MIL-F-45216A
15 July 1984
SUPERSEDING
MIL-F-45216
1 November 1976
MIL-F-83670 (USAF)
3 September 1979

MILITARY SPECIFICATION

FOAM-IN-PLACE PACKAGING, PROCEDURES FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification provides procedures for packaging of supplies using foam-in-place materials.

1.2 Classification. The procedures covered by this specification shall be of the following techniques, as specified (see 6.2):

Technique I	- Split pack, standard.
Technique II	- Split pack, alternate.
Technique III	- Split pack, inverted.
Technique IV	- Foam-in-bag.
Technique V	- Special technique, modified.
Technique VI	- Foamed container.
Technique VII	- Encapsulated pack.
Technique VIII	- Preformed molding.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

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

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Director, DARCOM Packaging, Storage, and Containerization Center (PSCC), ATTN: SDSTO-TP-S, Tobyhanna, PA 18466, by using the self-addressed DD Form 1426 (Standardization Document Improvement Proposal) appearing at the end of this document or by letter.

NO DELIVERABLE DATA REQUIREMENTS

SPECIFICATIONS

Federal

L-P-378	-	Plastic Sheet and Strip, Thin Gauge, Polyolefin
FF-N-105	-	Nails, Brads, Staples and Spikes: Wire, Cut and Wrought
QQ-S-781	-	Strapping, Steel, and Seals
UU-P-268	-	Paper, Kraft, Wrapping
NN-P-530	-	Plywood, Flat Panel
PPP-F-320	-	Fiberboard, Corrugated and Solid, Sheet Stock (Container Grade), and Cut Shapes
PPP-S-760	-	Strapping, Nonmetallic (and Connectors)
PPP-T-42	-	Tape, Pressure-Sensitive Adhesive, Packaging/Paper
PPP-T-60	-	Tape, Packaging, Waterproof
PPP-T-97	-	Tape, Packaging/Industrial, Filament Reinforced

Military

MIL-P-116	-	Preservation, Methods of
MIL-B-117	-	Bags, Sleeves and Tubing - Interior Packaging
MIL-B-121	-	Barrier Material, Greaseproofed, Waterproofed, Flexible
MIL-F-83671	-	Foam-in-place Packaging Materials, General Specification for
MIL-F-87075	-	Foam-in-place Packaging Systems, General Specification for

STANDARDS

Federal

FED-STD-101	-	Test Procedures for Packaging Materials
Method 5005	-	Cornerwise-Drop (Rotational) Test
Method 5007	-	Free Fall Drop Test
Method 5008	-	Edgewise-Drop (Rotational) Test
Method 5011	-	Mechanical Handling Test
Method 5012	-	Pendulum-Impact Test
Method 5019	-	Vibration (Repetitive Shock) Test
Method 5023	-	Incline-Impact Test

Military

MIL-STD-105	-	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	-	Marking for Shipment and Storage
MIL-STD-731	-	Quality of Wood Members for Containers and Pallets

(Copies of 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:

DARCOMPSCC

DARCOMPSCC Pamphlet No. 0296 - Procedures for Opening/ Reusing Total Encapsulated Foam-In-Place Packs

(Application for copies should be addressed to the Director, DARCOMPSCC, ATTN: SDSTO-TP-S, Tobyhanna, PA 18466.)

The Upjohn Company

Technical Bulletin 107 - Precautions for the Proper Usage of Polyurethanes, Polyisocyanurates, and Related Materials

(Application for copies should be addressed to The Upjohn Company, Chemical Division, Kalamazoo, MI 49003.)

Code of Federal Regulations

Title 40, Part 261 - Identification and Testing of Hazardous Waste

(The Code of Federal Regulations (CFR) may be obtained from the Superintendent of Documents, US Government Printing Office, Washington, DC 20402.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Materials. Associated materials required to facilitate the development of foam-in-place packs shall be as specified herein.

3.1.1 Foam chemicals. The foam-in-place chemicals and characteristic end product shall conform to the requirements

of MIL-F-83671 and shall be selected for the prescribed procedure from the approved classes and grades specified (see 6.2). Additionally, the applied foams shall conform to the workmanship requirements of 3.13.

3.1.2 Use of recycled polyurethane. Recycled polyurethane shall be the same as that of the new foam to be dispensed. The use of recycled polyurethane shall be limited only to the extent that formed foam packs meet the performance requirements of this specification and that such reused foam does not exceed 50 percent of the total foam volume. Recycled polyurethane foam shall not be used as filler for technique VII packs.

3.2 Sensitive items. Unless otherwise specified (see 6.2), foam-in-place techniques shall not be used to protect items susceptible to damage when exposed to static electrical charges as foam-in-place urethanes are an enormous static generator. When the use of foam-in-place techniques are permitted, parting films shall be limited to electrically conductive types. Those items susceptible to damage from foam exotherm temperatures reaching as high as 150° F. on contact surface (excluding technique VII, preformed molding) shall not be packed using foam-in-place techniques.

3.3 Unit protection. Prior to applying the specified technique, unit protection required for an item (cleaning, preservation, wraps, barriers, etc.) shall be governed by MIL-P-116 for the method of preservation or other applicable documents specified (see 6.2). When required, a wrap-type cushioning material shall be used to cover projections, sharp edges, or corners of the item.

3.4 Foam dispensing equipment. Any equipment may be used to mix and dispense the chemical ingredients provided the qualities of the finished foam meet the requirements of MIL-F-83671. Foam dispensing equipment conforming to MIL-F-87075 has been used successfully to meet the requirements specified herein.

3.5 Foaming conditions. All components, surfaces, wraps, and void areas of the proposed foam pack to be filled should be conditioned and maintained at a constant temperature within the limiting temperature range of 60° F. to 100° F. to insure efficient, continuous foam production and optimum foam properties. Chemical ingredients shall not be exposed to temperatures other than those recommended by the formulation supplier. Surfaces expected to come in contact with the foaming chemicals shall be free of grease, oil, loose particles, moisture, and other deleterious (harmful) foreign matter.

3.6 Predetermination of foam thicknesses. Unless otherwise specified (see 6.2), minimum foam thickness determination shall be made, as specified herein. In the case of flexible foams, cushioning requirements are based on item static-bearing stress and fragility (see fig 1). For rigid foams, minimum thickness shall be 2 inches. Where semirigid foam is intended for use with items weighing 150 pounds or less, constraints are also based on load bearing of the prepared item. In this specific application, a "new" bearing surface can essentially be formed around items of irregular configurations so that minimum allowable surface areas can be met (see fig 2 for 0.5 pound per cubic foot density). For special application of technique IV procedures, thickness determination listed in figure 3 may be used; however, the final thickness determination will be based on results of the rough handling tests specified (see 6.2).

3.7 Determination of foam volume (quantities). The amounts of foam may vary based on the characteristics of the void area; i.e., foam wall thickness, adjoining contact surfaces, environmental temperatures, extent of volume to be filled, and method of container restraint against anticipated foaming pressures. In general, cool surfaces or low environmental temperatures will retard normal foaming action and require additional chemical components. Adjustment of foam quantities will normally be necessary after foaming initial packs.

3.8 Utilization of restraining devices. Foaming bucks shall be fabricated of sufficient material to prevent distortion of container walls during foaming operations. The selected design shall be based on the procedure technique used and of such construction as to allow for some venting and subsequent release of entrapped gases. Additional restraining devices shall be used, as necessary, to limit the tendency for certain items to "float" or move from their designated orientation during foam rise. Pressures actually developed are dependent upon the class and grade of foam material used.

3.9 Marking for shipment/storage. Marking shall be in accordance with MIL-STD-129 with special markings added, as prescribed herein.

3.10 Occupational/environmental safety and health controls. For contract application, appropriate Occupational Safety and Health Act standards associated with foam-in-place packaging will be followed. Foam-in-place dispensing operations within Department of Defense installations and facilities (land and afloat) shall have medical service for environmental health/safety approval concerning ventilation and protective equipment requirements. Additional safety and health considerations and waste management are listed in 6.3 and 6.4, respectively.

1. Determine the static-bearing stress (pounds per square inch (psi)) for each surface (weight/each surface area that will be bearing on the cushion).

2. Next, determine the item's fragility measured in g's (obtained from manufacturer or engineering estimate).

3. The thickness of foam needed may be found by looking at the cushion curves. All curves are for 30-inch drop.

4. To find foam thickness for each face of item, draw a line upward from horizontal axis at point of static stress for that item face (1).

5. Follow a line drawn from the left (2) to a point on the vertical axis equal to the fragility estimated earlier.

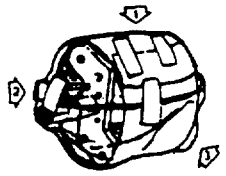
6. The point (3) when these two lines cross will be near one of the cushion curves on the graph.

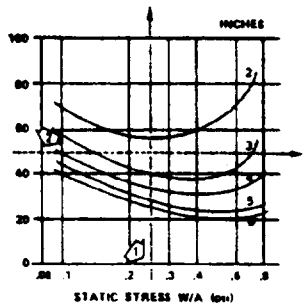
7. The closest cushion curve below crossing point will be the thickness of foam needed to protect face of the item in a 30-inch drop.

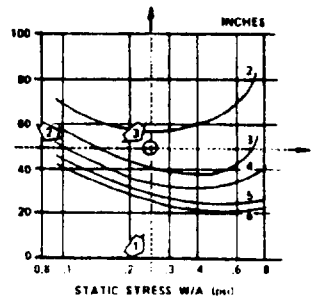
8. Repeat process for each of the other faces of the item. Use these values for each face or use the thickest for all faces for extra protection.

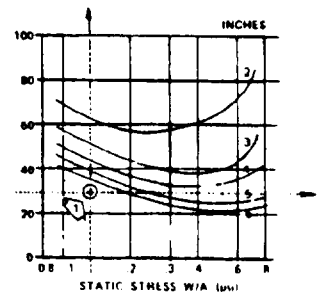
9. Do not package item in flexible foam if the point where the two lines cross is below the curves.

10. The optimum loading point is indicated by the arrow. This point is defined as the lowest shock level that can be achieved using a particular 2-inch thickness cushion. Obviously then, the optimum static stress is defined by the vertical line. The problem really begins when a calculated static stress is greater than the optimum value. This could be the case in the example shown on the curve (indicated by A). In this case, item fragility was determined to be 60 g's and the calculated static stress is 0.5. If the "closest cushion curve below the crossing point" is assumed to be the 2 inch, there is a dangerous condition existing. The cushion is overloaded; such a situation allowing serious loss of thickness of the cushion and increasing shock loads during subsequent drops. Two options are available; i.e., (1) change static stress to a lower value by adding support pieces to spread the load, or (2) go to the next lower cushion curve wherein the crossing point occurs either at or to the left of the optimum point.









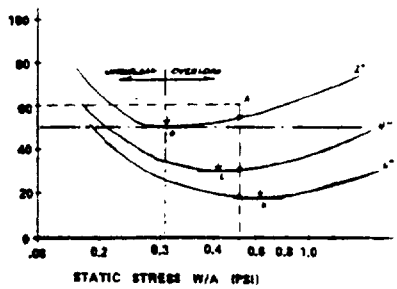


Figure 1. Design for flexible foam packs.

2 in/5.1 cm		3 in/7.6 cm		4 in/10.2 cm		5 in/12.7 cm		6 in/	
Maximum weight 2/ (lb/kg)	Minimum allowable bearing surface 3/ (sq in/sq cm)	Maximum weight (lb/kg)	Minimum allowable bearing surface 3/ (sq in/sq cm)	Maximum weight (lb/kg)	Minimum allowable bearing surface 3/ (sq in/ sq cm)	Maximum weight (lb/kg)	Minimum allowable bearing surface 3/ (sq in/sq cm)	Maximum weight (lb/kg)	Minimum allowable bearing surface 3/ (sq in/sq cm)
1/0.5	2.5/15	26/11.8	52/340	51/23.1	85/550	76/34.5	110/710	104/	130/
2/0.9	5.0/30	27/12.2	54/350	52/23	85/550	77/34.9	110/710	108/	140/
3/1.4	7.5/50	28/12.7	56/360	53/24.0	90/580	78/35.4	110/710	112/	140/
4/1.8	10.0/65	29/13.2	58/370	54/24.5	90/580	79/35.8	115/740	116/	150/
5/2.3	12.5/80	30/13.6	60/390	55/25.0	90/580	80/36.3	115/740	120/	150/
6/2.7	15.0/95	31/14	62/400	56/25.4	95/610	81/36.7	115/740	124/	160/
7/3.2	17.5/115	32/14.5	64/410	57/25.9	95/610	82/37.2	115/740	128/	160/
8/3.6	20.0/130	33/15.0	66/430	58/26.3	95/610	83/37.6	120/770	132/	170/
9/4.1	22.5/145	34/15.4	68/440	59/26.8	100/645	84/38.1	120/770	136/	170/
10/4.5	25.0/160	35/15.9	70/450	60/27.2	100/645	85/38.6	120/770	140/	180/
11/5.0	27.5/175	36/16.3	72/460	61/27.7	100/645	86/39.0	125/810	144/	180/
12/5.4	30.0/195	37/16.8	74/480	62/28.1	105/680	87/39.5	125/810	148/	190/
13/5.9	32.5/210	38/17.2	76/490	63/28.6	105/680	88/40.0	125/810	152/	190/
14/6.4	35.0/225	39/17.7	78/500	64/29.0	105/680	89/40.4	125/810	156/	200/
15/6.8	37.5/240	40/18.1	80/520	65/29.5	110/710	90/40.8	130/840	160/	200/
16/7.3	40.0/260	41/18.6	82/530	66/29.9	110/710	91/41.3	130/840	164/	210/
17/7.7	42.5/275	42/19.1	84/540	67/30.4	110/710	92/41.7	130/840	168/	210/
18/8.2	45.0/290	43/19.5	86/550	68/30.8	115/740	93/42.2	135/870	172/	220/
19/8.6	47.5/305	44/20.0	88/570	69/31.3	115/740	94/42.6	135/870	176/	220/
20/9.1	50.0/320	45/20.4	90/580	70/31.8	115/740	95/43.1	135/870	180/	230/
21/9.5	52.5/340	46/20.8	92/590	71/32.2	120/770	96/43.6	135/870	184/	230/
22/10.0	55.0/355	47/21.3	94/610	72/32.7	120/770	97/44.0	140/900	186/	240/
23/10.4	57.5/370	48/21.8	96/620	73/33.1	120/770	98/44.4	140/900	190/	240/
24/10.9	60.0/385	49/22.2	98/630	74/33.6	125/810	99/44.9	140/900	194/	240/
25/11.3	62.5/405	50/22.7	100/645	75/34.0	125/810	100/45.4	140/900	200/	260/

1/ If these parameters cannot be met, this foam material composition shall not be used.

2/ Item weight includes total weight ready for foaming, i.e., item plus wraps, barriers, tapes, pads, adhesives, straps, etc. When the weight falls exactly between two successive weight ranges, use the higher figure.

3/ When minimum allowable bearing surface area falls exactly between two successive figures, use next highest figure.

Note. When using semirigid (semiflexible) foams, bearing surfaces can be improved (increased), as necessary, by affixing them to platform, containerizing, etc., then foaming, as required.

Figure 2. Design for 0.5 pound density semirigid foam packs.

1. Determine the tube/bag width by applying the following formula:

FOR FLEXIBLE FOAM

$$\text{Tube/bag width (inches)} = \frac{M/N}{IW \times 4} + FT$$

FOR RIGID FOAM

$$\text{Tube/bag width (inches)} = \frac{M/N}{IW \times 20} + FT$$

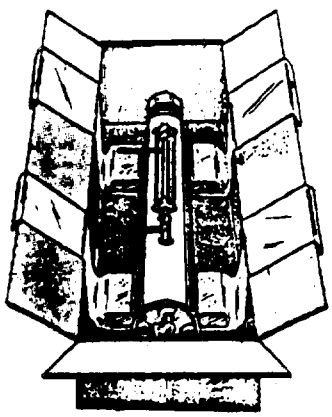
M = Weight of prepared item (lb)
N = Number of bags to be used
IW = Width of item (inches)
FT = Desired/required foam thickness (inches)

2. Round off the calculated tube/bag width to the nearest inch.

3. If tube/bag width is calculated to be less than 12 inches, use a 12-inch tube/bag.

4. If the calculated tube/bag width exceeds 18 inches, consider increasing the number of tubes/bags.

5. Tube/bag width may have to be recalculated for each tube/bag to provide for variations in item width.



FOR RIGID FOAMS ONLY:

Bag width should at no time be less than one and one-half times the desired/required foam thickness.

If calculated tube/bag width is less than one and one-half times the foam thickness, select a wider tube/bag to meet the one and one-half minimum.

Figure 3. Determine tube/bag width - Technique IV.

3.11 Foaming techniques. The steps to be followed in accomplishing the various techniques shall be as specified herein. In conjunction with these techniques, consideration shall be given to the special features inherent in the pack formed as the end product. Prepared item dimension, as referenced herein, shall be considered as those dimensions determined by inclusion of all required pads, wraps, and other material applied to facilitate the readiness of the item for foaming operations. The prepared item, protected as in 3.3, shall be enclosed in a container, as specified (see 6.2), except where prescribed in the design of the technique, as detailed herein. The foam materials shall be in accordance with 3.1.

3.11.1 Technique I, split pack, standard. This procedure is adaptable for many items. The technique I procedure requires a minimum of two consecutive pours. Time is required between each pour to allow the foam to set (tack free) properly. The foam materials shall be of the class specified (see 6.2).

3.11.1.1 Procedures (see fig 4).

Step a. Select the best orientation for the item while considering the ready availability of supporting surfaces. Orientation selected shall also depend on locations of critical item projections and item void areas that may later cause difficult removal of the item.

Step b. Select container of appropriate dimensions.

Step c. Drape polyethylene sheet film (L-P-378) loosely inside container covering bottom and extending over flaps, where applicable. Smooth the sheet toward all corners. Tape, if necessary, to hold temporarily. The following formulas shall be used to tabulate film requirements:

Sheet length = 2 X depth + 1.5 X length of container interior.

Sheet width = 2.5 X depth + width of container interior.

Step d. Place prefoamed support block, to support weight of prepared item to required height, in container bottom (see 3.1.1). Position to support item uniformly.

Step e. Remove item, then dispense enough foam mix into the container to encase block(s) and rise to the required height.

Step f. Fold polyethylene film inward, completely covering foam as it completes its rise.

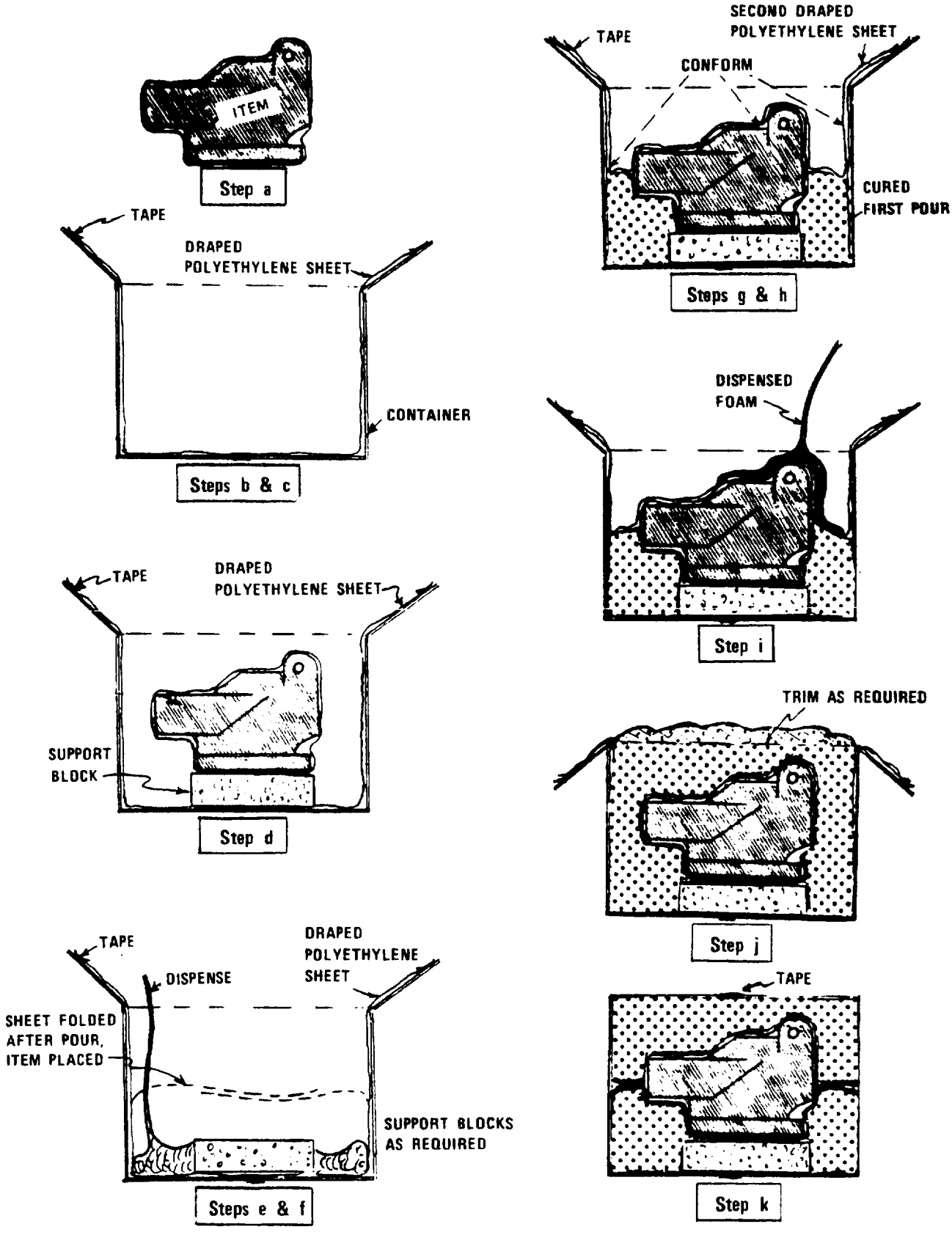


Figure 4. Split pack, standard.

Step g. Immediately place and hold prepared item on top of the polyethylene film/foam until foam has risen and set enough to support the item. (Some items have a tendency to float during foaming.)

Step h. Drape a second sheet of polyethylene film loosely inside the container covering the prepared item and foam and extending over flaps. Tape, if necessary, to hold temporarily.

Step i. Dispense a sufficient amount of foam mix into the container to surround the item and fill the container with expanded foam.

Step j. Fold the polyethylene film inward when certain that the rising foam will fill the container. Close container. If the container is overfilled, trim off excess.

Step k. Apply appropriate closure. Allow time for foam to set before moving container.

3.11.2 Technique II, split pack, alternate. This procedure is a variation of technique I split pack, providing a more simplified means of completing foam packs as in remote areas or aboard ship and with retrograde materials or items that are rapidly deployed. Time is required between each pour to allow the foam to set (tack free) properly. Prefoamed support blocks are not used. Foam material shall be of the class specified (see 6.2).

3.11.2.1 Procedures (see fig 5).

Step a. Select the best orientation for the item. Minimum use shall be made of additional protective material except to prevent puncture of the plastic sheet around the item with the subsequent danger of the foam either contacting the item or escaping and locking the mold halves together.

Step b. Select specified container to hold prepared item.

Step c. Drape sheet polyethylene film (L-P-378) loosely inside the container covering bottom and extending over flaps. Tape, if necessary, to hold temporarily.

Step d. Dispense sufficient amount of foam mix into the container to center item in container. Fold polyethylene film inward, completely covering foam as it completes its rise.

Step e. Place prepared item, overwrapped in polyethylene (L-P-378), on the foam surface after foam has risen and set enough to support the item. (The item shall be centered in container.)

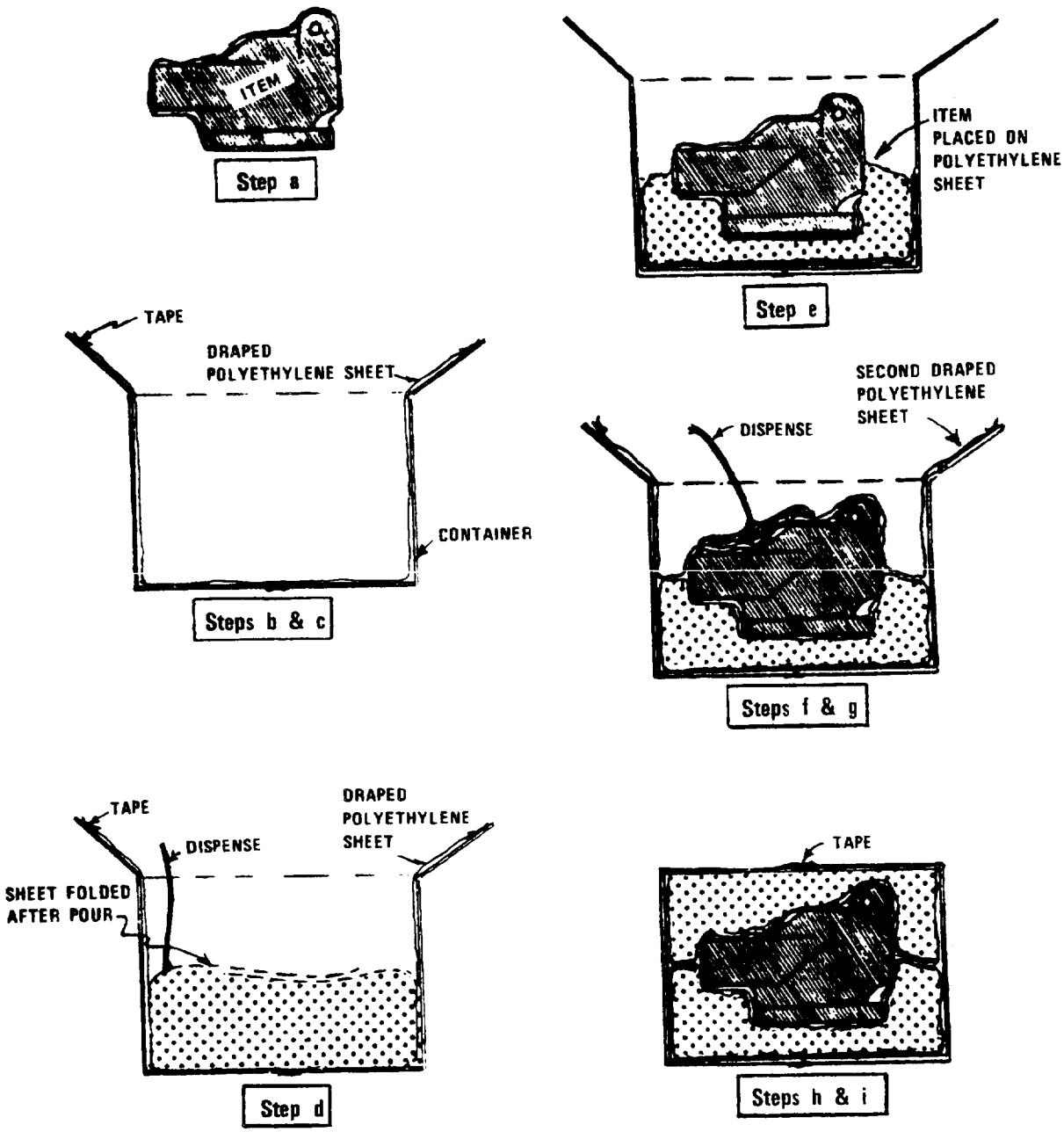


Figure 5. Split pack, alternate.

Step f. Drape a second sheet of polyethylene film loosely inside the container covering the prepared item and foam and extending over flaps. Tape, if necessary, to hold temporarily.

Step g. Dispense a sufficient amount of foam mix into the container to surround the item and fill the container with expanded foam.

Step h. Fold the polyethylene film inward when certain that the rising foam will fill the container. Close container. If the container is overfilled, trim off excess.

Step i. Apply applicable closure. Allow time for foam to set before moving container.

3.11.3 Technique III, split pack, inverted. The inverted pack shall not be used for items that must always remain in an upright position to prevent internal damage. Foam material shall be of the class specified (see 6.2).

3.11.3.1 Procedures (see fig 6).

Step a. Select the best orientation for the item while considering the ready availability of supporting surfaces. Orientation selected shall also depend on locations of critical item projections and item void areas that may later cause difficult removal of the item.

Step b. Select specified container to hold prepared item.

Step c. Cut a pad(s) of foam the same length and width as the container's inside dimensions with a depth equal to the foam thickness. This will result in the item being vertically centered in the container.

Step d. Place prepared item on foam pad, centered in the container.

Step e. Drape a sheet of polyethylene film (L-P-378) loosely inside the container covering the prepared item, foam pad, and extending over the flaps. Tape, if necessary, to hold temporarily.

Step f. Dispense enough foam mix into the container to surround the item and fill container with expanded foam.

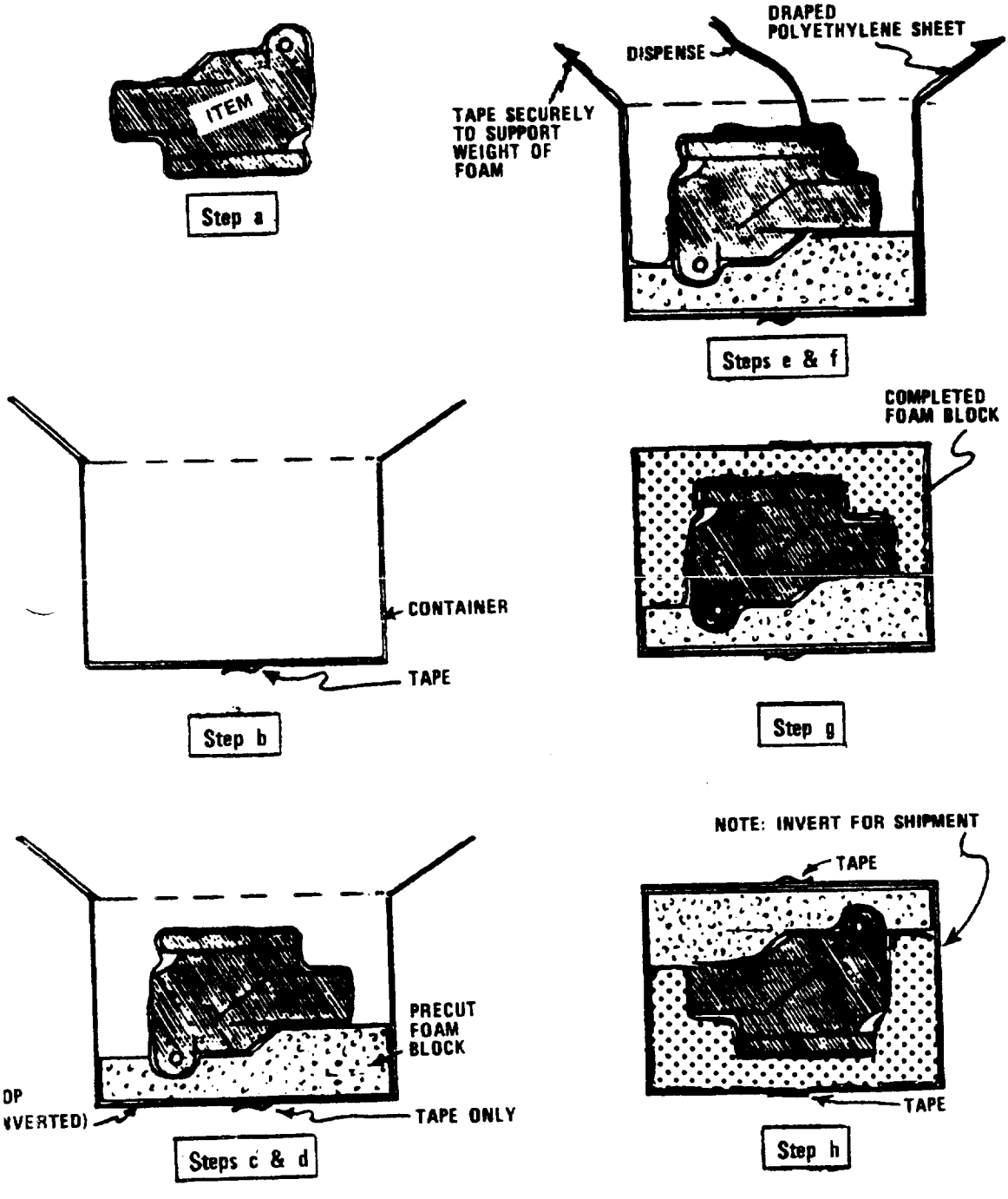


Figure 6. Split pack, inverted.

Step g. Fold the polyethylene film inward when certain that the rising foam will fill the container. Close container and tape. (If overfilled, trim off excessive foam before taping.)

Step h. Foam must be able to support item weight before container is turned upright. After foam is cured 15 minutes, invert container to upright position.

3.11.4 Technique IV, foam-in-bag. This procedure is adaptable to a wide variety of items regardless of dimension; however, where long items exceeding approximately 32 inches in length are being foamed, it is preferable to use a multiple bag unit design. Foam material shall be of the class specified (see 6.2).

3.11.4.1 Procedures (see fig 7).

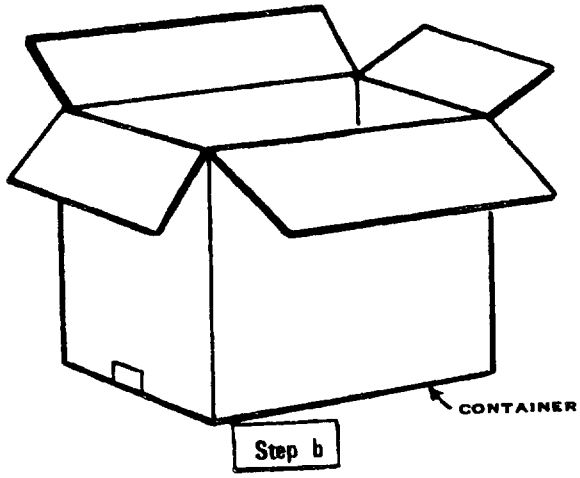
Step a. Select the best orientation for the item while considering the ready availability of supporting surfaces. Orientation selected shall also depend on locations of critical item projections and item void areas that may later cause difficult removal of the item.

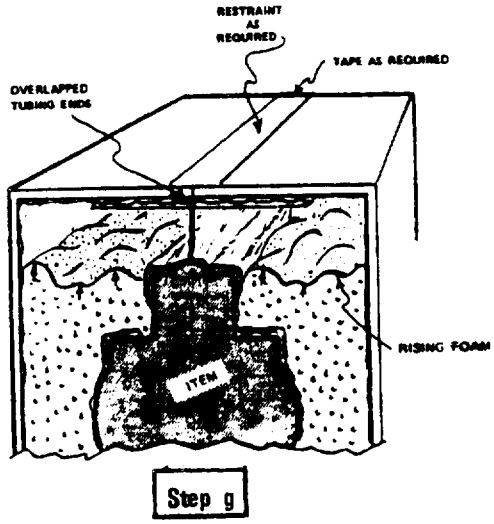
Step b. Select container of appropriate dimension (specific container or restraining device) based on prepared item dimension.

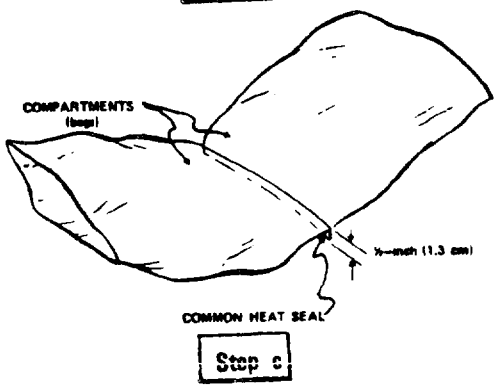
Step c. Determine dimensions (see fig 3) and fabricate or select bags (or tubes) fabricated from polyethylene film (L-P-378) in a width (diameter) and thickness, as specified (see 6.2), necessary to hold the item immobile in the container. Tubes shall be heat sealed transversely at the centerline to form two compartments. The flat tubing dimension shall be determined by the interior dimension of the container or restraining device. Formulas shall be used as follows:

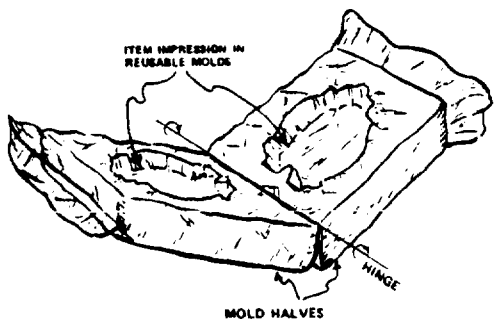
Tubing length (LT) = 2 X depth + width + 4 inches
Tubing width (WT) = length + width + 2 inches

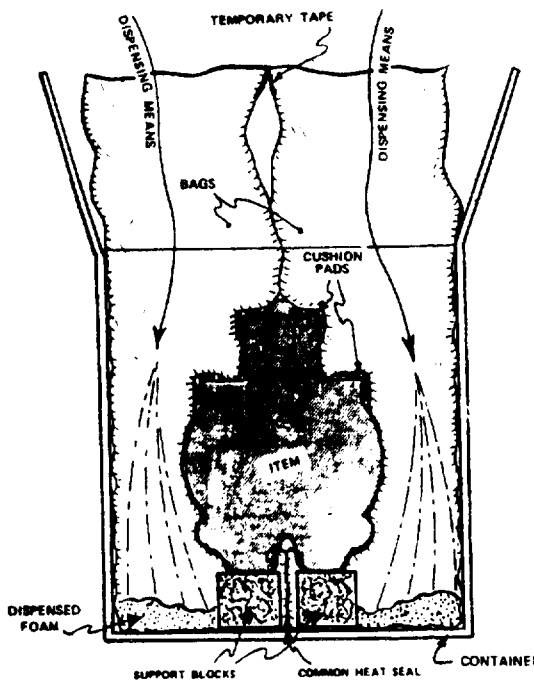
Step d. Prepare sufficient cut prefoamed blocks (see 3.1.2) to support the prepared item to its required height above the bottom of the container during the foaming operation. Place these prefoamed blocks inside the bags or tubes (in close proximity to the common heat seal), then position inside the container. The bags or tubes may be taped or clipped to the container walls or flaps to hold them in place to facilitate easier dispensing of foam mix.











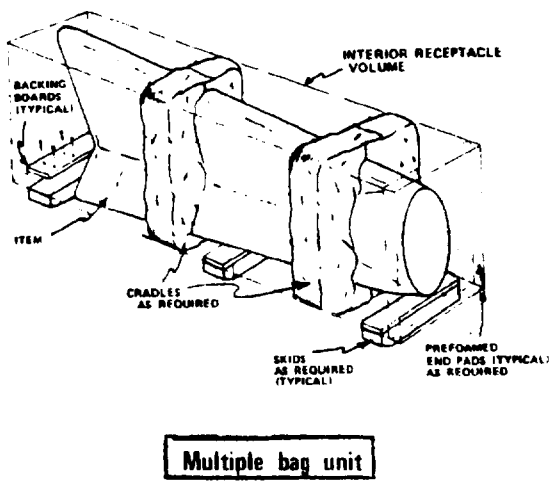


Figure 7. Foam-in-bag.

Step e. Position the prepared item in the center of the container supported by the foam blocks inside the tubes. Hold prepared item in place until foam has risen and set enough to support the item.

Step f. Dispense equal amounts of foam mixture into each set of bags or tubes. When foam reaches half of its rise, remove any tape or clips holding the bags to the container.

Step g. Overlap the tube or bag ends and close the container. Secure temporarily until rise has stopped. Open the container to make sure that the item is immobilized by the bags and allow the foam to cure 15 minutes before handling. Close flaps and secure with tape.

3.11.5 Technique V, special technique, modified. This procedure is identified with specific modification or variation of established techniques 3.11.1 through 3.11.4. In general, the degree of modification or variation is of sufficient magnitude to cause special description (see 6.2). Such description shall include:

Step a. Container specification and size.

Step b. Foam material in accordance with MIL-F-83671.

Step c. Required design steps.

Step d. Associated wraps or other materials.

Step e. All figures, illustrations, and drawings necessary to fully describe the special design techniques.

Step f. Special markings.

3.11.6 Technique VI, foamed container. This procedure is adaptable to heavier and larger items and is essentially a split pack using special fabrication techniques. Foam material shall be of the class specified (see 6.2). Specific fabrication procedures shall be developed by the fabricator to meet the requirements of the engineering drawing/specification (see 6.2). The following design steps are intended for general guidance only.

3.11.6.1 Procedures (see fig 8).

Step a. Set up the specified mold for fabricating the foamed container (a simulated item can be used). Mold design shall allow easy disassembly that will insure against damage of the foamed container upon removal.

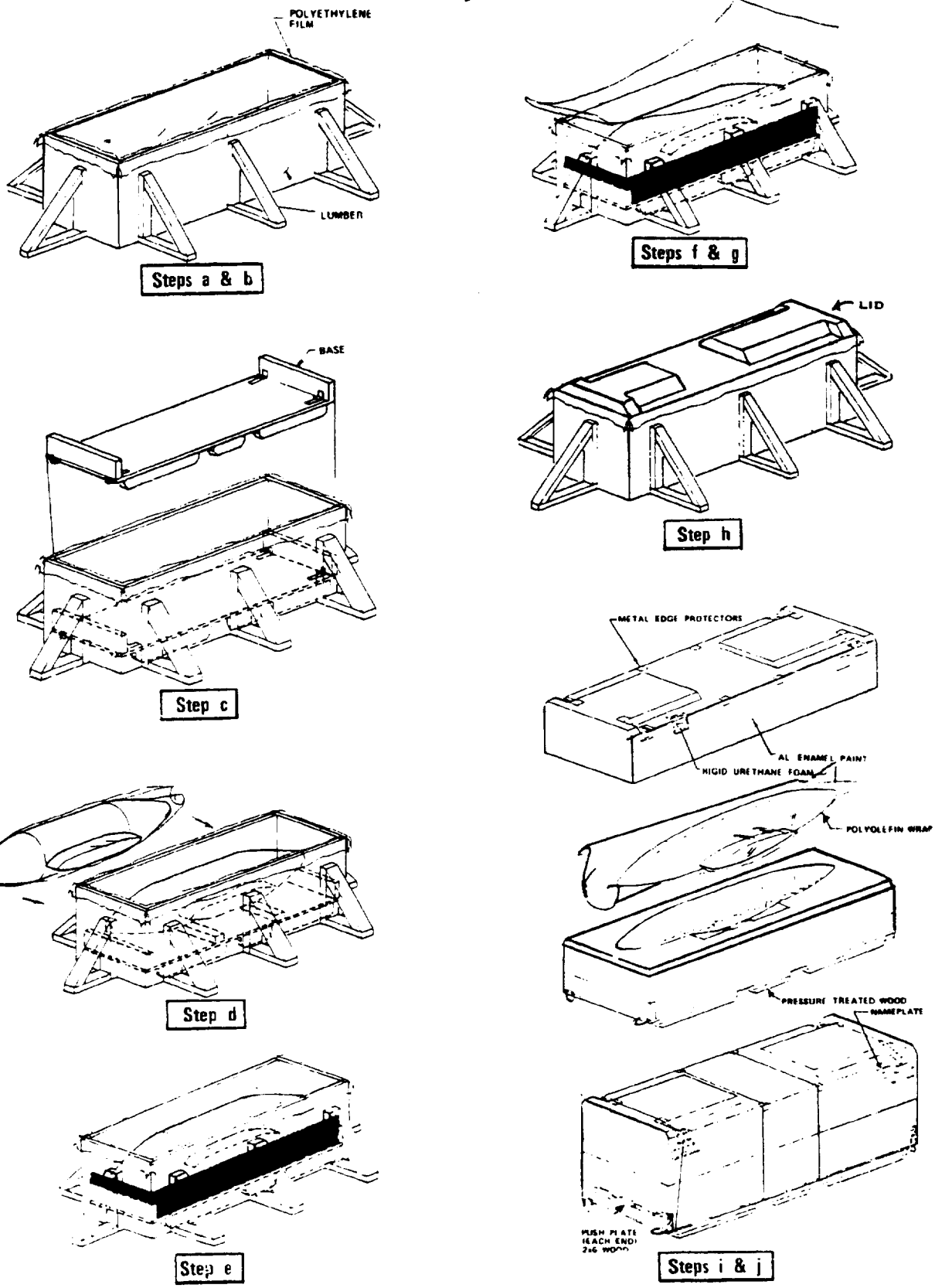


Figure 8. Foamed container.

Step b. Apply release material (polyethylene plastic sheet (L-P-378), wax coatings, etc.) to the inside surfaces of the mold and completely around or on the surfaces of the item. Tape plastic sheet, if necessary, to hold in place temporarily.

Step c. Position inserts such as base with skids, push plates, tiedown rings, reinforcements, etc., in the mold and secure.

Step d. Position and secure item in the proper location in the mold. The item can be suspended from a hoist or supported with prefoamed blocks.

Step e. Dispense the required quantity of foam into the mold so that the total rise reaches approximately one-half of the depth of the item. Where consecutive pours are necessary, time is required between each pour to allow the foam to set properly.

Step f. Apply release materials to the top surfaces of the risen foam.

Step g. Dispense the required quantity of foam into the remaining void so that it surrounds the prepared item completely. Consecutive pours are performed as in step e above.

Step h. When there is assurance that the rising foam will fill the mold, place and secure the lid. The lid may contain holes to allow release of excess expanded foam and gases. Allow the foam to cure for 15 minutes before moving or opening the mold.

Step i. Remove foamed container from mold. Apply edge protectors for strapping.

Step j. Coat outside surfaces of foamed containers, as required by engineering drawing/specifications. Assemble and secure closure.

3.11.7 Technique VII, encapsulated pack. In this procedure, items are completely surrounded (encapsulated) in foam, thus achieving water vapor protection utilizing a minimum of 2-inch thickness of foam.

3.11.7.1 Select applicable design procedure (see 6.2):

Design 1. Small items, 0 to 100 pounds (see fig 9).

Design 2. Intermediate items, 75 to 125 pounds (see fig 10).

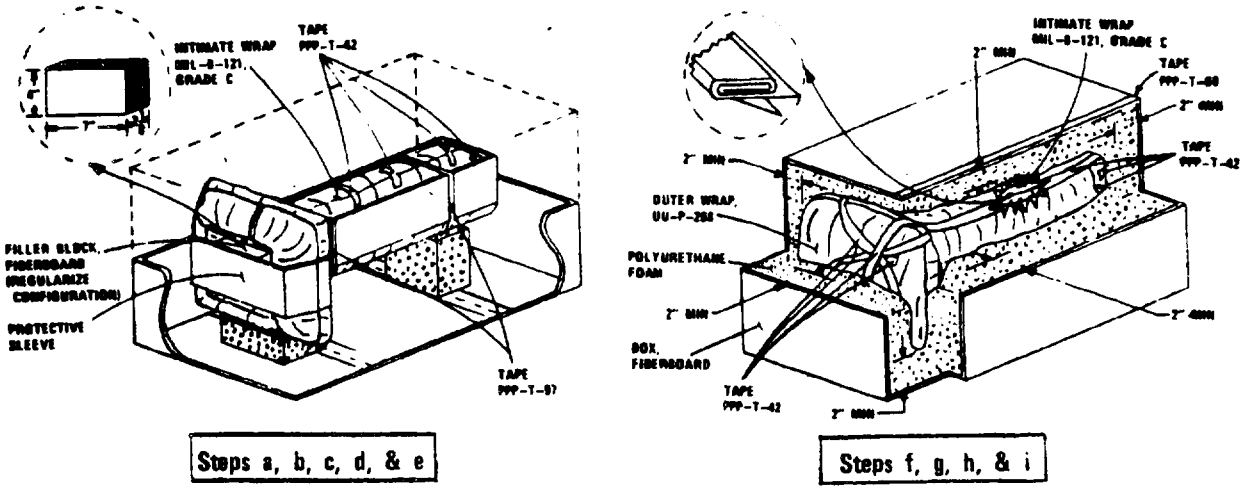


Figure 9. Encapsulated pack (design 1).

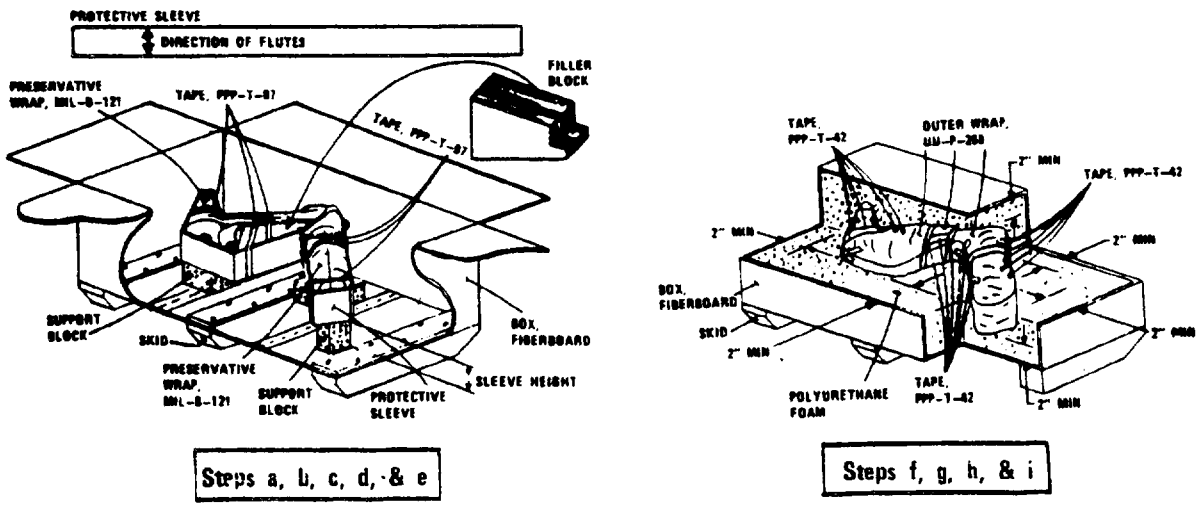


Figure 10. Encapsulated pack (design 2).

Design 3. Intermediate items, 100 to 250 pounds (see fig 11).

Design 4. Large and/or dense items, 150 to 400 pounds (see fig 12).

Design 5. Special items, as specified by procuring activity.

3.11.7.2 Procedure.

Step a. Select the best orientation for the item while considering the ready availability of supporting surfaces. Orientation selected shall also depend on locations of critical item projections and void areas that may later cause difficult removal of the item.

Step b. Select container and applicable design based on item dimension, weight, minimum foam thickness (see step g below), wraps, protective sleeve, and the orientation determined in step a above. Secure skids and deck boards, as applicable, for designs 2, 3, 4, and 5.

1. Nails, pallet, 10-gauge, 2 1/2 inches long, style 18, type II, FF-N-105, shall be driven through the deck board and into the skids. Nails shall be arranged in two rows, staggered pattern, with spacing between nails in each row not to exceed 6 inches.

2. All wood used in type VII packs shall conform to MIL-STD-731, group II or III, class 2.

3. All plywood decks used shall conform to NN-P-530, 5-ply, standard-interior with exterior glue, group PS-1, grades C-C. Quality shall conform to PS-1.

Step c. Prepare properly sized prefoamed blocks to support the item in a stable position during the foaming procedure. Blocks must be cut and positioned so that the direction of foam rise (maximum compressive strength) is supporting the item. This is very important on heavy items to prevent blocks from collapsing. When blocks are positioned with direction of foam rise parallel to the item, approximately one-half of the compressive strength of the foam is lost. Class and grade of foam shall be identical to the foam ingredients to be used (see 3.1.1). Thickness of the blocks shall be determined by the requirement for critical centering of the item between the top and bottom planes of the receptacle. Additionally, load-bearing material such as fiberboard or plywood may be further required to distribute concentrated loads over the area of the foam blocks and prevent compression and damage to the foam blocks prior to foaming.

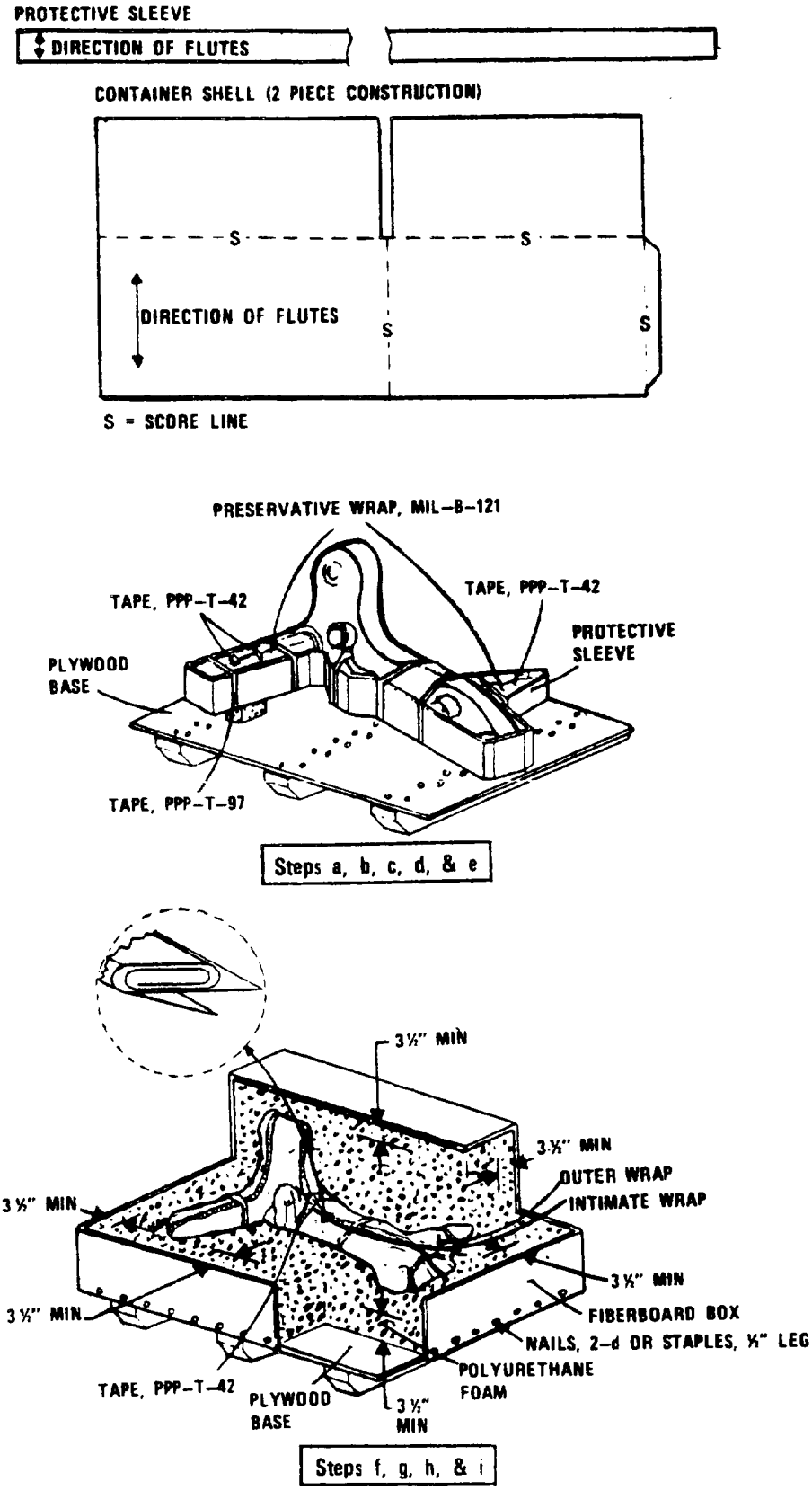


Figure 11. Encapsulated pack (design 3).

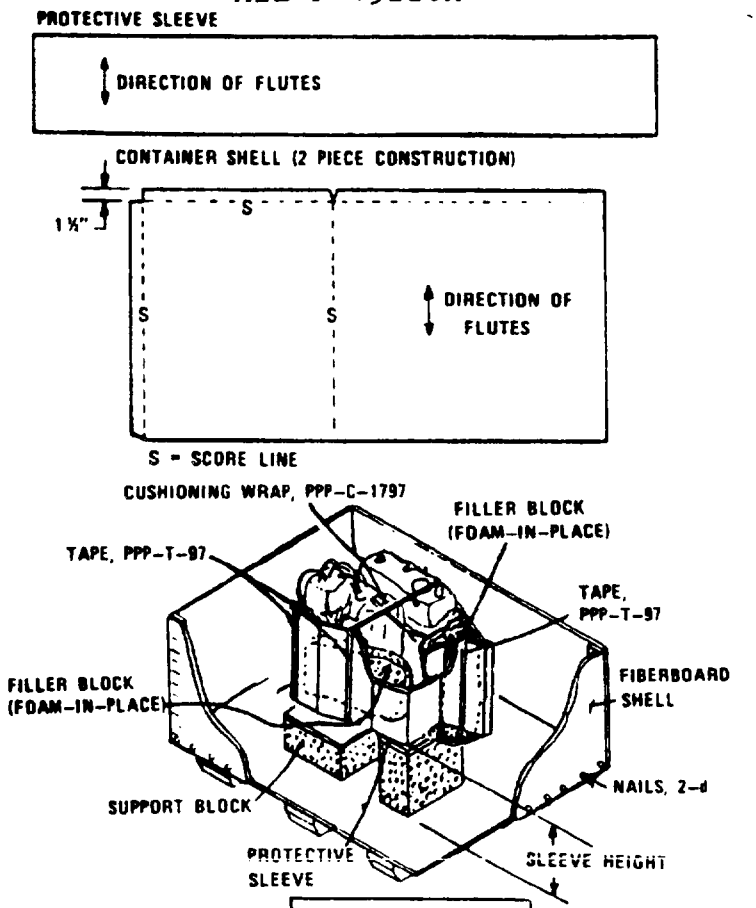
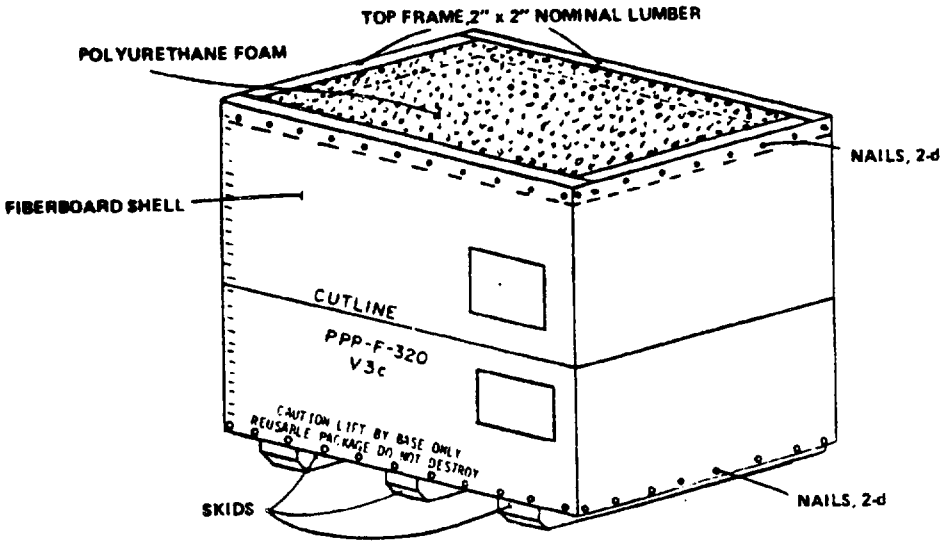
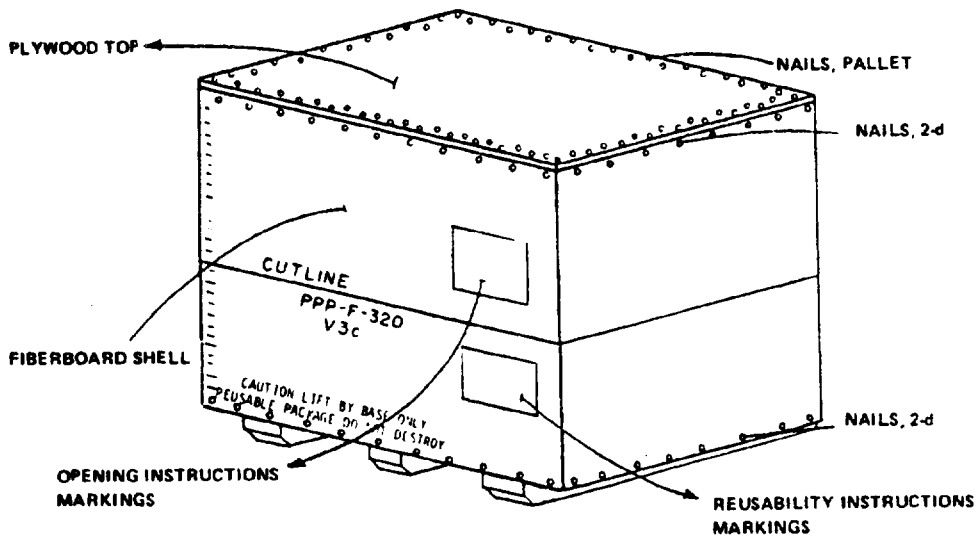


FIGURE 12. Encapsulated Pack (Design 4).



Step h



Step i

FIGURE 12. Encapsulated Pack (Design 4)--Continued.

Step d. With the item supported on the blocks, determine the cut line in the horizontal plane that will best permit removal of the top cut section of the foamed pack and removal of the item from the remaining bottom section.

Step e. A protective sleeve shall be fabricated so that it contours the item as closely as possible and positioned horizontally around the item so that the cut line marking to be applied on the exterior of the container will be located at the vertical center of the sleeve. The sleeve shall be fabricated and formed using fiberboard material conforming to type CF, grade V3c, class WR, PPP-F-320. The sleeve shall be secured in place with tape conforming to PPP-T-97 and drawn tightly to the item under adequate tension. This sleeve is designed to provide protection to the item during the cutting operation in opening, and to facilitate removal of both the top of the container and the item from the base section. For large container designs, at this point, preliminary foaming into selected polyethylene bag sizes conforming to MIL-B-117 (4-mil) may be accomplished for filling large void areas between the sleeve and the item (regularize configuration). Similarly, properly sized filler blocks built up of fiberboard sheet stock may be used. This process will insure support to the sleeve against anticipated external pressure from the expanding foam in step g below. Care shall be exercised to insure that there are no projections beyond the plane formed by the sleeve.

Step f. Two pieces of barrier material, one conforming to MIL-B-121, type I, grade C, class 1 and the second conforming to UU-P-268, type I, grade B, 40-pound basis weight (minimum) shall be prepared of such dimension as to completely encircle the item with sleeve attached. The first wrap, grade C, shall be applied with the "face" or wax-free side toward the item. Both wraps shall be applied in such a manner to conform to the contour of the item and shall not be loosely applied. Caution shall be taken to insure that no rips, tears, or holes are present in the wraps exposing any part of the item prior to application of foam. The overlaps (wrap joints) shall be rolled and pressed to insure that the foam does not enter the wraps and contact the item. Secure and seal outer kraft wrap joints, tucks, folds, seams, etc., with PPP-T-42 tape, 2-inch width minimum.

Step g. The wrapped item shall have a minimum clearance between the container walls and the outermost projections of the wrapped item, as specified (see 6.2).

Step h. The amount of foam specified (see 6.2) should only be used as a guide. Exact amount required is the responsibility of the packaging activity. Dispense foam into the void using successive pours, as required, insuring that any additional pour is dispensed at the tack free point of the previous

pour. The amount actually used per pack can be greatly influenced by type of equipment used, foam formulation, atmospheric conditions, facilities, etc. Sufficient quantities of foam shall be dispensed to provide total volume fill. Furthermore, for design 4, the polyurethane foam must lay level with the top of the 2 inch X 2 inch top frame around the circumference of the pack to permit the plywood cover to be nailed flush to the 2 inch X 2 inch top frame and still meet the performance characteristics of the pack.

Step 1. Close container with PPP-T-60, 2-inch wide tape for designs 1, 2, and 3. Design 4 shall be closed by nailing a minimum 3/8-inch thick plywood cover to top frame using pallet nails conforming to FF-N-105, type II, style 18, minimum of 1 5/8 inches long. Nailing shall be in a staggered pattern with nails not over 4 inches apart. Plywood cover shall not be nailed to top frame until foam pack has been inspected for 100 percent fill and allowed to set up for a minimum of 12 hours. All plywood covers shall be minimum 3/8-inch thick and shall extend to the outer edge of the ends and sides. The plywood shall conform to ANSI A199.1 or PS-1 and shall be a full exterior exposure durability and be a minimum grade C-C.

3.11.7.3 Special marking. Each design shall include the special markings as illustrated in figure 13. (Special markings shall be limited to stenciling, printing, or silk screening per MIL-STD-129. Labels are not permitted for any marking other than bar coding and shipping label.)

3.11.7.4 Reusability.

a. Reusability of technique VII packs is limited to the return of the unserviceable part.

b. Once the pack is opened, the item is subject to environmental deterioration and should be stored indoors under controlled conditions.

c. All packs opened for quality conformance inspection shall not be reused or repaired and shall be disposed of (see 6.4).

3.11.8 Technique VIII, preformed molding. This procedure is specifically intended to form individual mold halves for items using a specially designed molding box or jig. An essential part of this procedure is the requirement for a very rigid molding fixture. It is also the means for vacuum withdrawal of air to insure close conformity of plastic release material to the simulated surfaces of the item, the container, and the mold mating surfaces. Technique VIII readily permits the forming of foam molds that would fit a variety of shipping containers other than those having a solid, rectangular shape. Thus, contoured molds

OPENING INSTRUCTIONS:

1. CONTAINER SHALL BE OPENED BY CUTTING ALONG "CUT LINE" USING EITHER OF THE FOLLOWING METHODS:

A. MAKE INITIAL CUT WITH PORTABLE POWER SAW WITH BLADE SET AT 1-INCH DEPTH. CUT THROUGH THE REMAINDER OF THE POLYURETHANE FOAM WITH A HANDSAW OR LONG BLADE KNIFE.

B. USE A HANDSAW, PREFERABLY RIP-TYPE, MEDIUM BLADE.

2. USING EITHER METHOD, THE CUT SHALL BE CONTINUOUS AROUND THE PERIMETER OF THE CONTAINER. WHEN USING A HANDSAW, CUT THROUGH THE CONTAINER SHELL AND INTO THE FOAM USING A SABRE SAW CUTTING TECHNIQUE UNTIL THE BLADE REACHES THE PROTECTIVE SLEEVE. (CAUTION: DO NOT JAM BLADE THROUGH SLEEVE AS ITEM MAY RECEIVE DAMAGE.)

3. AFTER CUTTING, REMOVE TOP HALF OF CONTAINER. TO FACILITATE REMOVAL, TWO FLAT STEEL STRIPS OR ANGLE IRONS 3 INCHES WIDE AND OF SUFFICIENT LENGTH TO EXTEND A MINIMUM OF 12 INCHES BEYOND THE ENDS OF THE CONTAINER SHOULD BE INSERTED INTO THE CUT ALONG THE ENDS TO EFFECT THE INITIAL SEPARATION. EXERT PRESSURE AT BOTH ENDS SIMULTANEOUSLY.

4. REMOVE THE ITEM FROM THE LOWER HALF OF THE CONTAINER EXERCISING CAUTION NOT TO FRACTURE THE FOAM.

REUSABILITY INSTRUCTIONS:

ONCE OPENED, CONTAINER SHALL BE REUSED FOR SHIPMENT OF THE UNSERVICEABLE ASSET TO REPAIR OR REBUILD ACTIVITY.

1. PLACE ITEM IN CAVITY OF BOTTOM SECTION OF CONTAINER.

2. POSITION TOP SECTION OF CONTAINER OVER ITEM. (CAUTION: FILL VOID AREAS WITH CELLULOSE WADDING. IF LARGE VOIDS EXIST DUE TO FOAM REMOVAL, DO NOT REUSE.)

3. SECURE TOP TO BOTTOM BY PLACING STEEL STRAPS CONFORMING TO QQ-S-781 AROUND SIDES, TOP, AND BOTTOM OF CONTAINER. TIGHTEN STRAPS AND SECURE WITH STRAP SEALS.

4. REMOVE OR OBLITERATE OBSOLETE MARKING AND APPLY APPROPRIATE MARKING.

Note. Detailed opening and reusability information on technique VII packs is contained in DARCOMPSCC Information Pamphlet No. 0296, Procedures for Opening/Reusing Total Encapsulated Foam-In-Place Packs.

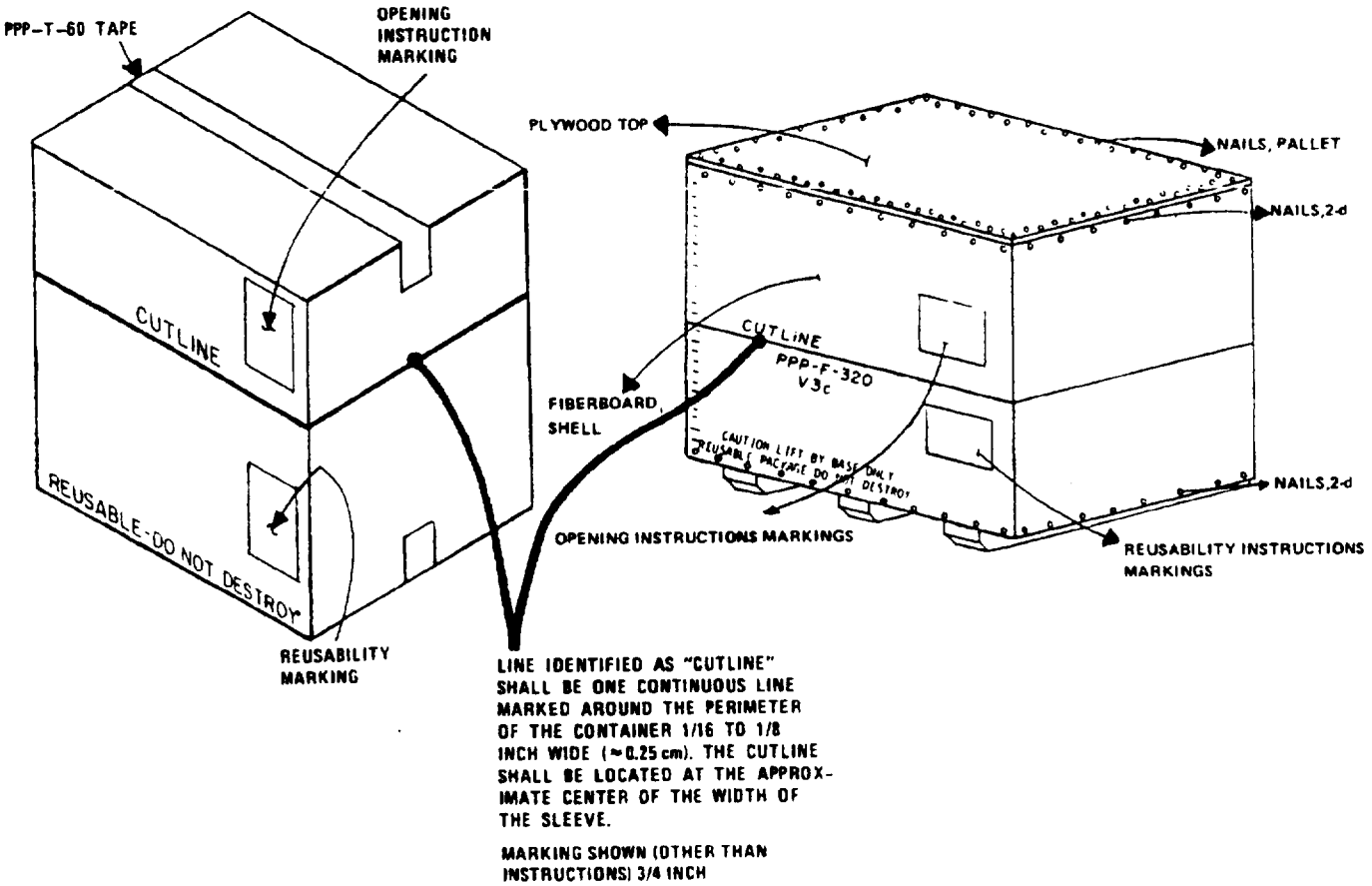


FIGURE 13. Encapsulated pack, special marking locations.

may be formed intended for shipment in cylindrical containers or cans. Mating molds may be fabricated in advance of the actual packaging process. Due to the nature of the preformed molding procedure, a single pour of foam is preferred for each mold half. Foam material shall be of the class specified (see 6.2).

3.11.8.1 Procedures (see fig 14).

Step a. Select applicable prefabricated mold fixture.

Step b. With the vacuum source connected, drape a 2-mil polyethylene sheet over the simulated item half and fixture flat surfaces, allowing sufficient overlap to completely cover the underside of the securing lid. With the vacuum source operating, insure that the plastic sheet is pulled flat and tightly creased, where necessary, over these surfaces. Leave the vacuum source on during the following step.

Step c. Dispense sufficient foam (single pour) into the prepared mold fixture.

Step d. Secure the polyethylene-lined lid over the rising foam in the fixture. Allow the filled mold to set for 15 minutes without handling or until it has sufficiently cured to prevent distortion of the molded foam.

Step e. Carefully remove the finished mold half from the fixture; check for conformity on all surfaces.

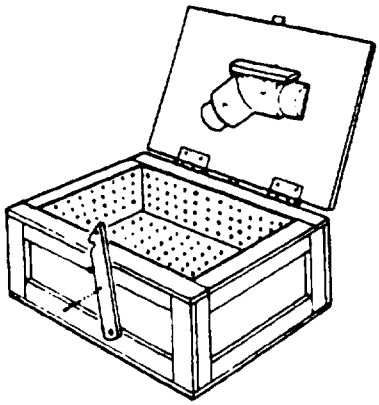
Step f. Duplicate step b through e to produce a mating mold half.

Step g. Wrap the item, if required, in accordance with the configuration used for item shape simulation, as in step a above. Place in formed mold halves and insert entire assembly in selected shipping container.

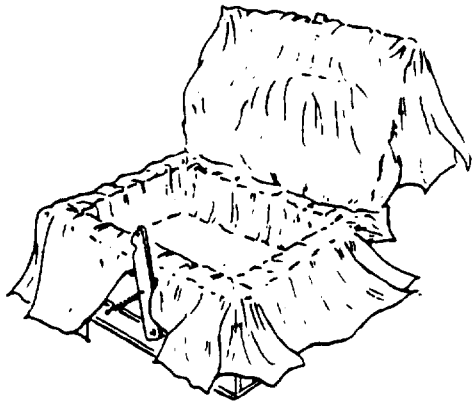
Step h. Close container and secure with tape.

3.12 Performance characteristics. The packs formed using the foam-in-place techniques specified in 3.11 shall be acceptable for their intended purpose and shall be capable of passing the tests and examinations specified in section 4.

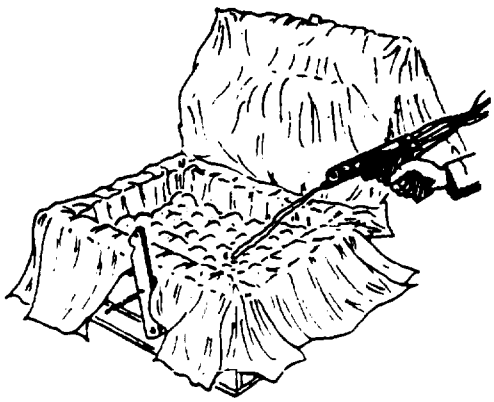
3.12.1 Exterior appearance. When inspected, as specified in 4.5.2, the exterior of the pack shall be free from surface distortions measuring in excess of 1/4 inch per 12 linear inches of container. Packs possessing skids or specialized bases and exceeding 150 pounds in gross weight shall be checked for base distortion while the base is resting on a flat surface. Surface



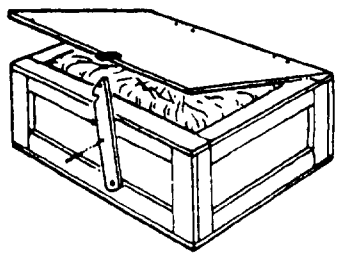
Step a



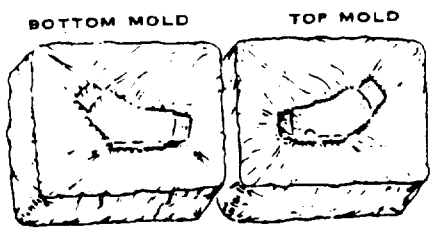
Step b



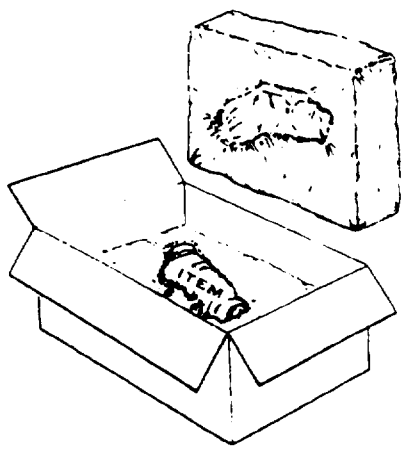
Step c



Step d



Steps e & f



Step g

FIGURE 14. Preformed mold.

distortion measurements shall not be more than 1/2 inch above the supporting surface at any point on the perimeter of the pack base. Opening and reusability instruction markings shall be as specified for the selected procedural design and as further identified in 3.11.7.3.

3.12.2 Rough handling test. There shall be no evidence of exterior pack deficiency or item looseness within the foam molds that affects the integrity of the pack or damage to the item when subjected to the appropriate rough handling test specified in 4.5.3. Exterior surfaces of the pack shall be inspected for evidence of container shell, base, and top frame separation from the polyurethane foam for those procedures not using intentional parting-type materials. Evidence of this separation shall be cause for rejection of the pack. Determination of conformance to the item looseness will be made following opening. Evidence of item movement in any direction; crushing of foam materials; item rotation from original placement; or item damage such as broken or distorted projections, loosened mountings, broken wires, or scorched surfaces shall be cause for rejection.

3.12.3 Shock mitigation (flexible foams). When specified (see 6.2), packs shall be capable of protecting items against the imposition of accidental shocks above prescribed fragility levels. Shock mitigation afforded by the flexible foam-in-place material shall be consistent over the temperature extremes from -20° F. to +125° F., and shall not exceed the specified fragility level when subject to the free fall drop test specified in 4.5.3. There shall be no exception to this requirement due to either weight or dimension (see 4.5.4).

3.12.4 Pack opening. Foam-in-place packs shall be fabricated in such a manner that the container can be opened and reclosed without damage to the item or cushioning material. Failure to meet this requirement shall be cause for rejection (see 4.5.4 and 4.5.5).

3.12.5 Completeness of fill. The resultant foam formed in the packs shall provide, as nearly as possible, a complete fill of the intended void space. Severe rounding off of interior container corners, excessive noncontact (bridging) over desirable item bearing surfaces, large void areas, and evidence of incomplete bonding of prefoamed materials shall not be permitted. For technique VII, foam must fill container 100 percent. No bridging (noncontact) over item surfaces shall be permitted. Voids or evidence of incomplete bonding shall not be permitted (see 4.5.4 and 4.5.5).

3.12.6 Foam adherence. There shall be no evidence of foam breakthrough; penetration; and adherence either on item, intimate wraps (except special wraps (see 3.2)), sealed bags, on inner

surfaces of containers (except where foam is applied directly against container walls), or restraining bucks (see 4.5.4 and 4.5.5).

3.12.7 Release of items. Items shall be easily removed from the foam molds with no evidence of accidental sealing between wraps, parting films, or bags. There shall be no evidence of locked items caused by improper application of multiple pours or excessive pressures created by void overfills (see 4.5.4 and 4.5.5).

3.12.8 Item condition. Items shall show no evidence of damage resulting from the application of foam-in-place materials. Apparent damage may include broken or distorted projections, loosening of mountings, broken wires, or scorched, painted surfaces (see 4.5.4 and 4.5.5). Humidity indicators, if used, shall indicate a safe condition.

3.12.9 Conditioning of pack. When specified (see 6.2), the pack shall be conditioned for 24 hours at a temperature of -20° F. (see 4.5.4).

3.13 Foam workmanship. The pack foam conforming to 3.1 and produced by the equipment specified in 3.4 shall form a unicellular plastic foam suitable for the intended techniques listed in 1.2 (see 4.5.7).

3.13.1 Rigid foams. The foam pack formed by a foam-in-place technique shall be essentially homogeneous throughout with a uniform cell structure. There shall be no splits, sparklers, void openings, or pockets over 1/2 inch in any direction that might be caused by rapid formation and/or release of the blowing agent before the polymer structure reaches sufficient strength to contain the gas. There shall be no evidence of shrinkage such as would be apparent by wrinkles or indentations in the foam surfaces. Further, there shall be no unexpanded resin, occlusions, or foam scorching evidenced by discoloration due to the generation of excessive heat during the exothermic reaction. The fusion line between successive pours, unless separated by parting films, shall be well knit and shall show no occlusions, cracks, or separations. The foam formed shall not be soft, tacky, or brittle after curing.

3.13.2 Flexible foams. The foam pack formed by the foam-in-place process shall not be soft, doughy, nonresilient, or brittle after curing. There shall be no multiple holes, voids, or "blowouts" exceeding 2 inches in diameter. Contaminated, recycled foam or more than 50 percent recycled foam shall not be integrated with the new foam pour in a completed pack. The

cured foam shrinkage shall not exceed 1/2 inch from any face of container inner walls.

3.14 Reusability. Formed foam molds are reusable when the prescribed procedures are followed, as required in 3.11 (see 4.5.8), except technique VII does not provide water vapor protection after the original seal is broken.

3.15 Special marking and labeling. Marking or labeling instructions specified for opening and reusability (see 6.2) shall be provided on the container (see 4.5.6).

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 order, the supplier may use his/her 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 insure supplies and services conform to prescribed requirements.

4.1.1 Alternate test procedure approval. In instances where a test may necessitate an impractical manipulation of a mounted item, where the overall size or weight of the item, or test equipment availability obviates compliance with a specific test requirement of this specification, the contractor may submit a request accompanied by detailed justification through the cognizant Government inspector for approval of an alternate test procedure.

4.2 Classification of inspections. The inspections specified herein are classified as quality conformance inspections (see 4.4).

4.3 Inspection conditions. Unless otherwise specified (see 6.2), all inspections shall be performed under environmental conditions of temperature ranging between 68° F. and 85° F. and a relative humidity range of 40 to 60 percent. Regardless of procedure being used, no foam packs shall be either examined or tested prior to 48 hours after final pouring of the polyurethane ingredients.

4.4 Quality conformance inspection.

4.4.1 Inspection of product for delivery. Inspection of product for delivery shall consist of group A, B, and C inspections. Sequence of inspections shall be exactly as specified herein. This will insure that procedural steps have been followed

correctly and end product foam characteristics achieved without adverse effects on items, other protective packaging materials, and containers.

4.4.1.1 Inspection lot. An inspection lot shall consist of all foam packs of the same technique produced under essentially the same conditions and offered for inspection at one time.

4.4.1.2 Group A inspection. Group A inspection shall consist of certification supported by verifying data specified in table I in the order shown. Sample selection, inspection level, and acceptable quality level shall be as specified in MIL-P-116.

4.4.1.3. Group B inspection. Group B inspection shall consist of the examinations and tests specified in table I in the order shown.

4.4.1.3.1 Sampling plan. The sampling plan shall be in accordance with MIL-STD-105 for special inspection level S-1. The sample size shall be based on the inspection lot size from which the sample was selected. The acceptable quality level (AQL) and the level of inspection shall be 4.0 percent defective for all group B examinations and tests performed at each inspection station.

4.4.1.3.2 Disposition of sample units. Sample units that have been subjected to group B inspection shall not be delivered on the contract or purchase order.

4.4.1.4 Group C inspection. Group C inspection shall consist of the examinations and tests specified in table I, as required, for the procedure and foam formulation used.

4.4.1.4.1 Sampling plan. When group C tests are specified in the contract or order for quality conformance inspection, samples shall be selected at random and subjected to group C tests. AQL and the level of inspection shall be specified in the contract or order (see 6.2).

4.4.1.5 Rejected lots. If an inspection lot is rejected, the supplier may rework it to correct the defects or screen out the defective units and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection in accordance with MIL-STD-105. Such lots shall be separate from new lots and shall be clearly identified as reinspected lots.

4.5 Methods of examination and test.

4.5.1 Examinations of packs. Group A examinations shall be affirmed by certification from the contractor. Group B examinations shall be visual inspections or tests, as required. Failure to comply with all of the visual examinations and test certification requirements shall be cause for rejection (table I).

TABLE I. Test required for the procedure and foam formulation utilized.

GROUP A (examinations)	Require para	Test para
--Designated packaging materials and foam-in-place ingredients used in the fabrication of the foam pack.	3.1 thru 3.1.2	
--Required foaming equipment and supplies selected for development of foam pack.	3.4	
--Preparations for developing foam packs--acceptable.	3.5 thru 3.7	
--Environmental considerations pertinent to conditions affecting operating personnel, ecology, and waste management--acceptable.	3.10	
--Foaming technique followed for the applicable procedure.	3.11	
--Opening method suitably described on pack exterior.	3.11	
GROUP B	**Require para**	**Test para**
--Reliability of opening method.	3.12.4	4.5.5
--Completeness of void fill, as required.	3.12.5	4.5.5
--No evidence of foam breakthrough and undesirable adherence.	3.12.6	4.5.5
--Complete release of item from foam pack.	3.12.7	4.5.5
--No evidence of item damage, foam particles, static charges, or unsafe humidity indicators.	3.12.8	4.5.5
--Foam workshop.	3.13	4.5.7
--Reusability.	3.14	4.5.8
--Marking and labeling of foam packs properly applied.	3.15	4.5.6
GROUP C	**Require para**	**Test para**
--Surface distortion.	3.12.1	4.5.2
--Rough handling test.	3.12.2	4.5.3
--Shock mitigation (flexible foams).	3.12.3	4.5.4

4.5.2 Surface distortion. Packages shall be inspected for surface distortion characterized by split closure tape, bulging container walls, or container concavity. The degree of surface distortion shall be determined using a straight edge of appropriate length for the particular dimensions of the pack. All surfaces, excluding bottom surfaces where skids are attached, shall be checked for measurable distortion, as determined by placing the straight edge along the diagonal of each surface (see 3.12.1).

4.5.3 Rough handling test. Packs shall be subjected to the following sequence of rough handling tests in accordance with the applicable methods of FED-STD-101.

4.5.3.1 Small containers. Those having no edge or diameter over 60 inches and a gross weight of 150 pounds or less. Any container with skids shall be tested as a large container.

Drop Test (Free Fall), Method 5007.1, procedure B.
Drop Test (Free Fall), Method 5007.1, procedure E.

4.5.3.2 Large containers - all others.

Cornerwise Drop (Rotational) Test, Method 5005.1
Edgewise Drop (Rotational) Test, Method 5008.1
Mechanical Handling Test, Method 5011.1 (Technique II)
Vibration (Repetitive Shock) Test, Method 5019.1 (when specified, see 6.2)
Incline-Impact Test, Method 5023 (when specified, see 6.2) of Pendulum-Impact Test, Method 5012, as applicable.

Graduated drop and impact test heights and number of impacts shall be in accordance with table IV of MIL-P-116, as determined by the gross weight of container and contents. Conformance to this requirement will be in accordance with 3.12.2.

4.5.4 Shock mitigation (flexible foams). Packs shall be opened and examined initially for conformance to 3.12.4 through 3.12.9 and the test specified in 4.5.5. Prior to determining reusability, the item shall be removed, as necessary, to permit attachment of appropriate accelerometers. Three accelerometers, one for each major axis or a single triaxial unit, shall then be mounted on the item or simulated item as close to the center of gravity as possible, in such a manner to insure against improper movement during subsequent shock tests. Cable leads shall then be attached to the sensors and the pack reclosed. During the reclosure, the pack shall be examined for conformance with the requirement in 3.14 and the test specified in 4.5.7. Access through the container wall shall be accomplished for extending the sensor cable leads to the instrumentation. Readout provision shall consist of necessary measuring instruments to include any calibration reference, amplifiers, or recorders that will insure an accuracy of ±5 percent in the readings obtained. Free fall, flat drop tests shall be performed initially at ambient temperatures in accordance with procedure B of Method 5007, FED-STD-101, using the graduated drop heights of table I of that standard for level A requirements. A series of six drops shall be made on each flat surface of the container with only the final five drops being recorded. From the readings taken for each drop, the resultant "g's" shall be determined for that drop. The average of the five resultant shocks shall be compared with the required "g" protection. A higher "g" figure than that allowed shall be cause for rejection of the pack. The identical pack shall be conditioned for 24 hours at a temperature of -20° F. (see 3.12.9). Immediately following conditioning of the pack, two additional drops

shall be performed using the same procedure as used at ambient temperatures. Resultant "g's", as determined by the second drop, shall not exceed the specified fragility level. Failure shall be cause for rejection of the pack (see 3.12.3).

4.5.5 Opening test. All techniques of foam-in-place packs shall be opened in accordance with instructions provided on the pack exterior (see 3.11) or for those packs in which opening is obvious. For purposes of this test, opening shall include those operations required to provide access to the prepared item and those visual examinations necessary to confirm the acceptability of the procedure (see 3.12.5 through 3.12.9). The interior of the pack shall then be examined for degree of void fill, improper foam adherence or loose particles (breakthrough), difficult item removal (locking or sealing), humidity indicator in a safe condition, and suspected damage to items. A minimum of 95 percent fill of the intended void space shall exist. Where the specified procedure permits, the foam exterior surfaces shall be examined for void areas (see 3.12.4.

4.5.6 Marking and labeling. Visual examination of the exterior of the completed package shall verify the proper application of any marking and labeling, as specified (see 3.15).

4.5.7 Foam workmanship. The foam-in-place packs shall be examined for evidence of splits, sparklers, shrinkage, voids, irregularities, or striations in the foam (caused by incomplete foam mix). Sample blocks shall be cut from the foam pack(s) and trimmed to provide plane and parallel surfaces to a size of 4 inches X 4 inches X 2 inches. The thickness dimension shall be perpendicular to the direction of rise. One specimen shall be taken from each of two opposite sides. For purpose of this test, halves formed constitute a single block. In the case of successive pours, the specimen(s) shall incorporate any fusion line somewhere near their midpoint. The examined specimens shall be free of soft or tacky particles (unexpended resin) or show evidence of splits, sparklers, or shrinkage. Further, there shall be no void openings or pockets (blow holes) exceeding 1/2 inch in any direction or evidence of scorching during foam formation. Packs utilizing reused foam shall be examined for incomplete bonding of refoamed materials caused by using excessive amounts of previously foamed materials without enough virgin foam around these materials to provide a complete bond (see 3.13). Failure to comply with any of these foam workmanship examinations shall be cause for rejection.

4.5.8 Reusability. Formed foam mold packs shall be tested to insure that, once open as in 4.5.5, the molds formed allow ready replacement of the prepared item and reuse of the pack. Failure to accomplish these requirements shall be cause for rejection (see 3.14).

5. PREPARATION FOR DELIVERY

This section is not applicable to this specification.

6. NOTES

6.1 Intended use. This specification is intended to describe the technique for foam-in-place packs where authority for that use for any given item is specified or approved by the Government. It is intended for use in conjunction with MIL-F-83671 that describes flame retardant polyurethane foam-in-place materials. Applicable dispensing equipment is described in MIL-F-87075.

6.2 Ordering data.

a. Title, number, and date of this specification.

b. Technique procedure (see 1.2).

c. Foam ingredients approved for the specified procedure (see 3.1.1).

d. Sensitive items permitted (see 3.2).

e. Method of preservation required (see 3.3).

f. Minimum foam thickness requirement (see 3.6).

g. Rough handling test requirement (see 3.6 and 4.5.3).

h. Complete container requirements, including specifications, classification, and dimension (see 3.11).

i. Class and grade of foam material (see 3.11.1, 3.11.2, 3.11.3, 3.11.4, and 3.11.8).

j. Width (diameter) of polyethylene film bag (or tube), technique IV (see 3.11.4.1).

k. Thickness of polyethylene sheet (see 3.11.4.1).

l. Complete description to include chemical class and grade, associated materials, and applicable drawings (see 3.11.5, 3.11.6, and 3.11.7).

m. Design procedures, technique VII (see 3.11.7.1).

n. Minimum clearance requirement, technique VII (see 3.11.7.2).

o. Amount of foam required, technique VII (see 3.11.7.2).

p. Established fragility level for shock-sensitive items (see 3.12.3).

q. Pack conditioning requirement (see 3.12.9).

r. Additional special marking, as required (see 3.15).

s. Group C quality conformance test, inspection, and AQL requirement (see 4.4.1.4.1).

6.3 Safety and health considerations. Potential hazards associated with the use of foam-in-place procedures should be minimized through the use of proper preventive measures and controls. Specific guidance may be found in Upjohn Technical Bulletin 107 and from local industrial hygiene, medical, and safety personnel. Also consult MIL-F-83671 and MIL-F-87075 for additional safety and health considerations.

6.3.1 Chemical hazards. Foam chemicals are toxic, both from the standpoint of the individual ingredients and the mixed reacted foam. Further hazards occur when materials are not stored properly, dispensing equipment not maintained correctly, or purging operations improperly performed (see 6.3.2). Of the materials involved in a complete foaming operation, the following list identifies significant ones with their potential effects:

a. Di and polyisocyanates (component A). Skin irritant, harmful to eye tissues, and causes bronchospasm and respiratory tract sensitization in susceptible individuals.

b. Trichlorofluoromethane (typical blowing agent). Can cause unconsciousness and anesthesia leading to asphyxiation following prolonged breathing of high concentration.

c. Silicone oils (cell control agents). Low toxicity but repeated contact to be avoided.

d. Phosphate esters (for flame retardancy). Readily absorbed through skin causing blurred vision, nausea, headaches, abdominal cramps, coughing, and breathing difficulties.

e. Amines (catalysts). Vapors are eye irritants and can irritate mucous membranes. Aliphatic amines can produce skin burns and dermatitis. Respiratory irritant.

f. Methylene chloride (purging solvent). Skin and respiratory irritant. Methylene chloride can also act as a chemical asphyxiant.

g. Ethylene glycol monoethyl ester (cleaning solvent). Skin and respiratory irritant.

h. Dioctyl or diallyl phthalate (plasticizor/lubricant). Skin and respiratory irritant.

6.3.2 Purging dispensing head. It is recommended that when purging the dispensing head of a foam machine, the discharge solvent should be directed into a container containing approximately 1 inch of water. This action will limit the escape of solvent (methylene chloride) vapors.

NOTE: Methylene chloride is a solvent that can cause skin, eye, liver, respiratory tract, and central nervous system toxicity. Workers should use the appropriate skin, eye, and respiratory protection, as designated by local industrial hygiene personnel.

6.3.3 Pyrolysis. Smoking in foaming areas shall be prohibited. This is required due to the pyrolysis breakdown products and not the flammability characteristics of the foam chemicals.

6.3.4 Combustibility. Combustion of solid foam and the foaming ingredients produce toxic gases, as do most packaging materials. In the event of fire, the local fire departments shall be immediately notified. Full face, self-contained breathing apparatus shall be employed for these fires. For small fires, CO_2 or dry chemical fire extinguishers are suitable.

6.3.4.1 Personal protective measures. Protective measures involved with foaming operations include proper training, assignment of personal safety equipment, location of approved emergency facilities, and the designation of safe operating and reporting procedures. Eye wash fountain(s) and shower(s) should be located in the immediate foaming area or readily accessible thereto.

6.3.4.2 First aid. If chemicals containing isocyanates (primarily component A) are splashed on the skin, treatment should be started immediately as follows:

a. Shower immediately (major splash only).

b. Apply tincture of green soap (full strength) or rubbing alcohol to the remaining contaminated area.

c. After 2 to 4 minutes, wash off the tincture of green soap or rubbing alcohol with water. If there is still an indication of isocyanate present, another application will be

necessary. If the isocyanate contamination is on the face, care should be taken to prevent getting the tincture of green soap in the eyes.

d. When polyol component (component B) is splashed on the skin, it should be washed away with soap and water.

e. If either component is splashed in the eyes, the eyes should be flushed immediately with clean water for 15 minutes. The eyelids should be held apart during this treatment. Medical attention should be promptly obtained.

f. If a person accidentally swallows the isocyanate component, and is conscious, vomiting shall be induced by having the victim drink one or two glassfuls of water and tickling the back of the throat with a spoon handle or other blunt object. Do not wait for vomiting, but transport the victim to a physician immediately. Once under medical care, consideration should be given to administering mild or additional water followed by a mild cathartic such as milk of magnesia. Do not attempt to induce vomiting in an unconscious or convulsing individual. In this event, transport victim to a physician immediately. If a person is overexposed to the vapors of components, he should be removed from exposure immediately and transported to a physician. Oxygen may be administered by qualified personnel en route if the exposed person has difficulty breathing.

6.3.4.3 Vapor detection. Field detection must be performed under the direction of trained industrial hygiene personnel. Interpretation of sampling data must be performed by appropriate industrial hygiene or medical personnel. Field test kits that can detect the concentration of disphenylmethane diisocyanate vapors in the range up to 0.02 parts per million, the threshold limit value, are available from Mine Safety Appliance Company, 201 North Braddock Avenue, Pittsburg, PA 15208 and Industrial Products Company, 2820 North Fourth Street, Philadelphia, PA 19133.

6.3.5 Decontamination.

6.3.5.1 Clothing. Clothing splashed with the polyol component should be removed and washed in an aqueous detergent solution before wearing again. Clothing splashed with the isocyanate component should be removed immediately, the isocyanate scraped off the clothing, and the clothing washed in an aqueous detergent solution. For large spills soaked through the clothing, the clothing should be washed in an aqueous detergent solution before being discarded.

6.3.5.2 Spills. Accidental floor spills may be decontaminated by covering with an absorbent material such as absorbent shredded

paper, sawdust, Fuller's earth, or other absorbent material. If amine fumes are present, a vapor cartridge-type respirator should be used. Pour liquid decontaminant consisting of 90 to 94 percent water, 4 to 8 percent concentrated ammonium hydroxide, and 2 percent detergent on the spillage and allow to react for at least 10 minutes. Carefully remove all residues from the spill, placing them in open containers, and add further amounts of liquid deconcentrate. After removing containers to a safe place, the floor may be washed with liquid decontaminate, soapy water, or an ammonia solution.

6.3.5.3 Empty drums. Polyol drums may be decontaminated with soapy water and reclaimed through any suitable outlet. Isocyante drums may be decontaminated by slowly adding the liquid decontaminant. Under no circumstances should the drums be closed. After 24 to 48 hours, the drums may be drained (see 6.4) and pierced to prevent reuse.

6.4 Waste management. All waste (liquid or solid foam) should be disposed of in a manner that will minimize pollution and enhance the environment. The first consideration in waste management shall be reuse or recycling. Applicable directives and local environmental authorities should be consulted before complete disposal of these materials is attempted. Further specific guidance may be found in Upjohn Technical Bulletin 107. A partial list of incineration facilities may be obtained from the Air Force Packaging Evaluation Agency, ATTN: AFALD/PTPT, Wright-Patterson AFB, OH 45433.

6.4.1 Purging solvents. Some operations use solvents such as methylene chloride (dichloromethane) to clean foam mixing and dispensing equipment. Wastes from these mixtures of solvent and foam components must be managed as a hazardous waste with Environmental Protection Agency No. F001 (40 CFR 261).

6.4.2 Decontamination waste. The reacted (neutralized) waste solution may be disposed of by metering to the sewer at a rate based on solid content or by supervised incineration of noxious chemical waste.

6.4.3 Empty drums. Reclamation of decontaminated drums is preferable to landfill disposal. Alternatively, empty drums, as defined in 40 CFR 261.7, may be accepted at sanitary landfills by special arrangement and with the concurrence of State regulatory authorities.

6.5 Foam-in-place training. Specific on-site familiarization with basic urethane chemistry, finished foam properties, characteristics of various types of dispensing equipment, and practical exercises in forming various foam procedures are available through training courses offered by the Director, Joint Military Packaging Training Center, ATTN: DRXPT-S, Aberdeen Proving Ground, MD 21005.

6.6 Changes from previous issues. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

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

Preparing activity:
Army - SM

(Project PACK - 0623)

Review activities:
Army - AT, EA, MD, AL, ME
Navy - AS, OS
Air Force - 11, 43, 70, 71, 79, 80, 84, 99
DLA - CS, ES
User activities:
Army - MR, MT
Navy - EC, MC, SH, YD

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-F-45216A	Foam-In-Place Packaging, Procedures For

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
	☐ USER
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ MANUFACTURER
	☐ OTHER *(Specify)*:

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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