1, DSAM 4145.2, NAVSUP PUB 502, AFP 71-15, MCO 4030.31A) and Volume II, Packing (TM 38-230-2, DSAM 4145.2, NAVSUP PUB 503, AFP 71-16, MCO 4030.21B).

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NAME OF ORGANIZATION AND ADDRESS OF SUBMITTER

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