cleats, when required, on the sides, top and bottom (fig 3-24). Draw strapping tightly so as to sink into the edges of the cleats. Fasten strapping to the cleats with staples spaced approximately 6 inches apart, and within 4 inches from the edge of the box over which the strap passes (except over bands on the bottom of the box and bands applied over filler cleats on the top). Staples shall be applied just prior to shipment where practicable. Strapping used for unnailed closure boxes shall not be stapled. Alternately, each lengthwise and girthwise strap may be replaced by four corner straps each 8 inches long and secured to the box with three staples on each leg pneumatically driven through the strap into the cleat. However, corner straps shall not be used on unnailed closure boxes. Exercise care in strapping domestic styles so that the straps do not pass over voids between cleats and thus become susceptible to snagging.

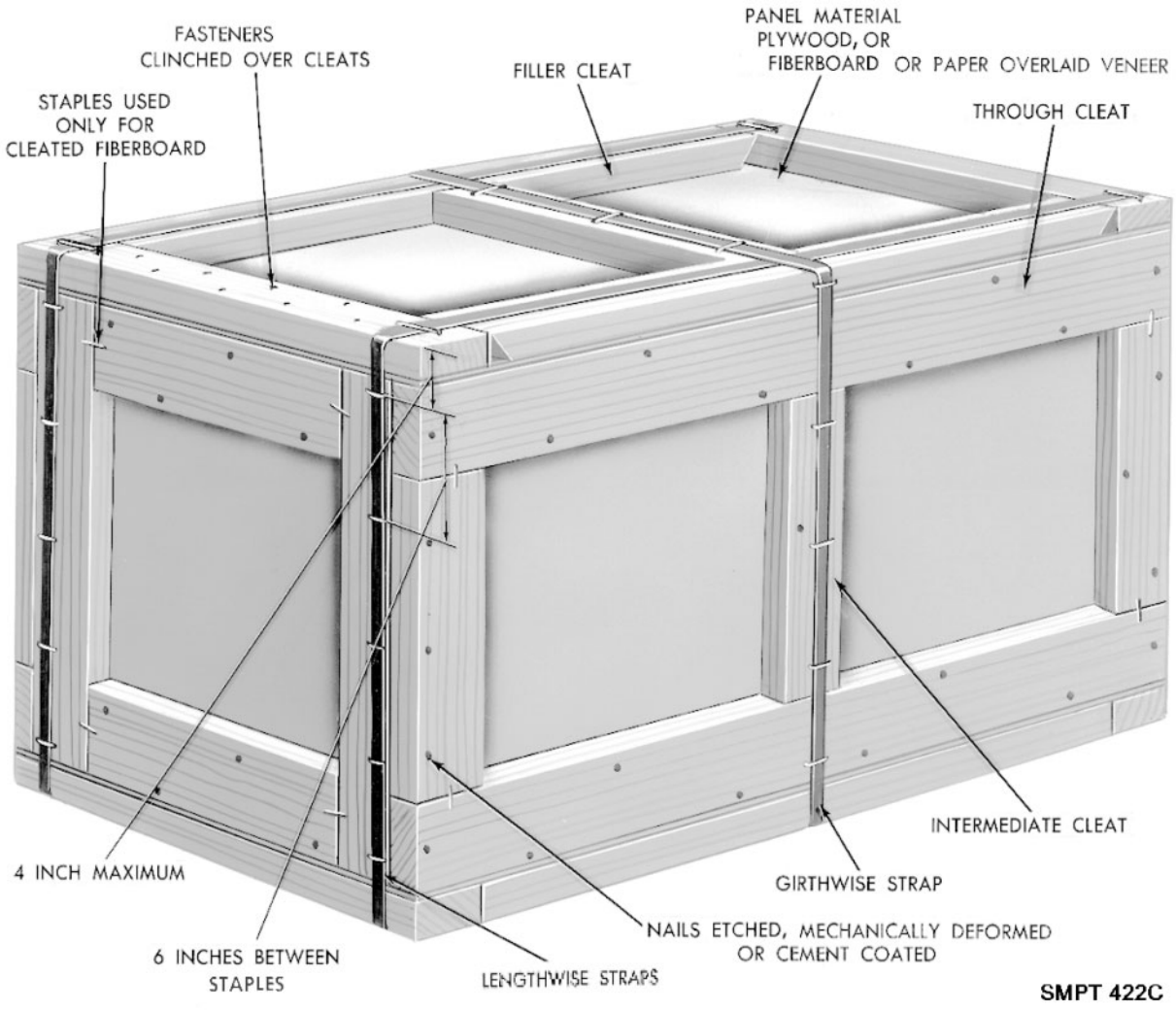


Figure 3-23. Strapping of cleated panel boxes.

Styles A, B, I and J (Domestic)

Strap domestic styles only where specified. Strap in accordance to the appendix to PPP-B-601.

Dimensions

Dimensions shall be given in the sequence of length, width and depth of the inside measurements. The first two dimensions will be the open face of the box. A tolerance of plus or minus 1/8 inch is permitted in the dimensions.

BOXES, WOOD-CLEATED PANELBOARD

Wood-cleated panelboard boxes are intended for use as containers for domestic and overseas equipment of general materials and supplies, not exceeding 500 pounds for domestic or 400 pounds for overseas shipments.

Wood-cleated, water-overlaid veneer boxes take all three types of loads to a maximum weight of 500 pounds for domestic use (class 1 boxes), and 400 pounds for oversea used (Class 2 boxes), in accordance with PPP-B-576. Styles A and B only are authorized for both domestic and oversea shipments. Tables 3-21 and 3-22 contain the requirements for the paper-overlaid veneer panelboard and the cleats for class 1 and 2 boxes, respectively, according to the weight of contents.

Skids are attached to the bottom of boxes having a gross weight of more than 200 pounds, or when the length and width dimensions are 48 inches by 24 inches or over and the gross weight is 100 pounds or over. The skids shall be a minimum of 2 1/2 inches high and 3 1/2 inches wide and may be fabricated from more than one piece of lumber to make up the required height. The skids shall be set not less than 2 1/2 inches not more than 4 inches in from each end. Filler cleats of the same thickness as the edge cleats and the same width as the skids and the bottom panel of the box.

WOOD-CLEATED, SKIDDED, LOAD-BEARING BASE BOXES (ASTM D6256)

These boxes may be used for the shipment of items which can be secured to a load-bearing base. The sides, tops, and ends are of cleated panel construction. Panels may be plywood, fiberboard, or paper-overlaid veneer and comply with the applicable requirements of PPP-B-601 and PPP-B-576, respectively. Styles A, B, and C are used for Type I, domestic, and Type II, oversea shipments. The bases are fabricated as Class 1, plywood base, and Class 2, lumber base (see fig 3-25).

INTENDED USE

Boxes covered by ASTM D6256 are intended to be used for items which can be attached to a load-bearing base. It is intended that the entire load be carried on the base. The super-structure (tops, ends, and sides) provides only for superimposed loads and protection against the elements. It is not intended for the box to be lifted or moved other than by the base. The super-structure may be removed when it is not required.

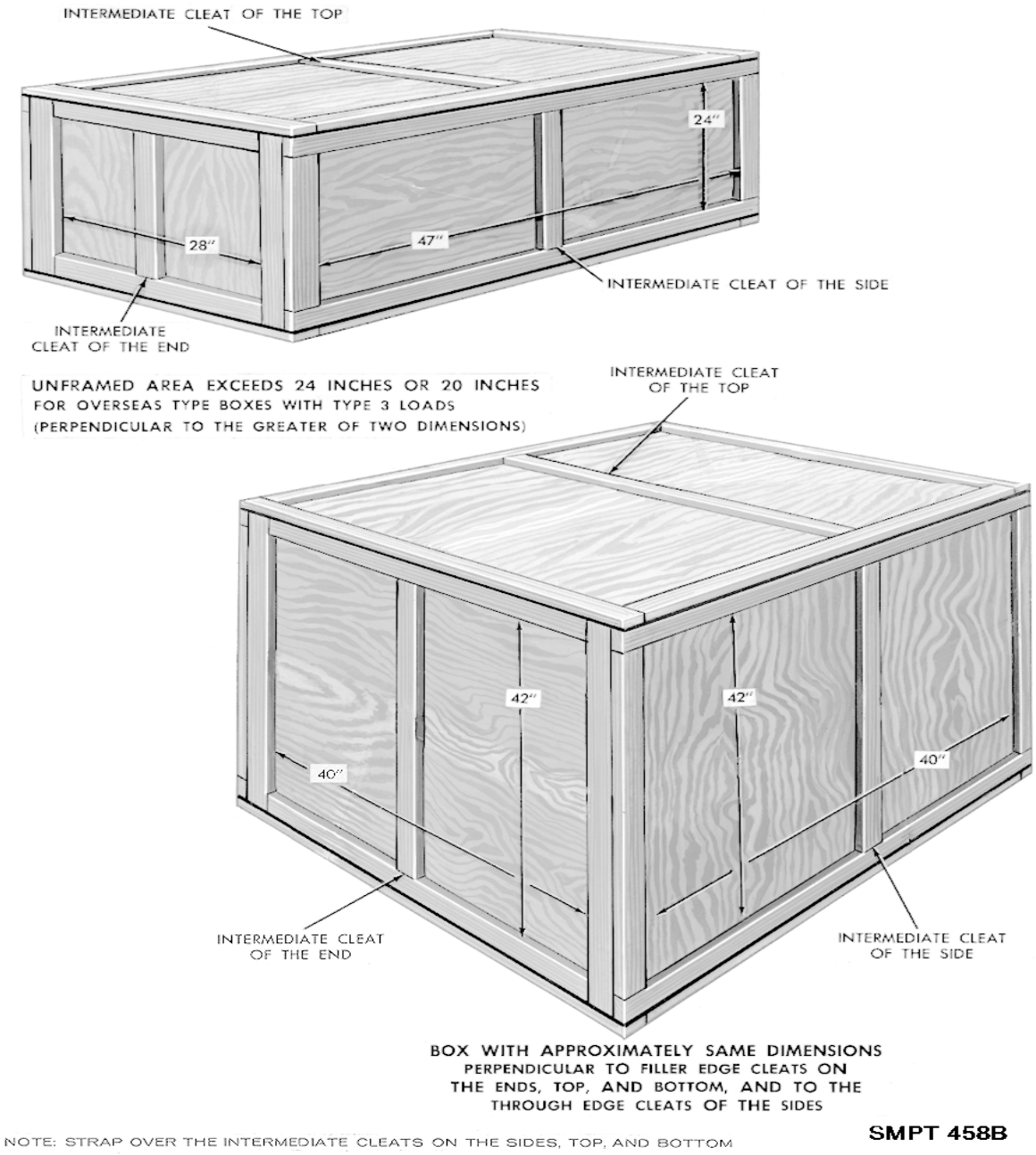


Figure 3-24. Spacing of intermediate cleats.

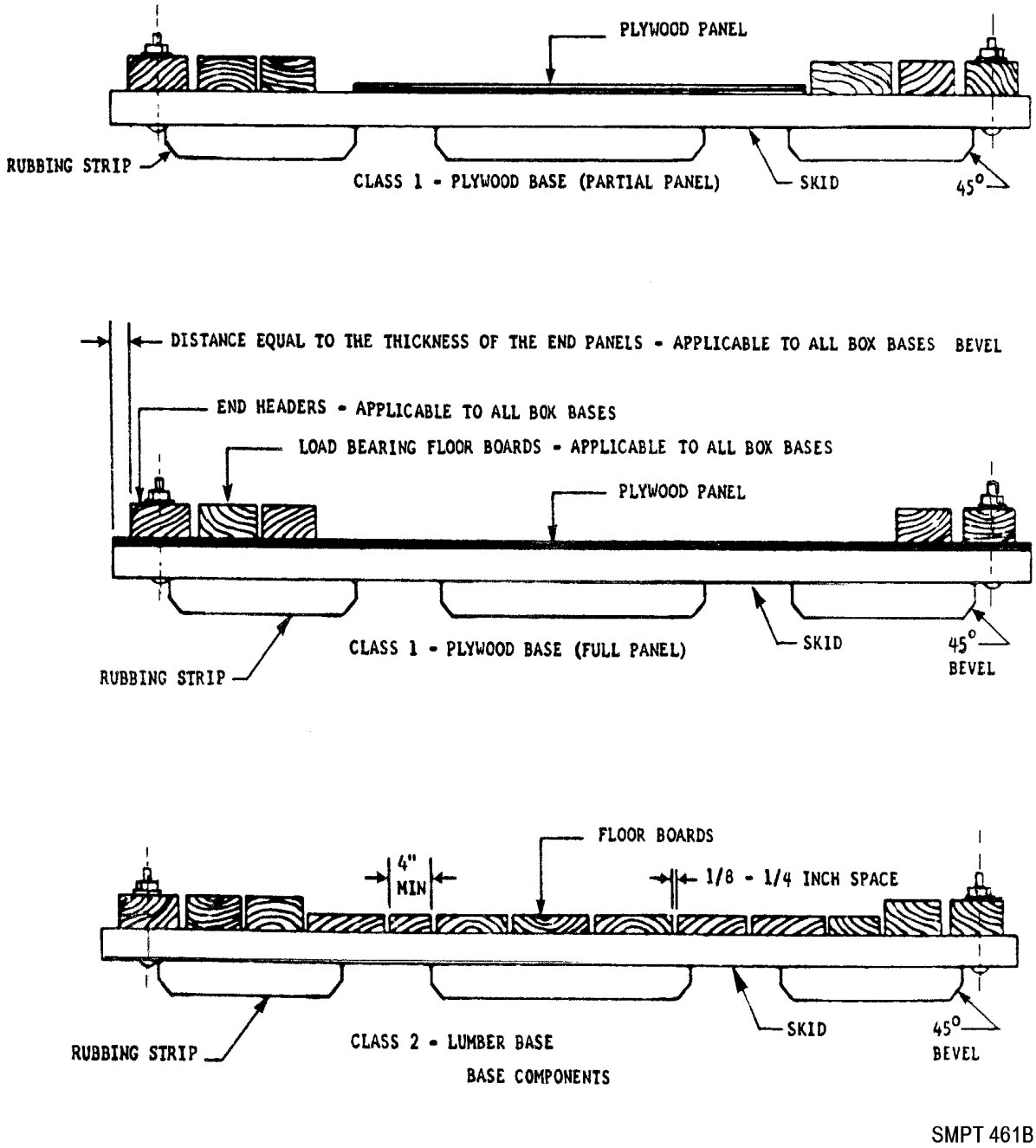


Figure 3-25. Classes 1 and 2 bases for wood-cleated, skidded, load-bearing base boxes, ASTM D6256.

Table 3-21. Class 1 boxes: Requirements for paper overlaid veneer panelboard and cleats

Weight contents		Size of cleats		Paper overlaid veneer panelboard	
Exceeding	Not exceeding	Minimum width	Minimum thickness	Types 1 and 2 loads	Type 3 loads
				Minimum thickness	Minimum thickness
Pounds	*Pounds*	*Inches*	*Inch*	*Inch*	*Inch*
0	75	1-3/8	5/8	0.070	0.090
75	150	1-3/4	5/8	0.115	0.140
150	225	1-3/4	3/4	0.115	0.140
225	300	1-3/4	3/4	0.170	0.195
300	400	1-3/4	13/16	0.225	-------

Table 3-22. Class 2 boxes: Requirements for paper overlaid veneer panelboard and cleats

Weight contents		Size of cleats		Paper overlaid veneer panelboard	
Exceeding	Not exceeding	Minimum width	Minimum thickness	Types 1 and 2 loads	Type 3 loads
				Minimum thickness	Minimum thickness
Pounds	*Pounds*	*Inches*	*Inch*	*Inch*	*Inch*
0	100	1-3/4	5/8	0.070	0.120
100	250	1-3/4	3/4	0.140	0.180
250	350	1-3/4	13/16	0.225	0.195

Fabrication of Panels

When panels are fabricated locally, they are made according to information contained in table 3-13 and HPMA-HP 1983. Also see PPP-B-601 construction of panels. Even filler cleat tolerance and drainage shall be in accordance with PPP-B-601. Cleat arrangement on top panels is illustrated in figure 3-26. When joists are required for the super-structure to hold superimposed loads, they are selected in accordance with table 3-23. Joist supports are required to be placed beneath each joist (see fig 3-27). The vertical and material supports shall comply with the material requirements for the cleat stock, except that the thickness shall not be less than one inch for container loads up to 1,000 pounds. For loads in excess of 1,000 pounds, the supports shall be not less than 2 inches. The vertical joist supports shall be nailed to the side panels with nails long enough to pass through the clinch of 1/8 inch for Groups II, III, and IV woods and 1/4 inch clinch for Group I woods.

Fabrication of Base Components (see fig 3-24)

Skids

Skids will be made of Group II, III, or IV lumber. The cross section and length of skids are chosen from table 3-28, based upon weight of contents and load conditions, as illustrated in figure 3-27. For boxes whose outside width exceeds 36 inches, a third skid conforming to table 3-28 is added. The third skid is placed equidistant between the outer skids. At the ends of each skid, the lower half is beveled approximately 45 degrees.

Load Bearing Members

Load bearing members will be free of defects which could materially weaken them. They are selected in accordance with table 3-25. The cross section of load bearing members for a particular load is determined either by assuming a total width of such load bearing members and determining the thickness necessary, or by assuming a thickness and determining a total width of load bearing members.

Lumber Flooring

Lumber flooring will be a minimum of 1-inch thick, and not less than 4 inches wide. Lumber is laid at right angles to the skids. The boards are separated one-eighth to one-fourth of an inch to allow for swelling and drainage. The board ends are placed flush with the outer edge of the skids.

Plywood Flooring

Unless otherwise specified, plywood used for Type I boxes shall conform to HPMA-HP 1983, Type II, Grade 3-4, PS1, standard interior. The minimum thickness shall be three-eighths of an inch. See table 3-13. It may be the full length and width of the base, or it may be a centrally located square piece with the length equal to the base width. When a full piece of plywood is used, a drainage hole one-half inch in diameter is placed in each corner of the base. Additional drainage holes are placed every three feet along the side of the base. When load bearing floorboards are placed over plywood panels, at least one drainage hole is placed on each side of the base between the load bearing floorboards.

End Headers

End headers are placed at the ends of the box. Headers are nominal 2 X 4 inches.

Rubbing Strips

When specified, rubbing strips shall be applied under each skid to facilitate forklift handling. They will provide a nominal 3-inch clearance for forklift entry.

Table 3-23. Selection of joists for wood cleated, skidded, load bearing base boxes (joists spaced 24 inches--center to center)

Nominal joist size (Inches)	Outside width of box (Inches)
None required	24
1X4	25-36
2X4	37-60

Table 3-24 . Nominal sizes and maximum lengths of skids for wood cleated,skidded, load bearing base boxes.

Weight of Contents (Pounds)	Load Condition1/	Nominal Sizes					
		2 X 4	2 X 6	2 X 8	4 X 4	4 X 6	6 X 6
		Maximum Length of Skid (Feet)					
0 - 100	A	16	--	--	--	--	--
	B	16	--	--	--	--	--
	C	16	--	--	--	--	--
	D	16	--	--	--	--	--
	E	16	--	--	--	--	--
101 - 200	A	16	--	--	--	--	--
	B	16	--	--	--	--	--
	C	16	--	--	--	--	--
	D	16	--	--	--	--	--
	E	16	--	--	--	--	--
201 - 400	A	11	15	16	--	--	--
	B	13	16	--	--	--	--
	C	8	12	16	--	--	--
	D	10	15	16	--	--	--
	E	13	16	--	--	--	--
401 - 600	A	8	11	14	16	--	--
	B	9	14	16	--	--	--
	C	5	8	11	16	--	--
	D	7	10	14	16	--	--
	E	9	14	16	--	--	--
601 - 800	A	7	9	11	16	--	--
	B	7	10	14	16	--	--
	C	4	6	8	16	--	--
	D	5	8	10	16	--	--
	E	7	10	14	16	--	--
801 - 1000	A	6	8	10	16	--	--
	B	5	8	11	16	--	--
	C	3	5	7	16	--	--
	D	4	6	8	16	--	--
	E	5	8	11	16	--	--
1001 - 1200	A	6	7	8	16	--	--
	B	4	7	9	16	--	--
	C	3	4	5	13	16	--
	D	3	5	7	16	--	--
	E	4	7	9	16	--	--
1201 - 1400	A	5	7	8	14	16	--
	B	5	6	8	16	--	--
	C	0	4	5	11	16	--
	D	3	4	6	14	16	--
	E	5	6	8	16	--	--

1/ The load condition is determined by the manner in which the load is applied to the skids (figure 3-27)

Table 3-24 (cont). Nominal sizes and maximum lengths of skids for wood cleated,skidded, load bearing base boxes.

Weight of Contents (Pounds)	Load Condition1/	Nominal Sizes					
		2 X 4	2 X 6	2 X 8	4 X 4	4 X 6	6 X 6
		Maximum Length of Skid (Feet)					
1401 - 1600	A	5	6	7	13	16	--
	B	3	5	7	16	--	--
	C	0	3	4	18	15	16
	D	3	4	5	12	16	---
	E	3	5	7	16	--	--
1601 - 1800	A	5	6	7	12	16	--
	B	3	5	6	15	16	--
	C	0	3	4	9	14	16
	D	0	3	4	11	16	--
	E	3	5	6	15	16	--
1801 - 2000	A	4	5	6	11	15	16
	B	3	4	5	13	16	--
	C	0	0	3	8	12	16
	D	0	3	4	10	15	16
	E	3	4	5	13	16	--
2001 - 2220	A	4	5	6	10	14	16
	B	0	4	5	12	16	--
	C	0	0	3	7	11	16
	D	0	3	4	9	14	16
	E	0	4	5	12	16	--
2201 - 2400	A	4	5	6	10	13	16
	B	0	3	4	11	16	16
	C	0	0	3	7	10	16
	D	0	0	3	8	13	16
	E	0	3	4	11	16	--
2401 - 2500	A	4	5	6	9	13	16
	B	0	3	4	10	16	--
	C	0	0	3	6	10	16
	D	0	0	3	8	12	16
	E	0	3	4	10	16	--

Table 3-25. Allowable load (pounds) per inch of width of load-bearing floor members

Length between outside skids (inches)	Nominal 1-inch thick boards (lbs per inch)		Nominal 2-inch thick boards (lbs per inch)		Nominal 3-inch thick boards (lbs per inch)	
	Wood Groups		Wood Groups		Wood Groups	
	I or II	III or IV	I or II	III or IV	I or II	III or IV
12	38	46	176	211	459	551
18	26	31	118	142	306	367
24	19	23	88	106	230	276
30	15	18	70	84	183	220
36	13	16	58	70	154	185
42	11	13	52	62	131	157
48	10	12	44	53	115	138
54	9	11	39	47	102	122
60	7	8	35	42	92	110

Figure 3-26. Styles A and B cleat arrangement for wood cleated, skidded, loadbearing base boxes.

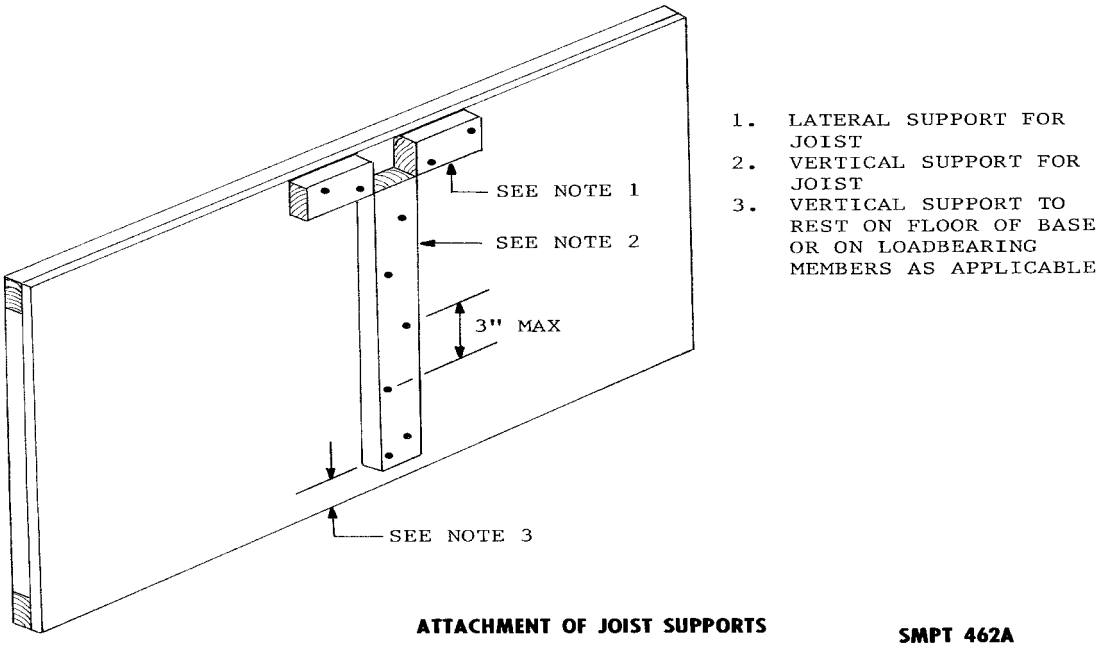


Figure 3-27. Attachment of joist supports for wood cleated, skidded, load bearing base boxes.

Assembly of the Base

Depending upon the weight of the item, load condition, size and length of skids, and whether it is a Class 1 or Class 2 base, the base parts are cut to size for fabrication. The nailing of plywood and lumber flooring to the skids is illustrated in figure 3-25.

Load bearing floor members over 2 inches thick and up to 4 inches in width are bolted to the skids with one carriage bolt at each end. Two carriage bolts are used at each end of load bearing floor members when they exceed two inches in thickness and 4 inches in width. The load bearing floor members are fastened to skids with 3/8-inch carriage bolts. Load bearing members less than 2 inches in thickness are nailed to the skids. Nails shall be as large as practicable without splitting the piece. The end headers are fastened to the skids with 3/8-inch carriage bolts.

Assembly of the Superstructure

The assembly of the cleated plywood, cleated fiberboard, and cleated paper-overlaid veneer panels into the superstructure shall comply with the applicable requirements of the specifications already described.

Assembly of the Superstructure to the Base

The end and side panels are assembled to the base with lag bolts (sometimes referred to as "lag screws"). One 3 inch lag bolt, three-eighths inch in diameter, is placed through the lower longitudinal cleat of the side panel and into the skid, at a distance not less than 2 inches from the end of the cleat. The distance between additional lag bolts shall not exceed 12 inches. In attaching the end to the header, one lag bolt is placed through the lower filler and into the end header, at a distance not less than 2 inches, not more than 3 inches from the end of the filler cleat. A minimum of two lag bolts are required through each end filler cleat.

CAUTION

Lag bolts shall not be driven with a hammer except to start them. They shall be turned in their holes the full distance. If the threads become stripped in the wood, the lag bolt is to be removed and inserted in a new hole near the old position. A washer is placed under the head of each lag bolt. Countersinking of lag bolts is not permitted.

WIREBOUND WOOD BOXES (PPP-B-585)

A wirebound wood box is a resilient engineered structure deriving both strength and economy from the substitution of steel wires for a considerable portion of wood. The sides, top, and bottom of this container are stapled to several binding wires and are fastened to a framework of cleats at each end by staples driven astride the end binding wires. The ends are nailed, stapled, or wired to the cleat framework to form the container.

Description of Box Components (fig 3-29)

Blank

A blank is the assembled parts of a wirebound wood box. The wood faceboards of the box are held together by wires which are stapled to them. Blanks are "set up" to form a box.

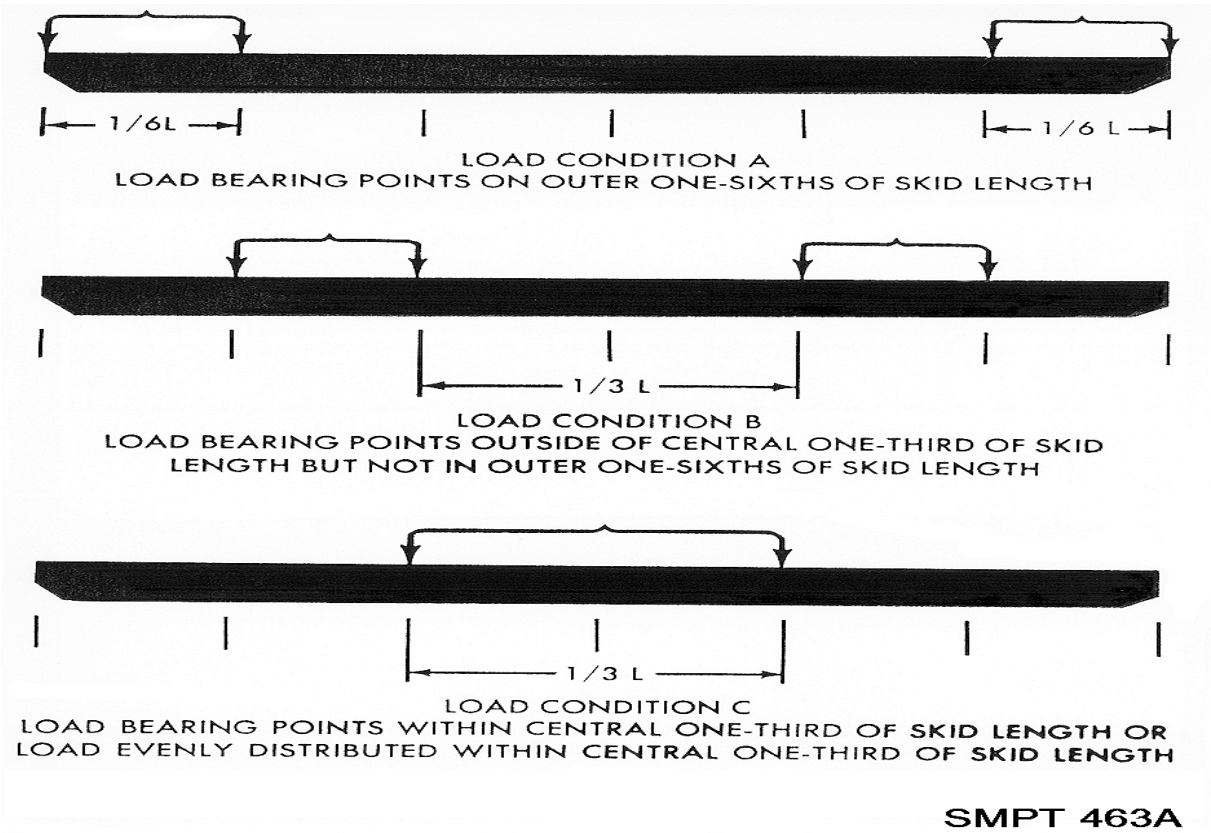


Figure 3-28. Load distributions of skids.

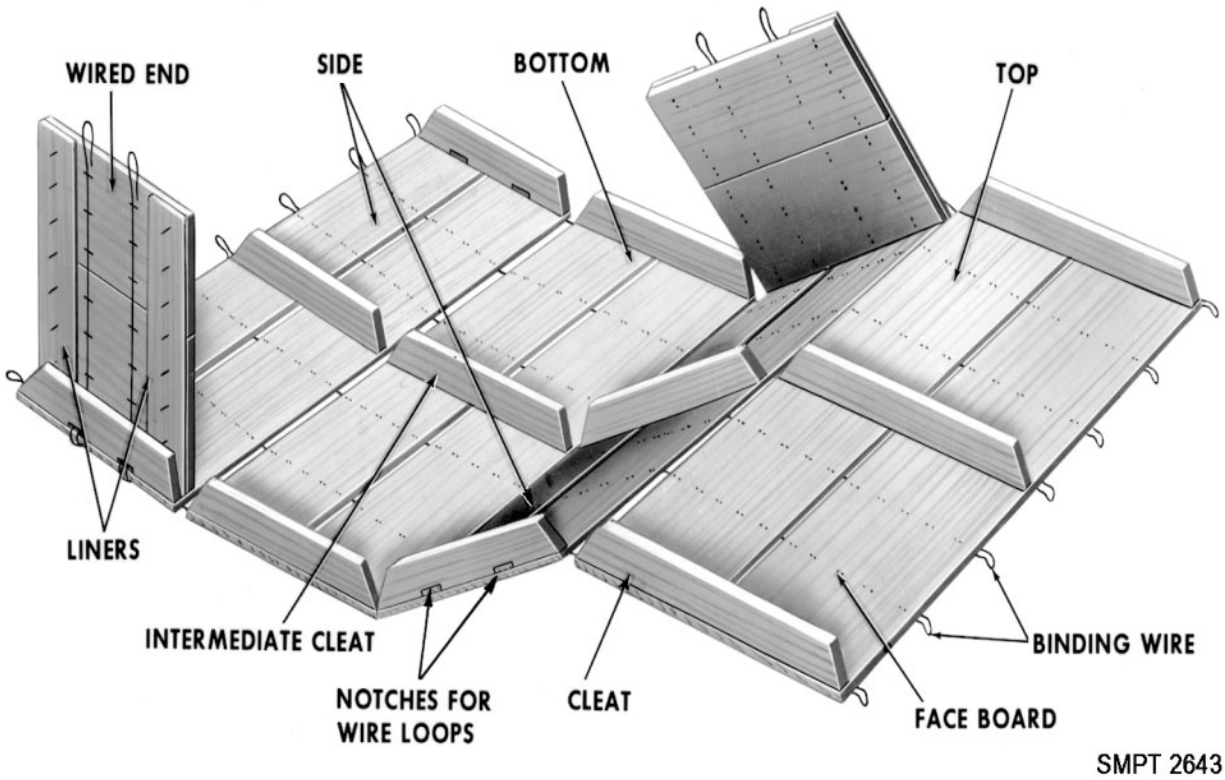


Figure 3-29. Components of wirebound wood boxes.

Cleats

Cleats form the framework to which the ends of the faceboards or slats are fastened. They are made with mitered or mortised and tenoned ends (tongued-and-grooved). Intermediate rows of cleats may be required to reinforce unsupported spans.

Faceboards

Faceboards are the thin boards that form the six faces of the box. They are made of veneer, resawn lumber, plywood, or paper-overlaid veneer. Their chief function is to hold the contents of the box in place.

Binding Wires

They hold the faces of the box together and carry most of the weight in the box.

Staples

They hold the faceboards and cleats to the binding wires.

Ends

The ends may be either plain, linered, or battened, according to the type of materials used, the weight of contents, and type of load. Only ends made from plywood are plain.

Battens

They are pieces of wood used on the ends of wirebound wood boxes to reinforce the ends, to reinforce the cleats, and to increase the strength of the box so that it may carry heavy stacking loads.

Liners

They are thinner pieces of boards stapled to the ends in order to tie all parts together and to strengthen the fastening section. The grain of the liner is placed at right angles to the grain of the end faceboard. They are stapled to either the outside or inside face of the ends. Liners for Styles 1 and 2 boxes are always vertical; liners for Style 3 boxes are always horizontal.

Skids

A wirebound box has two skids added when it carries a gross weight in excess of 200 pounds or when the gross weight exceeds 100 pounds, but the length and width are 48 inches by 24 inches or more. Additional skids are added if the distance between them exceed 48 inches. They are secured by two rows of nails in a staggered pattern. PPP-B-585 stipulates other requirements concerning the addition of skids.

Classes

Class 1 Domestic

For domestic shipments not involving sea transportation, but subject to storage, rehandling, or reshipment to domestic destinations. Weight limitation is 500 pounds.

Class 2 Normal Oversea

For off-shore and oversea shipments contemplating projected storage and commercial-type handling. Weight limitation is 400 pounds.

CLASS 3 MILITARY OVERSEA

For oversea shipments and handling in military supply systems, subject to repeated rehandling and unprotected storage, and which may also be subjected to extreme climatic conditions. Weight limitation is 300 pounds.

If required, Class 2 and 3 boxes are preserved with the same preservative treatment as PPP-B-621 and PPP-B-601 wood boxes.

STYLE OF BOXES

Three styles of wirebound wood boxes are used for domestic and oversea shipments. These styles differ primarily in the manner of closure of the binding wires. Each style can be easily recognized in figure 3-30. Style 1 has a twisted wire closure, Style 2 has a looped wire closure, and Style 3 has a looped wire closure and has the ends reinforced with wire instead of battens. Unless end battens are used, the Style 3 box is not recommended for Type 3 (difficult) loads.

ORDERING DATA

Wirebound wood boxes are engineered and manufactured commercially and are not made locally by military activities. Procurement documents should include the specification number (PPP-B-585); the inside length, width, and depth to the nearest one-sixteenth of an inch; the style of box; the class of box; the type of load; and the weight, quantity, and marking of the contents. If blocking or bracing is required, it is suggested that a drawing or a sample of the item be furnished to the box manufacturer.

CONTAINER MANUFACTURER'S IDENTIFICATION

Unless otherwise specified, each box is imprinted with the following information, which is limited to 15 square inches and placed in a lower corner of one side panel:

- Federal Specification PPP-B-585.
- Box manufacturer's name.
- Plant location.
- Maximum weight of contents...pounds.
- Class...box. For type...load. Style...Box.

BOX USAGE

Each box is manufactured to do a specific job. When used for the proper maximum weight of contents, type of load, and class of use, it will afford adequate protection to the item being shipped. It is important that the container manufacturer's identification be utilized prior to packing. The following points must be considered:

- In using the boxes, care should be exercised to select the box designed for the type of load to be shipped. A Type 2 load will not be packed in a box designed to carry a Type 1 load, and a Type 3 load will not be packed in a box designed to carry either a Type 1 or a Type 2 load.
- Type 1 and 2 loads, the inside dimensions of the box will be sufficiently exact so that the contents fit snugly into the box and give support to all its faces.
- Type 3 loads, other than bulk loads, the contents will be firmly bolted, blocked, braced, or otherwise anchored to the frame of the box in such a manner that shifting of the contents will not occur during handling of the shipment.

ECONOMY FACTORS

Wirebound wood box contains approximately one-half as much lumber as a nailed wood box of the same size which carries the same amount of contents. Wirebound wood boxes are usually available at a lower price than many other shipping containers of more rigid construction.

Style 3 boxes are resilient on all six faces. Items requiring this characteristic in the box can use a Style 3. Style 3 boxes are the most economical of the styles. The original cost of the box is less than that of the other styles. The savings of time in setting up the boxes is advantageous. Since the amount of lumber in a wirebound wood box is greatly reduced, compared to other types of wood containers, the tare weight is lower. Accordingly, the freight charges on a given size shipment are correspondingly lower. There is a saving in labor operations due to the simplicity of assembly and the ease of closure.

Styles 2 and 3 boxes can be opened and reclosed at intermediate stages of distribution much easier than other kinds of containers.

Wirebound boxes can be reparied and resused.

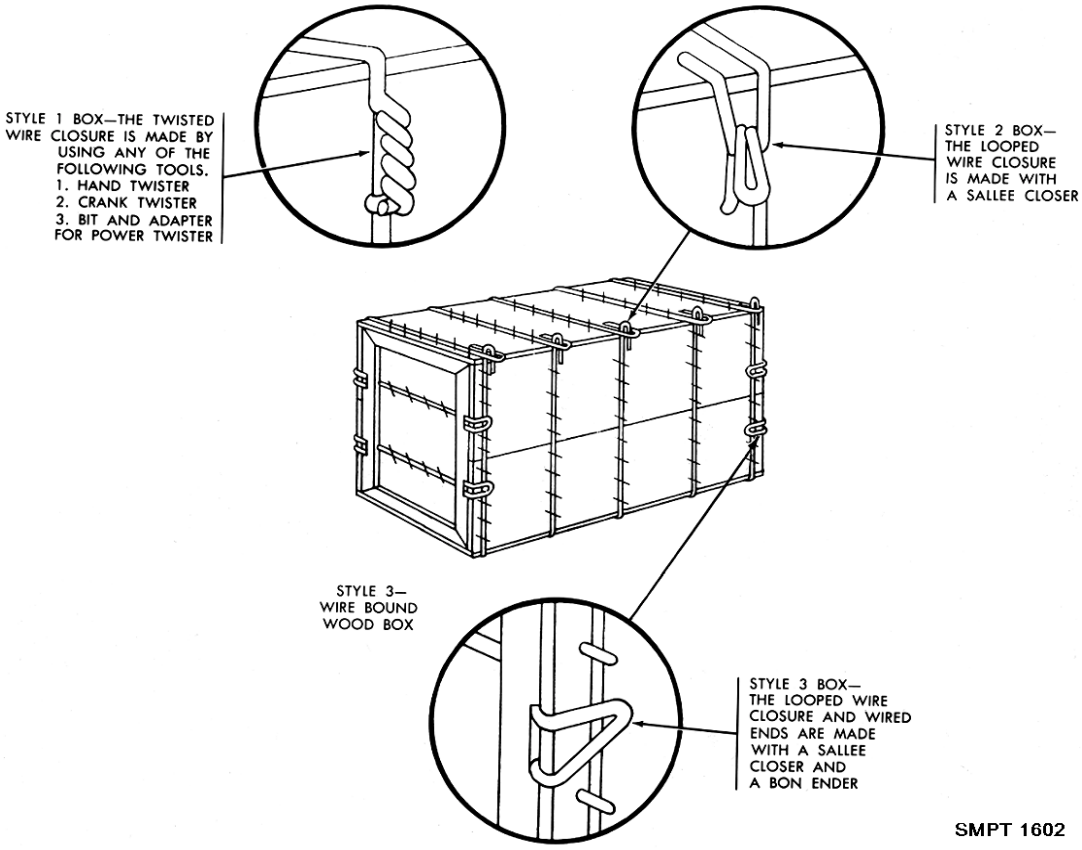


Figure 3-30. Styles of wirebound wood boxes.

SETTING UP THE BOXES

Boxes arrive from the manufacturer in a knockdown condition and are stored knockdown until the time of use. each box is then set up prior to loading of shipment. The method of setting up depends upon the style of the box.

Setting up of Styles 1 and 2 (fig 3-31)

Lift the sides of the blank slightly before folding. Fold the box by raising the sides at right angles to the bottom. Fasten the ends to the side cleats using a steel nailing table or an end stapling machine. Ends are fastened to side cleats by either staples or cement-coated and chemically-etched nails. Unless otherwise specified, staples for Class 3 use boxes are galvanized. The length of each fastening will be not less than the thickness of the end boards plus three-quarters the thickness of the cleats or battens. The points of the fastenings will not protrude from the cleats or battens, but, if driven through, they must be clinched. The average spacing of the fastenings will not exceed 2 1/2 inches.

Drive sevenpenny cement-coated or chemically-etched cooler or sinker nails through side cleats into adjacent battens and through bottom cleat into intermediate batten. Boxes having both vertical and horizontal battens adjacent and parallel to cleats should be fastened by nailing through bottom faceboards and cleats into the battens only. The spacing of nails driven into adjacent battens will not exceed 5 inches.

Setting up of Style 3 (fig 3-32)

Bend up looped end wires of ends using the hollowed end of a bon ender. Lift sides of the blank slightly before folding and raise sides at right angles to bottom. Pass the bent end loops through notches in the cleats. Using the tapered end of the bon ender, bend back the looped wire over and around the binding wire of the side.

When battens are used on the ends of style 3 boxes, battens adjacent to batten cleats are nailed by driving sevenpenny cement-coated or chemically-etched cooler or sinker nails through the bottom boards, through the cleat and into the adjacent batten. Spacing of nails will not exceed 5 inches. Intermediate battens are secured by driving one sevenpenny cement-coated or chemically-etched cooler and sinker nail through the board and cleat into the end of the intermediate batten.

Strapping Requirements

Where strapping is required, the top cleats shall be brought in contact with the side cleats and the strapping is applied before the wires at the closing edges are twisted or looped. This eliminates occasional slack which may develop when strapping is applied after closure is made. Strapping is placed as indicated in figure 3-33 wire strapping cannot be smaller than 13-gauge. Flat strapping cannot be less than 5/8 X 0.020 inch.

Figure 3-31. Setting up of styles 1 and 2, wirebound wood boxes.

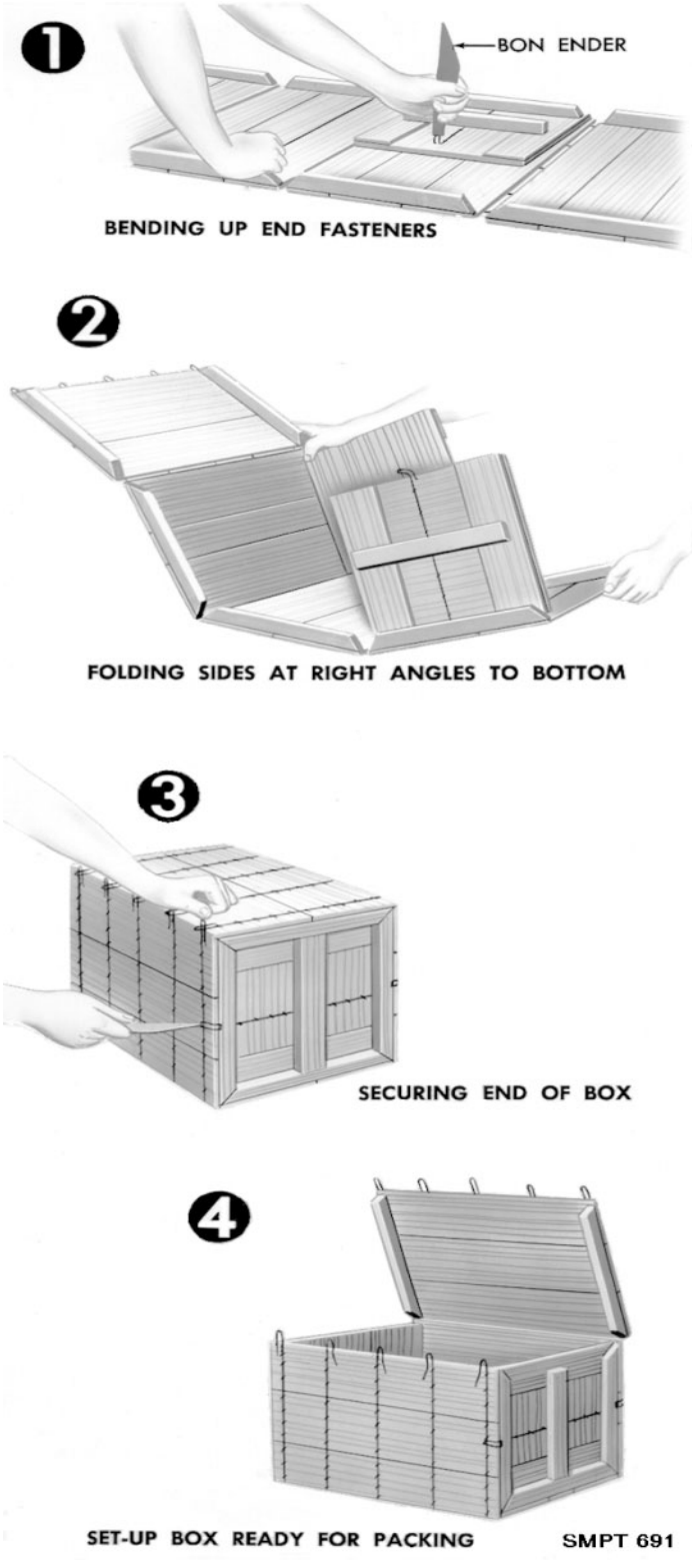


Figure 3-32. Setting up of style 3 wirebound wood box.

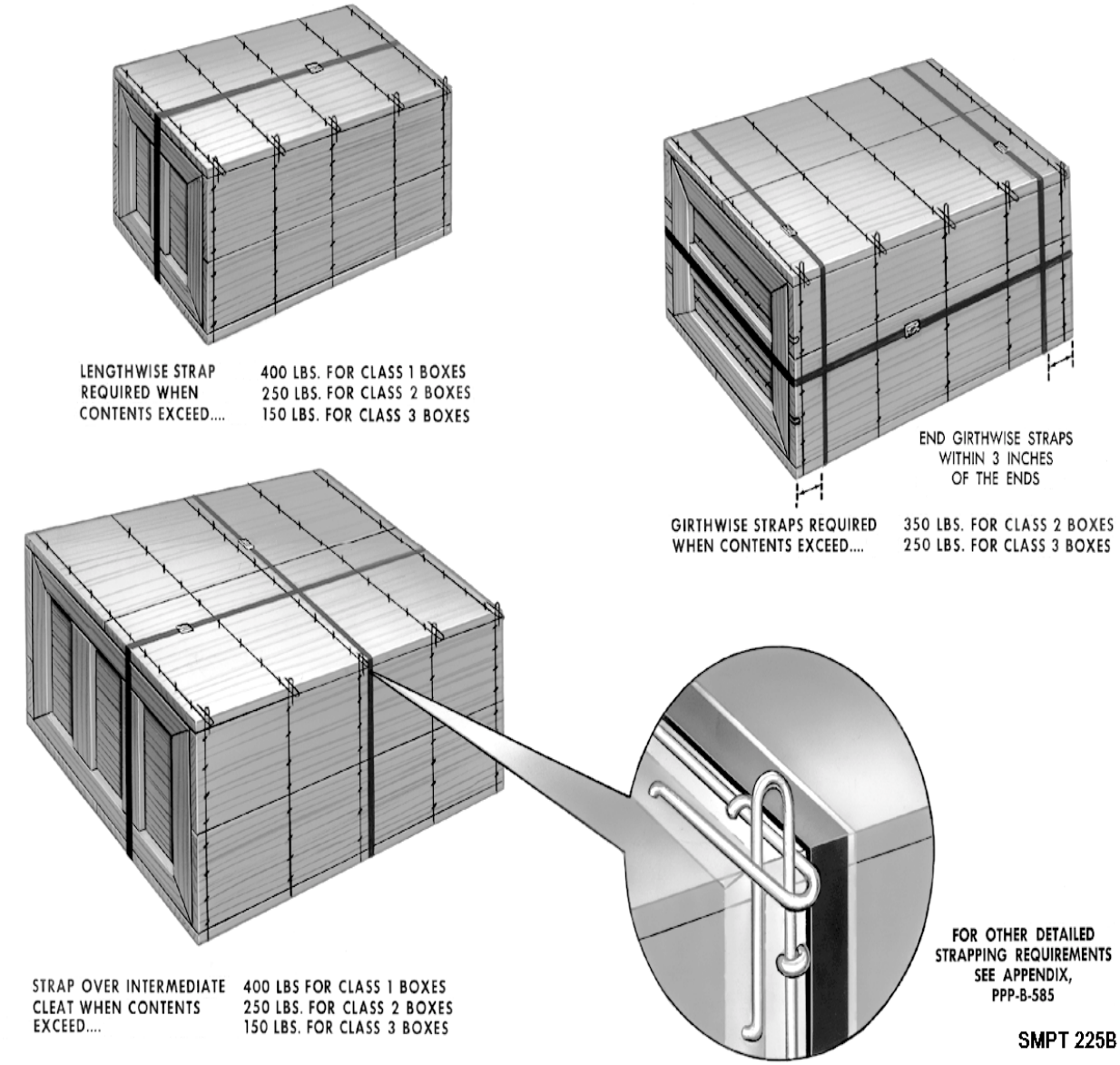


Figure 3-33. Strapping of wirebound wood boxes.

Closure of the Boxes

Closure of Style 1

Style 1 boxes are closed by using special tools (fig 3-34). When intermediate battens are used on the ends of the box, one sevenpenny cement-coated or chemically-etched sinker or cooler nail is driven through the top board and cleats and into the end of each intermediate batten. This is done prior to making the closures of the binding wires.

Closure of Styles 2 and 3

These styles are closed by using a Sallee closer. Perform the steps, as shown in figure 3-35. Insert the Sallee closer through the side loop and catch the top loop in the notch on the end of the tool. Raise the handle of the Sallee closer to slightly beyond a vertical position and push the top loop down against the side of the box. Complete closing by swinging the handle of the Sallee closer down

as far as possible. Drive a nail through the top cleat into each intermediate batten. Do not nail into the ends of the battens that are adjacent to the cleats.

Note. The applicable tools for making closures are illustrated in figures 3-34 and 3-35. Correct tools are available from box manufacturer. Do not use screw drivers, pliers, etc., because an adequate closure cannot be made and their use is time-consuming and may be a safety hazard.

PALLETS (GENERAL)

DESCRIPTION

A pallet is a portable platform on which material is placed to facilitate handling and transportation. This platform is generally a two-deck structure which permits mechanical handling and tiering of unit loads of supplies an equipment.

Types of Pallets

Pallets are classified as expendable an permanent. They are also classes as general purpose and special purpose.

Expendable Pallets

Expendable pallets are designed generally for one shipment and then discarded. Their construction is usually of wood, fiberboard, or a combination of the two. In order to be effective as one-trip pallets, they must be lightweight and low in cost. When the cost of using them is equalled or exceeded by the savings realized during a single trip, they are truly expendable pallets. Examples of expendable pallets are illustrated in figure 3-36.

Permanent Pallets

Permanent pallets are termed as general purpose and special purpose pallets.

General Purpose Pallets

The general purpose pallets are constructed of hard wood and are normally 40 inches by 48 inches in size. They fit economically into railroad and, motor vehicles, and trailers. Two general purpose pallets are the 4-way entry post pallet and the 4-way (partial) four-stringer pallet (fig 3-37).

Special Purpose Pallets

Pallets made of metal, which are suitable for certain heavy duty usage, are special purpose pallets. They are more rugged and will stand more abuse than wood pallets. There are no fasteners to work loose and cause damage to flexible containers and their contents. Pallets made of aluminum have been developed that are light in weight. The initial cost of metal pallets is high in comparison to pallets made of wood.

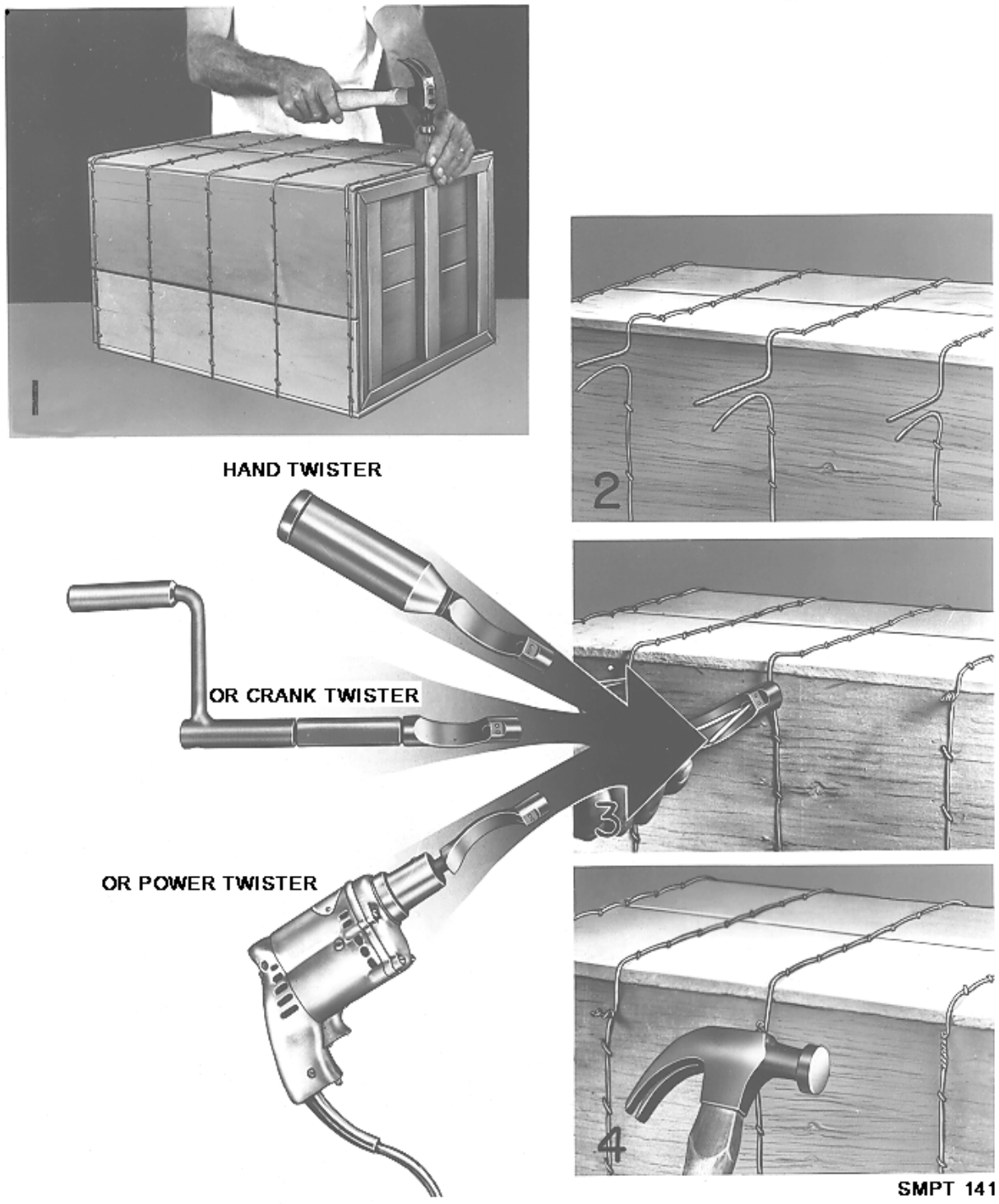


Figure 3-34. Closing of style 1 wirebound wood box with special tools.

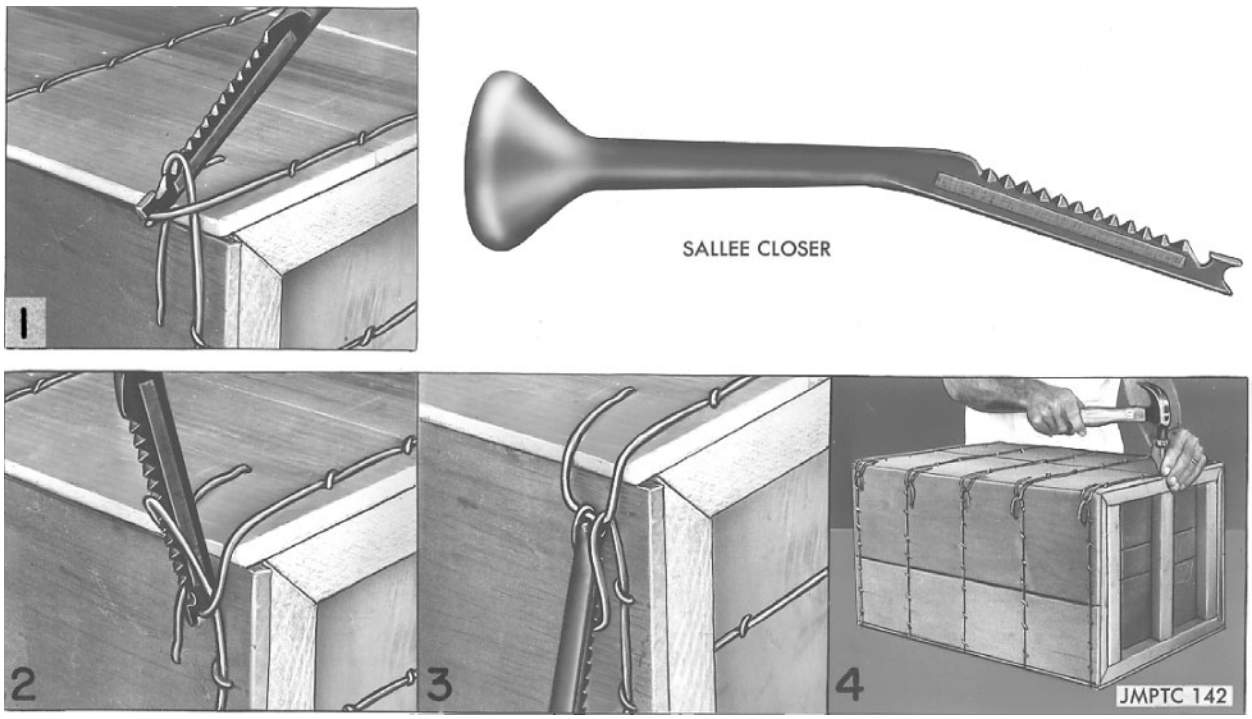


Figure 3-35. Closing of style 2 and 3 wirebound wood boxes.

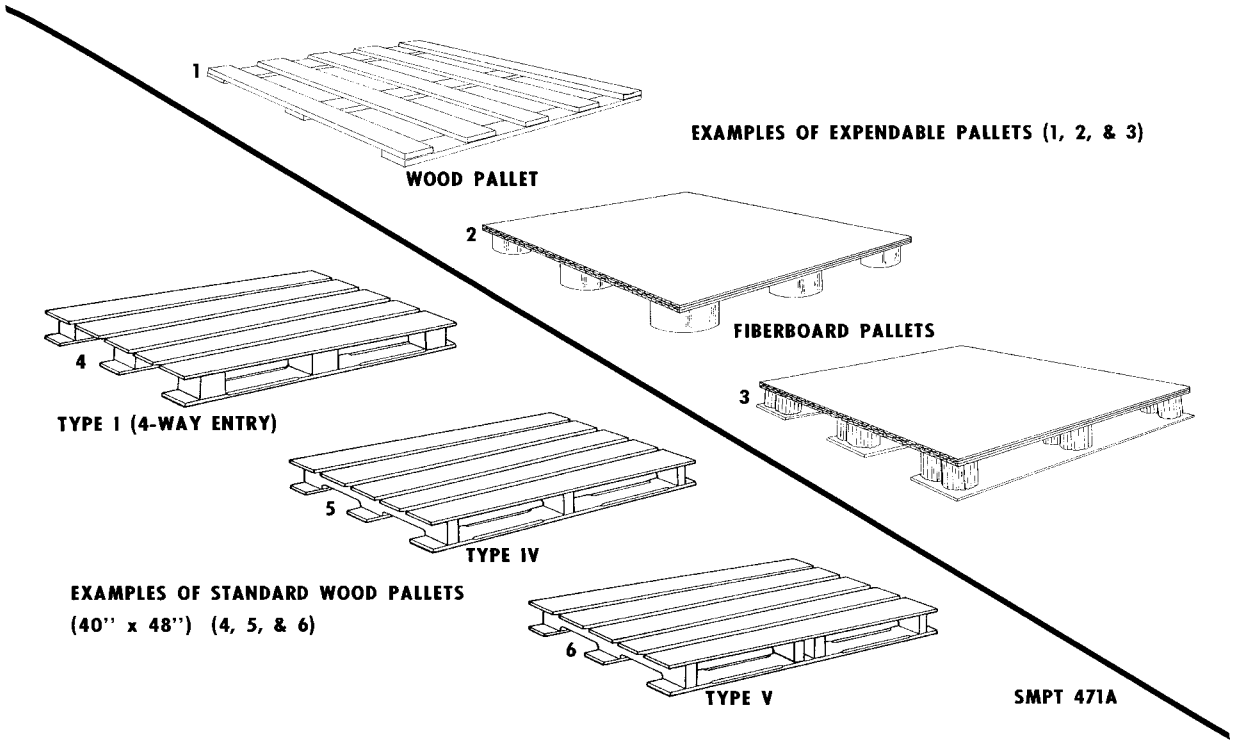


Figure 3-36. Examples of expandable pallets.

FOUR-WAY POST CONSTRUCTION PALLETS (MIL-P-15011)

These pallets are available in two types: Type I (assembled) and Type II (unassembled). Each type is available in two classes: Class 1 (seasoned lumber, 22 percent maximum average moisture content); Class 2 (Unseasoned lumber, unspecified moisture content). There are four styles. Style 1 is the general storage pallet and is of the standard 40 inch by 48 inch size, and unless otherwise specified, is constructed of high density wood. Style 1A pallets are constructed the same as Style 1 pallets except that the size is 35 inches long by 45 1/2 inches wide. The smaller, Style A1 pallets are designed for better utilization in intermodal transporters and the fourth style, style 2 is a light-weight, air cargo pallet, 40 inches by 48 inches in size. It is constructed of the low or medium density woods with thickness less than that for Styles 1 And 1A. These pallets provide full 4-way entry to materials handling equipment. As indicated in figure 3-37 nine posts are placed on the bottom boards with drive-screw nails conforming to Type II, Style 18, of ASTM F 1667-95. Stringers extending the length (40 inches, Styles 1 and 2 and 35 inches for Style 1A and 42 inches for Style 1B) of the pallet are fastened to each row of posts. The deck boards are nailed through the stringers and into the posts. Style 1B pallets are constructed the same as Style 1 pallets except that the size is 42 inches long by 53 inches wide.

FOUR-WAY (PARTIAL) STRINGER CONSTRUCTION PALLETS (NN-P-71)

Two-way and four-way stinger pallets are available in several types and may be assembled or unassembled (fig 3-37). Each type is available in various sizes. They are used wherever two-way or partial four-way entry is required by conventional materials handling equipment. Four stringers made form 2 inch by 4 inch lumber are nailed or bolted at right angles to the bottom deck boards. The stringers are cut out to enable fork lift entry. The top deck boards are nailed to the stringers.

MAINTENANCE OF PALLETS

Wooden pallets are susceptible to damage and must be kept in constant repair. Broken or split deck boards must be replaced when their holding power is impaired. Fastenings that work loose should be carefully repaired. When nails must be replaced, snip off nail heads and drive into stringer or block. Make sure that new nails do not line up with previously occupied nail holes. It is recommended that a stock of repair parts be available for making all repairs.

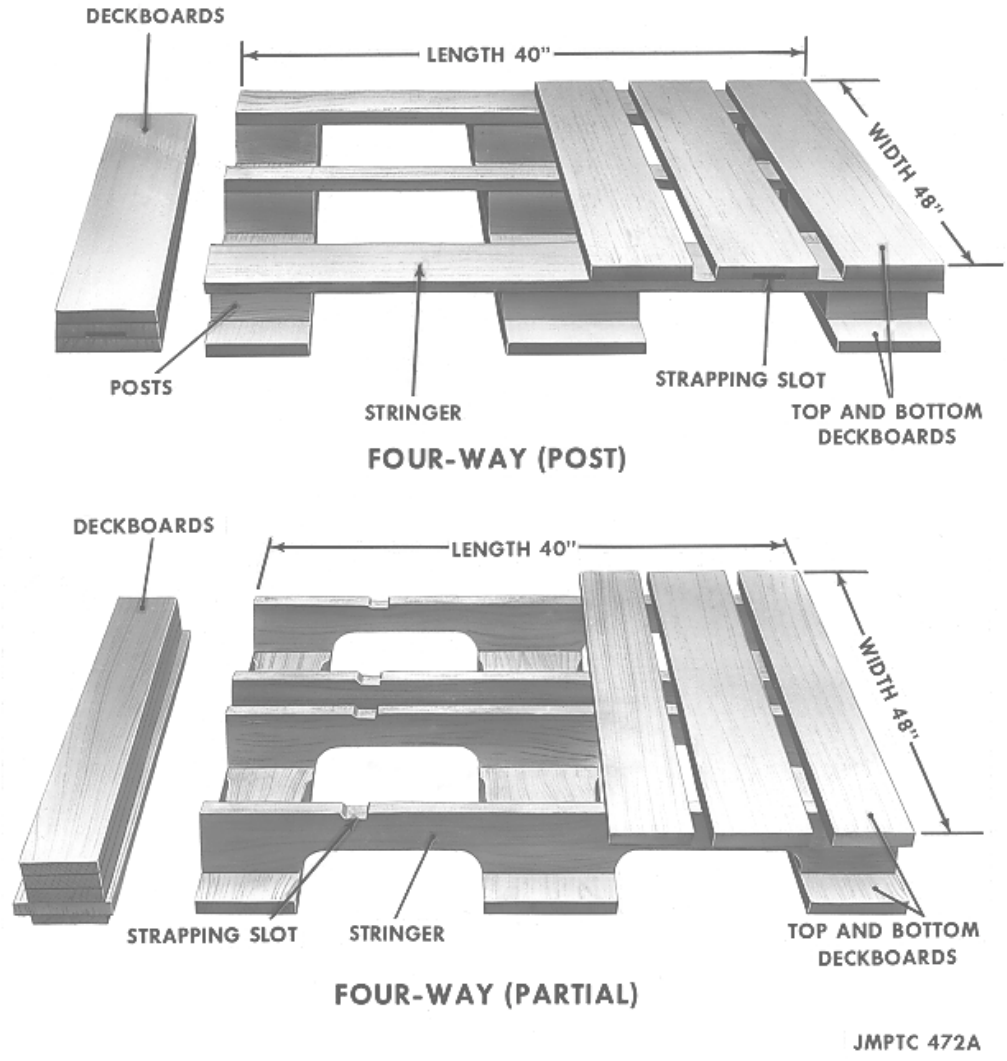


Figure 3-37. Four-way entry post and (partial)four-stringer pallets.

CHAPTER 4

BAGS AND SACKS

NEED FOR BAGS AND SACKS

While a considerable amount of the materiel furnished to the military services is shipped in fiberboard, metal, or wooden containers, there are many supplies which can be most economically shipped in bulk quantities in bags and sacks. Items such as food products, building materials, some chemicals and minerals are effectively shipped in bags and sacks. Bags and sacks possess the inherent advantages of having low tare weight ratio (that is, the ratio of the weight of the container to the weight of the contents); being flexible; providing ease in filling and handling; requiring a minimum storage space; and being constructed of low cost materials.

BAGS DEFINED

A bag is a preformed container made of flexible material, generally closed on all sides except one which forms an opening that may or may not be sealed after filling. It may be made of a single ply or multiple plies of flexible material, or a combination of two or more materials such as paper, metal foil, cellulose, and plastic films and textiles, any of which may be coated, laminated, or treated to provide the properties required for packaging, storing, and distributing the commodity.

SACKS DEFINED

A sack often used as a synonym for a bag, generally refers to heavier duty or shipping bags. No exact line of separation can be drawn between what is referred to as heavy duty bag and shipping sack. In this section, both bags and sacks are discussed and may be employed to handle the same weights and kinds of commodities. Usually, a container designed to carry over 50 pounds is considered a shipping sack.

SHIPPING BAGS AND SACKS

For shipping military supplies, there are four flexible containers that are approved for use by the DOD. These containers are: cotton mailing bags (A-A-2714); cushioned paper shipping sacks (A-A-160); burlap (A-A-1588); and shipping bags (A-A-881).

COTTON MAILING BAGS (A-A-2714)

This description covers cloth mailing bags with a drawstring closure. Cotton mailing bags are intended for packaging and mailing small miscellaneous items.

Classification

Bags shall be of the following types and sizes:

Type 1 - Regular
Type 2 - Fire Retardant

Size A - 3 inches wide X 4 inches high
Size B - 3 inches wide X 5 inches high
Size C - 4 inches wide X 9 inches high
Size D - 4-1/2 inches wide X 8 inches high
Size E - 5-1/2 inches wide X 14 inches high
Size F - 6 inches wide X 9 inches high
Size G - 6-1/2 inches wide X 10 inches high
Size H - 7-1/2 inches wide X 18 inches high
Size I - 8 inches wide X 10 inches high

CHARACTERISTICS

Components

Bags furnished under this description shall be made from components meeting the requirements of table 4-1.

Construction

All seams shall be sewn with stitch type 401, seam type EFa-1 of FED-STD-751, with 4 to 6 stitches per inch. Bottom and side seams shall have a stitching margin of not less than 1/4 inch from the edge of the bag. The top seam shall have a stitching margin of not less than 3/8 inch to allow for insertion of the drawstring. A twine drawstring shall be inserted through the hem at the top of the bag so that each end of the drawstring projects not less than 2 inches from the bag. The total length of the drawstring shall be not less than twice the overall width of the bag plus an additional 6 inches. A tag, made from cloth lined paper stock and measuring 3 ± 1/16 inches by 5-1/2 ± 1/16 inches, shall be inserted into the bottom of the bag and shall be sewn in place. When the bag is turned with the seam edges inside, the tag shall extend not less than 5 inches from the bottom of the bag. The paper side of the tag shall have a hard surface suitable for pen and ink addressing.

Dimensions

Dimensions shall be outside dimensions, expressed as overall width X overall height. The tolerance for each dimension shall be + 3/8 inches, or - 1/4 inches.

Workmanship

The bags shall be uniformly made, neatly trimmed, free from holes, stains, tears, or other defects which may impair their serviceability or appearance. The tags shall be firmly attached.

Packaging, Packing, and Marking

Packaging, packing, and marking shall be as specified in the contract or order.

Table 4-1

Component	Test	Requirement	Test Method
Fabric	Breaking Force	Warp, not less than 48 pounds. Filling, not less than 35 pounds.	ASTM D 5304
	Fabric Count	Warp yarns, not less than 40 per inch. Filling picks, not less than 40 per inch.	ASTM D 3775
	Surface Flammability (applies only to fabric for Type 2 bags.) Specific	Average flame spread index, not more than 25.	ASTM E 162
	Optical Density of Smoke (Applies only to fabric for Type 2 bags.)	Average maximum specific optical density, not more than 100.	ASTM E 662
Seam Thread	Breaking Force	Average breaking force, not less than 3.0 pounds	ASTM D 2256, Option A1
Drawstring	Breaking Force	Average breaking force, not less than 24 pounds	ASTM D 2256, Option A1

PROCUREMENT

Buyers shall specify the following:

- Type and size required;
- Preservation, packaging, packing, labeling, and marking required.
- Item Identifiers/Reference Part Number System. (For cataloging use only.)

A-A-2714 - 1 B This example describes a regular 3 inch high bag.

Size A - 3 inches wide X 4 inches high
Size B - 3 inches wide X 5 inches high
Size C - 4 inches wide X 9 inches high
Size D - 4-1/2 inches wide X 8 inches high
Size E - 5-1/2 inches wide X 14 inches high
Size F - 6 inches wide X 9 inches high
Size G - 6-1/2 inches wide X 10 inches high
Size H - 7-1/2 inches wide X 18 inches high
Size I - 8 inches wide X 10 inches high

Type 1 - Regular
Type 2 - Fire Retardant

CUSHIONED PAPER SHIPPING SACKS (A-A-160, A-A-1588)

Cushioned paper shipping sacks are made of two sheets of kraft paper separated by an evenly distributed cushioning medium. They may be used for interior or exterior packaging where insulation, water resistance, or light cushioning effect is required for items weighing not more than 10 pounds.

CUSHIONED WITH POST CONSUMER RECOVERED MATERIAL (A-A-160)

CHARACTERISTICS

Construction

The walls of the sack shall consist of 2 layers of kraft paper with a cushioned medium such as macerated paper inserted between the layers. The outer layer of kraft paper shall be water resistant. The fabricated sacks shall pass

the water resistance test and the impact resistance test. The edge of the inside seam shall be located not more than 1 inch from the side of the sack.

Dimensions

Dimensions of the sacks shall be outside measurements, expressed as width by length. Dimensions shall be as specified with a tolerance of ± 1/4 inch. Sack opening shall be on the short side.

Workmanship

Sacks shall be uniformly constructed and free from holes, tears, cuts, splits, or other defects which might impair their usefulness.

QUALITY ASSURANCE

Examination of the End Item For Dimensions and Workmanship

The sample unit shall be one sack. The Inspection Level shall be S-2 with an Acceptable Quality Level (AQL) of 2.5 percent defective in accordance with ANSI/ASQC Z1.4-1993.

Testing of the End Item For Water Resistance and impact resistance

The same unit shall be one sack. The Inspection Level shall be S-1 with an Acceptable Quality Level (AQL) of 2.5 percent defective in accordance with ANSI/ASQC Z1.4-1993.

Water Resistance Test

Two drops of water shall be placed on the outside of the sack and covered with a watchglass. The water shall remain on the outside of the sack without being absorbed for not less than 30 minutes.

Impact Resistance Test

Determine the cubic capacity of the sack by multiplying the three factors F1, F2, and F3, together:

Cubic capacity = F1 x F2 x F3
F1 = specified length
F2 = 90% of specified width
F3 = 10% of specified width

Fill a graduated cylinder or similar volumetric device to 75 percent of the cubic capacity of the sack with dry, unpopped, popcorn. Transfer the popcorn to the sack and seal the open end of the sack with packaging tape. Drop each sack six times from a height of 36 inches onto a hard, unyielding surface such as uncarpeted concrete. The sack shall be dropped once on each face and once on each side. If any popcorn spills from the sack, the sack does not pass the impact resistance test.

Examination of packaging, packing and marking

The sample unit for this examination shall be one fully prepared shipping container. The Inspection Level shall be S-2 with an Acceptable Quality Level (AQL) of 4.0 percent defective in accordance with ANSI/ASQC Z1.4-1993.

REGULATORY REQUIREMENTS

The manufacturer/contractor shall certify that the kraft paper used to make the sacks contains not less than 5 percent post consumer recovered material. The Government reserves the right to require proof of such content prior to the first delivery and thereafter as may be provided for under the provisions of the contract. Post consumer recovered material is defined as paper, paperboard and fibrous wastes from factories, retail stores, office buildings, homes, etc., which has passed through an end use as a consumer item, including: Used corrugated boxes, old newspapers, old magazines, mixed waste paper, tabulating cards, used cordage; and all paper, paperboard, or fibrous waste collected from municipal solid waste.

PACKAGING, PACKING AND MARKING

Packaging, packing, and marking shall be as specified in the contract or order.

CUSHIONED WITH CLOSED CELL PLASTIC FILM (A-A-1588)

CHARACTERISTICS

Construction

Sacks shall be fabricated from a composite material consisting of kraft paper bonded to closed cell plastic film cushioning material. The composite material shall have a thickness of not less than 0.131 inches. The sacks shall be fabricated so that the kraft paper forms the outside surface of the sack. The open end of the sack shall be provided with an adhesive sealing flap extending the entire width of the sack. The sealing flap shall have a strip of pressure sensitive adhesive, protected by a liner, extending across the entire width of the flap. The weight and test volume for each size sack shall be as specified in table 4-2. The fabricated sacks shall pass the impact resistance test and the creep test.

Table 4-2

Size	Minimum inside dimensions, inches	Test load, Weight per sack, maximum	pounds
000	3-3/4 x 6-1/4	0.44 oz. (12 g)	0.3
0	5-3/4 x 8-1/4	0.77 oz. (22 g)	0.8
1	7 x 10	0.99 oz. (28 g)	1.4
2	8-1/4 x 10	1.1 oz. (31 g)	2.0
3	8-1/4 x 12-1/4	1.4 oz. (40 g)	2.4
4	9-1/4 x 12-1/4	1.5 oz. (43 g)	3.0
5	10-1/4 x 13-3/4	1.9 oz. (54 g)	4.2
6	12-1/4 x 16-3/4	2.5 oz. (71 g)	7.2
7	14 x 17-3/4	3.0 oz. (85 g)	10.0

Dimensions

Dimensions of the sacks shall be inside measurements, exclusive of the flap, expressed as width by length. Inside dimensions for each size, excluding the flap, shall be not less than specified in table 4-2. Sack opening shall be on the short side.

Workmanship

Sacks shall be uniformly constructed and free from holes, tears, cuts, splits, or other defects which might impair their usefulness.

QUALITY ASSURANCE

Examination of the End Item For Weight, Dimensions, and Workmanship

The sample unit shall be 1 sack. The Inspection Level shall be S-2 with an Acceptable Quality Level (AQL) of 2.5 percent defective in accordance with ANSI/ASQC Z1.4-1993.

Testing of the End Item For Impact Resistance and Creep

The sample unit shall be 2 sacks, 1 for each test. The Inspection Level shall be S-1 with a Acceptable Quality Level (AQL) of 2.5 percent defective in accordance with ANSI/ASQC Z1.4-1993.

Impact resistance shall be verified using the test load for each size specified in from table 4-2. The test load for Sizes 000, 0, 1, 2, and 3 shall consist of dry, unpopped, popcorn. The test load for Sizes 4, 5, 6, and 7 shall consist of bond paper, writing paper, or paperback books. For each size sack, the test load shall weigh within ± 0.1 pound of the weight specified in table 4-2. The popcorn shall be placed in plastic bottles or vials which will fit in the sack being tested. The test load may be distributed among more than 1 bottle or vial. Cap the bottles or vials. The paper or paperback books may be wrapped in paper or plastic for ease of insertion and removal from the sack. Place the appropriate test loads into the sack selected for this test. Remove the liner from the flap, close and seal the sack. Drop each sack 6 times from a height of 36 inches onto a hard, unyielding surface such as uncarpeted concrete. The sack shall be dropped once on each face and once on each side. If any tears more than 1/2 inch long, extending from the exterior through to the interior of the sack, are present at the conclusion of the impact resistance test, the sack does not pass the impact resistance test.

Creep Test

Four test specimens, each 3" 1/8 inches square, shall be cut from each sack selected for the creep test. Two specimens shall be cut from the front face of the sack, and 2 from the rear face of the sack. The specimens shall be evenly stacked on a piece of glass approximately 3-1/2 inches square. The bottom specimen shall be placed bubble side up, the second specimen bubble side down, the third specimen bubble side up, and the top specimen bubble side down. A second 3-1/2 inch square piece of glass shall be placed on top of the stack and a weight sufficient to exert a pressure of 1.0 " 0.1 pound per square inch on the test specimens shall be placed on the top piece of glass. After 60 " 5 minutes, the vertical distance between the glass plates shall be measured at each of the 4 corners of the stack with an instrument capable of measuring to 0.001 inch. The measurements shall be taken carefully so as not to disturb the stack. The average of these 4 measurements shall be recorded as the initial stack thickness. The initial stack thickness divided by 4 shall be recorded as the thickness of the composite material. The weight shall be kept on the stack for a total of 168 " 2 hours, then the distance between the glass plates shall be measured and averaged in the same way as was done for the initial stack thickness. This measurement shall be recorded as the final stack thickness. The final stack thickness shall be not less than 80 percent of the initial stack thickness.

Examination of packaging, packing and marking. The sample unit for this examination shall be one fully prepared shipping container. The Inspection Level shall be S-2 with an Acceptable Quality Level (AQL) of 4.0 percent defective in accordance with ANSI/ASQC Z1.4-1993.

REGULATORY REQUIREMENTS

The manufacturer/contractor shall certify that the kraft paper used to make the sacks contains not less than 5 percent post consumer recovered material. The Government reserves the right to require proof of such content prior to the first delivery and thereafter as may be provided for under the provisions of the contract. Post consumer recovered material is defined as paper, paperboard and fibrous wastes from factories, retail stores, office buildings, homes, etc., which has passed through an end use as a consumer item, including: Used corrugated boxes, old newspapers, old magazines, mixed waste paper, tabulating cards, used cordage; and all paper, paperboard, or fibrous waste collected from municipal solid waste.

PACKAGING, PACKING, AND MARKING

Packaging, packing, and marking shall be as specified in the contract or order.

PROCUREMENT

Buyer shall specify:

- Size, as listed in table 4-2.
- Packaging, packing, and marking required.

BURLAP SHIPPING BAGS (A-A-881)

This description covers standard new or used burlap bags for use in domestic and overseas shipment of supplies and materials.

CHARACTERISTICS

Cloth

The bags shall be fabricated from jute burlap cloth conforming to the requirements in table 4-3.

Construction

Bags shall be furnished new or used, as specified.

The bags shall have open-mouth tops and shall have bottom and/or side seams. The minimum average number of stitches shall be 3.0 to the inch, machine sewn and of stitch type 301 or 401 of Fed. Std. No. 751. The raw edges of the bag shall be sewn with export seams, such as those in Fed. Std. No. 751, SSd-1. Seams shall have a breaking load of not less than 80 percent of the breaking load of the burlap from which the bags are made. Raw top edges of bags shall be hemmed. Selvaged edges shall be sewn with flat seams, and raw edges with export seams.

The size or capacity of the bags shall be as specified in the contract order. When specified, bags shall be suitable for subsistence items. Each bag shall be furnished with a polyethylene liner inserted. The liner shall have a Water Vapor Transmission Rate of now more than 15g per m^2 per day. The liner shall extend not less than 3 inches beyond the top of the burlap.

Table 4-3

	Fabric Count Minimum	Yarns per inch Maximum	Weight, per linear yard by 40 inch width (+8, -2 percent)
Warp Filling	8 8	11 11	 7.5 ounces

Workmanship

Bags shall be clean, dry, and free of holes, tears, frayed threads, objectionable odors, or foreign matter impregnated in or adhering to the sides of the bags. The bags shall be free from other defects which may affect serviceability. If mended, there shall be no more than two mends per bag, and the maximum size of each mend shall not be more than 2 inches.

QUALITY ASSURANCE

Testing of Burlap Cloth

The burlap cloth shall be tested in accordance with the methods listed below. The sample unit shall be one roll of cloth. The Inspection Level shall be S-2 with an Acceptable Quality Level (AQL) of 2.5 percent defective in accordance with ANSI/ASQC Z1.4-1993.

TESTS	METHODS
Fabric Count	ASTM D 3775
Weight	ASTM D 3776
Breaking Load	ASTM D 1682 (Grab Test)

Testing of Polyethylene

The polyethylene shall be tested in accordance with ASTM Method F 372, Water Vapor Transmission Rate. The sample unit shall be one roll of polyethylene. The Inspection Level shall be S-2 with an Acceptable Quality Level (AQL) of 2.5 percent defective in accordance with ANSI/ASQC Z1.4-1993.

Examination of the end item for defects in workmanship, size, or capacity. The sample unit shall be one bag. The Inspection Level shall be S-2 with an Acceptable Quality Level (AQL) of 2.5 percent defective in accordance with ANSI/ASQC Z1.4-1993.

Testing of the End Item For Seam Strength

The sample unit shall be one bag. The Inspection Level shall be S-1 with an Acceptable Quality Level (AQL) of 2.5 percent defective in accordance with ANSI/ASQC Z1.4-1993. Each seam of the sample unit shall be tested in accordance with ASTM Standard Test Method D 1682, Grab Test. The test specimens shall be cut so that the seam to be tested is in the middle of the specimen, parallel to the 4 inch sides. One determination shall be made on each seam of the sample unit. Breaks in the fabric outside the seam area, including jaw breaks, are acceptable provided they yield breaking loads in excess of 80 percent of the breaking load of the burlap. Any seam which has a breaking load less than 80 percent of the breaking load of the burlap from which the bags are made is a defect.

Examination of Packaging, Packing and Marking

The sample unit for this examination shall be one fully prepared shipping container. The Inspection Level shall be S-2 with an Acceptable Quality Level (AQL) of 4.0 percent defective in accordance with ANSI/ASQC Z1.4-1993.

REGULATORY REQUIREMENTS

The manufacturer/contractor is encouraged to use recovered material in accordance with Public Law 94-580 to the maximum extent practicable.

PACKAGING, PACKING AND MARKING

Packaging, packing, and marking shall be as specified in the contract or order.

CHAPTER 4

BAGS AND SACKS

NEED FOR BAGS AND SACKS

While a considerable amount of the materiel furnished to the military services is shipped in fiberboard, metal, or wooden containers, there are many supplies which can be most economically shipped in bulk quantities in bags and sacks. Items such as food products, building materials, some chemicals and minerals are effectively shipped in bags and sacks. Bags and sacks possess the inherent advantages of having low tare weight ratio (that is, the ratio of the weight of the container to the weight of the contents); being flexible; providing ease in filling and handling; requiring a minimum storage space; and being constructed of low cost materials.

BAGS DEFINED

A bag is a preformed container made of flexible material, generally closed on all sides except one which forms an opening that may or may not be sealed after filling. It may be made of a single ply or multiple plies of flexible material, or a combination of two or more materials such as paper, metal foil, cellulose, and plastic films and textiles, any of which may be coated, laminated, or treated to provide the properties required for packaging, storing, and distributing the commodity.

SACKS DEFINED

A sack often used as a synonym for a bag, generally refers to heavier duty or shipping bags. No exact line of separation can be drawn between what is referred to as heavy duty bag and shipping sack. In this section, both bags and sacks are discussed and may be employed to handle the same weights and kinds of commodities. Usually, a container designed to carry over 50 pounds is considered a shipping sack.

SHIPPING BAGS AND SACKS

For shipping military supplies, there are four flexible containers that are approved for use by the DOD. These containers are: cotton mailing bags (A-A-2714); cushioned paper shipping sacks (A-A-160); burlap (A-A-1588); and shipping bags (A-A-881).

COTTON MAILING BAGS (A-A-2714)

This description covers cloth mailing bags with a drawstring closure. Cotton mailing bags are intended for packaging and mailing small miscellaneous items.

Classification

Bags shall be of the following types and sizes:

Type 1 - Regular
Type 2 - Fire Retardant

Size A - 3 inches wide X 4 inches high
Size B - 3 inches wide X 5 inches high
Size C - 4 inches wide X 9 inches high
Size D - 4-1/2 inches wide X 8 inches high
Size E - 5-1/2 inches wide X 14 inches high
Size F - 6 inches wide X 9 inches high
Size G - 6-1/2 inches wide X 10 inches high
Size H - 7-1/2 inches wide X 18 inches high
Size I - 8 inches wide X 10 inches high

CHARACTERISTICS

Components

Bags furnished under this description shall be made from components meeting the requirements of table 4-1.

Construction

All seams shall be sewn with stitch type 401, seam type EFa-1 of FED-STD-751, with 4 to 6 stitches per inch. Bottom and side seams shall have a stitching margin of not less than 1/4 inch from the edge of the bag. The top seam shall have a stitching margin of not less than 3/8 inch to allow for insertion of the drawstring. A twine drawstring shall be inserted through the hem at the top of the bag so that each end of the drawstring projects not less than 2 inches from the bag. The total length of the drawstring shall be not less than twice the overall width of the bag plus an additional 6 inches. A tag, made from cloth lined paper stock and measuring 3 ± 1/16 inches by 5-1/2 ± 1/16 inches, shall be inserted into the bottom of the bag and shall be sewn in place. When the bag is turned with the seam edges inside, the tag shall extend not less than 5 inches from the bottom of the bag. The paper side of the tag shall have a hard surface suitable for pen and ink addressing.

Dimensions

Dimensions shall be outside dimensions, expressed as overall width X overall height. The tolerance for each dimension shall be + 3/8 inches, or - 1/4 inches.

Workmanship

The bags shall be uniformly made, neatly trimmed, free from holes, stains, tears, or other defects which may impair their serviceability or appearance. The tags shall be firmly attached.

Packaging, Packing, and Marking

Packaging, packing, and marking shall be as specified in the contract or order.

Table 4-1

Component	Test	Requirement	Test Method
Fabric	Breaking Force	Warp, not less than 48 pounds. Filling, not less than 35 pounds.	ASTM D 5304
	Fabric Count	Warp yarns, not less than 40 per inch. Filling picks, not less than 40 per inch.	ASTM D 3775
	Surface Flammability (applies only to fabric for Type 2 bags.) Specific	Average flame spread index, not more than 25.	ASTM E 162
	Optical Density of Smoke (Applies only to fabric for Type 2 bags.)	Average maximum specific optical density, not more than 100.	ASTM E 662
Seam Thread	Breaking Force	Average breaking force, not less than 3.0 pounds	ASTM D 2256, Option A1
Drawstring	Breaking Force	Average breaking force, not less than 24 pounds	ASTM D 2256, Option A1

PROCUREMENT

Buyers shall specify the following:

- Type and size required;
- Preservation, packaging, packing, labeling, and marking required.
- Item Identifiers/Reference Part Number System. (For cataloging use only.)

A-A-2714 - 1 B This example describes a regular 3 inch high bag.

Size A - 3 inches wide X 4 inches high
Size B - 3 inches wide X 5 inches high
Size C - 4 inches wide X 9 inches high
Size D - 4-1/2 inches wide X 8 inches high
Size E - 5-1/2 inches wide X 14 inches high
Size F - 6 inches wide X 9 inches high
Size G - 6-1/2 inches wide X 10 inches high
Size H - 7-1/2 inches wide X 18 inches high
Size I - 8 inches wide X 10 inches high

Type 1 - Regular
Type 2 - Fire Retardant

CUSHIONED PAPER SHIPPING SACKS (A-A-160, A-A-1588)

Cushioned paper shipping sacks are made of two sheets of kraft paper separated by an evenly distributed cushioning medium. They may be used for interior or exterior packaging where insulation, water resistance, or light cushioning effect is required for items weighing not more than 10 pounds.

CUSHIONED WITH POST CONSUMER RECOVERED MATERIAL (A-A-160)

CHARACTERISTICS

Construction

The walls of the sack shall consist of 2 layers of kraft paper with a cushioned medium such as macerated paper inserted between the layers. The outer layer of kraft paper shall be water resistant. The fabricated sacks shall pass

the water resistance test and the impact resistance test. The edge of the inside seam shall be located not more than 1 inch from the side of the sack.

Dimensions

Dimensions of the sacks shall be outside measurements, expressed as width by length. Dimensions shall be as specified with a tolerance of ± 1/4 inch. Sack opening shall be on the short side.

Workmanship

Sacks shall be uniformly constructed and free from holes, tears, cuts, splits, or other defects which might impair their usefulness.

QUALITY ASSURANCE

Examination of the End Item For Dimensions and Workmanship

The sample unit shall be one sack. The Inspection Level shall be S-2 with an Acceptable Quality Level (AQL) of 2.5 percent defective in accordance with ANSI/ASQC Z1.4-1993.

Testing of the End Item For Water Resistance and impact resistance

The same unit shall be one sack. The Inspection Level shall be S-1 with an Acceptable Quality Level (AQL) of 2.5 percent defective in accordance with ANSI/ASQC Z1.4-1993.

Water Resistance Test

Two drops of water shall be placed on the outside of the sack and covered with a watchglass. The water shall remain on the outside of the sack without being absorbed for not less than 30 minutes.

Impact Resistance Test

Determine the cubic capacity of the sack by multiplying the three factors F1, F2, and F3, together:

Cubic capacity = F1 x F2 x F3
F1 = specified length
F2 = 90% of specified width
F3 = 10% of specified width

Fill a graduated cylinder or similar volumetric device to 75 percent of the cubic capacity of the sack with dry, unpopped, popcorn. Transfer the popcorn to the sack and seal the open end of the sack with packaging tape. Drop each sack six times from a height of 36 inches onto a hard, unyielding surface such as uncarpeted concrete. The sack shall be dropped once on each face and once on each side. If any popcorn spills from the sack, the sack does not pass the impact resistance test.

Examination of packaging, packing and marking

The sample unit for this examination shall be one fully prepared shipping container. The Inspection Level shall be S-2 with an Acceptable Quality Level (AQL) of 4.0 percent defective in accordance with ANSI/ASQC Z1.4-1993.

REGULATORY REQUIREMENTS

The manufacturer/contractor shall certify that the kraft paper used to make the sacks contains not less than 5 percent post consumer recovered material. The Government reserves the right to require proof of such content prior to the first delivery and thereafter as may be provided for under the provisions of the contract. Post consumer recovered material is defined as paper, paperboard and fibrous wastes from factories, retail stores, office buildings, homes, etc., which has passed through an end use as a consumer item, including: Used corrugated boxes, old newspapers, old magazines, mixed waste paper, tabulating cards, used cordage; and all paper, paperboard, or fibrous waste collected from municipal solid waste.

PACKAGING, PACKING AND MARKING

Packaging, packing, and marking shall be as specified in the contract or order.

CUSHIONED WITH CLOSED CELL PLASTIC FILM (A-A-1588)

CHARACTERISTICS

Construction

Sacks shall be fabricated from a composite material consisting of kraft paper bonded to closed cell plastic film cushioning material. The composite material shall have a thickness of not less than 0.131 inches. The sacks shall be fabricated so that the kraft paper forms the outside surface of the sack. The open end of the sack shall be provided with an adhesive sealing flap extending the entire width of the sack. The sealing flap shall have a strip of pressure sensitive adhesive, protected by a liner, extending across the entire width of the flap. The weight and test volume for each size sack shall be as specified in table 4-2. The fabricated sacks shall pass the impact resistance test and the creep test.

Table 4-2

Size	Minimum inside dimensions, inches	Test load, Weight per sack, maximum	pounds
000	3-3/4 x 6-1/4	0.44 oz. (12 g)	0.3
0	5-3/4 x 8-1/4	0.77 oz. (22 g)	0.8
1	7 x 10	0.99 oz. (28 g)	1.4
2	8-1/4 x 10	1.1 oz. (31 g)	2.0
3	8-1/4 x 12-1/4	1.4 oz. (40 g)	2.4
4	9-1/4 x 12-1/4	1.5 oz. (43 g)	3.0
5	10-1/4 x 13-3/4	1.9 oz. (54 g)	4.2
6	12-1/4 x 16-3/4	2.5 oz. (71 g)	7.2
7	14 x 17-3/4	3.0 oz. (85 g)	10.0

Dimensions

Dimensions of the sacks shall be inside measurements, exclusive of the flap, expressed as width by length. Inside dimensions for each size, excluding the flap, shall be not less than specified in table 4-2. Sack opening shall be on the short side.

Workmanship

Sacks shall be uniformly constructed and free from holes, tears, cuts, splits, or other defects which might impair their usefulness.

QUALITY ASSURANCE

Examination of the End Item For Weight, Dimensions, and Workmanship

The sample unit shall be 1 sack. The Inspection Level shall be S-2 with an Acceptable Quality Level (AQL) of 2.5 percent defective in accordance with ANSI/ASQC Z1.4-1993.

Testing of the End Item For Impact Resistance and Creep

The sample unit shall be 2 sacks, 1 for each test. The Inspection Level shall be S-1 with a Acceptable Quality Level (AQL) of 2.5 percent defective in accordance with ANSI/ASQC Z1.4-1993.

Impact resistance shall be verified using the test load for each size specified in from table 4-2. The test load for Sizes 000, 0, 1, 2, and 3 shall consist of dry, unpopped, popcorn. The test load for Sizes 4, 5, 6, and 7 shall consist of bond paper, writing paper, or paperback books. For each size sack, the test load shall weigh within ± 0.1 pound of the weight specified in table 4-2. The popcorn shall be placed in plastic bottles or vials which will fit in the sack being tested. The test load may be distributed among more than 1 bottle or vial. Cap the bottles or vials. The paper or paperback books may be wrapped in paper or plastic for ease of insertion and removal from the sack. Place the appropriate test loads into the sack selected for this test. Remove the liner from the flap, close and seal the sack. Drop each sack 6 times from a height of 36 inches onto a hard, unyielding surface such as uncarpeted concrete. The sack shall be dropped once on each face and once on each side. If any tears more than 1/2 inch long, extending from the exterior through to the interior of the sack, are present at the conclusion of the impact resistance test, the sack does not pass the impact resistance test.

Creep Test

Four test specimens, each 3" 1/8 inches square, shall be cut from each sack selected for the creep test. Two specimens shall be cut from the front face of the sack, and 2 from the rear face of the sack. The specimens shall be evenly stacked on a piece of glass approximately 3-1/2 inches square. The bottom specimen shall be placed bubble side up, the second specimen bubble side down, the third specimen bubble side up, and the top specimen bubble side down. A second 3-1/2 inch square piece of glass shall be placed on top of the stack and a weight sufficient to exert a pressure of 1.0 " 0.1 pound per square inch on the test specimens shall be placed on the top piece of glass. After 60 " 5 minutes, the vertical distance between the glass plates shall be measured at each of the 4 corners of the stack with an instrument capable of measuring to 0.001 inch. The measurements shall be taken carefully so as not to disturb the stack. The average of these 4 measurements shall be recorded as the initial stack thickness. The initial stack thickness divided by 4 shall be recorded as the thickness of the composite material. The weight shall be kept on the stack for a total of 168 " 2 hours, then the distance between the glass plates shall be measured and averaged in the same way as was done for the initial stack thickness. This measurement shall be recorded as the final stack thickness. The final stack thickness shall be not less than 80 percent of the initial stack thickness.

Examination of packaging, packing and marking. The sample unit for this examination shall be one fully prepared shipping container. The Inspection Level shall be S-2 with an Acceptable Quality Level (AQL) of 4.0 percent defective in accordance with ANSI/ASQC Z1.4-1993.

REGULATORY REQUIREMENTS

The manufacturer/contractor shall certify that the kraft paper used to make the sacks contains not less than 5 percent post consumer recovered material. The Government reserves the right to require proof of such content prior to the first delivery and thereafter as may be provided for under the provisions of the contract. Post consumer recovered material is defined as paper, paperboard and fibrous wastes from factories, retail stores, office buildings, homes, etc., which has passed through an end use as a consumer item, including: Used corrugated boxes, old newspapers, old magazines, mixed waste paper, tabulating cards, used cordage; and all paper, paperboard, or fibrous waste collected from municipal solid waste.

PACKAGING, PACKING, AND MARKING

Packaging, packing, and marking shall be as specified in the contract or order.

PROCUREMENT

Buyer shall specify:

- Size, as listed in table 4-2.
- Packaging, packing, and marking required.

BURLAP SHIPPING BAGS (A-A-881)

This description covers standard new or used burlap bags for use in domestic and overseas shipment of supplies and materials.

CHARACTERISTICS

Cloth

The bags shall be fabricated from jute burlap cloth conforming to the requirements in table 4-3.

Construction

Bags shall be furnished new or used, as specified.

The bags shall have open-mouth tops and shall have bottom and/or side seams. The minimum average number of stitches shall be 3.0 to the inch, machine sewn and of stitch type 301 or 401 of Fed. Std. No. 751. The raw edges of the bag shall be sewn with export seams, such as those in Fed. Std. No. 751, SSd-1. Seams shall have a breaking load of not less than 80 percent of the breaking load of the burlap from which the bags are made. Raw top edges of bags shall be hemmed. Selvaged edges shall be sewn with flat seams, and raw edges with export seams.

The size or capacity of the bags shall be as specified in the contract order. When specified, bags shall be suitable for subsistence items. Each bag shall be furnished with a polyethylene liner inserted. The liner shall have a Water Vapor Transmission Rate of now more than 15g per m^2 per day. The liner shall extend not less than 3 inches beyond the top of the burlap.

Table 4-3

	Fabric Count Minimum	Yarns per inch Maximum	Weight, per linear yard by 40 inch width (+8, -2 percent)
Warp Filling	8 8	11 11	 7.5 ounces

Workmanship

Bags shall be clean, dry, and free of holes, tears, frayed threads, objectionable odors, or foreign matter impregnated in or adhering to the sides of the bags. The bags shall be free from other defects which may affect serviceability. If mended, there shall be no more than two mends per bag, and the maximum size of each mend shall not be more than 2 inches.

QUALITY ASSURANCE

Testing of Burlap Cloth

The burlap cloth shall be tested in accordance with the methods listed below. The sample unit shall be one roll of cloth. The Inspection Level shall be S-2 with an Acceptable Quality Level (AQL) of 2.5 percent defective in accordance with ANSI/ASQC Z1.4-1993.

TESTS	METHODS
Fabric Count	ASTM D 3775
Weight	ASTM D 3776
Breaking Load	ASTM D 1682 (Grab Test)

Testing of Polyethylene

The polyethylene shall be tested in accordance with ASTM Method F 372, Water Vapor Transmission Rate. The sample unit shall be one roll of polyethylene. The Inspection Level shall be S-2 with an Acceptable Quality Level (AQL) of 2.5 percent defective in accordance with ANSI/ASQC Z1.4-1993.

Examination of the end item for defects in workmanship, size, or capacity. The sample unit shall be one bag. The Inspection Level shall be S-2 with an Acceptable Quality Level (AQL) of 2.5 percent defective in accordance with ANSI/ASQC Z1.4-1993.

Testing of the End Item For Seam Strength

The sample unit shall be one bag. The Inspection Level shall be S-1 with an Acceptable Quality Level (AQL) of 2.5 percent defective in accordance with ANSI/ASQC Z1.4-1993. Each seam of the sample unit shall be tested in accordance with ASTM Standard Test Method D 1682, Grab Test. The test specimens shall be cut so that the seam to be tested is in the middle of the specimen, parallel to the 4 inch sides. One determination shall be made on each seam of the sample unit. Breaks in the fabric outside the seam area, including jaw breaks, are acceptable provided they yield breaking loads in excess of 80 percent of the breaking load of the burlap. Any seam which has a breaking load less than 80 percent of the breaking load of the burlap from which the bags are made is a defect.

Examination of Packaging, Packing and Marking

The sample unit for this examination shall be one fully prepared shipping container. The Inspection Level shall be S-2 with an Acceptable Quality Level (AQL) of 4.0 percent defective in accordance with ANSI/ASQC Z1.4-1993.

REGULATORY REQUIREMENTS

The manufacturer/contractor is encouraged to use recovered material in accordance with Public Law 94-580 to the maximum extent practicable.

PACKAGING, PACKING AND MARKING

Packaging, packing, and marking shall be as specified in the contract or order.

CHAPTER 5

PAILS AND DRUMS

DESCRIPTION, CLASSIFICATION, AND SELECTION FACTORS

DESCRIPTION

Pails

Pails are cylindrical containers made of metal or plastic, with or without a bail handle. They have a capacity of 1 to 12 gallons. Metal pails are constructed of 20 gage or heavier metal. The sides and bottoms of the plastic pails are integral units having a minimum thickness of 0.045 inches and designed so they can be easily stacked. Pails may have fixed heads employing pour spouts of various designs or have full removable heads.

Drums

Drums are cylindrical, straight-walled containers made of metal plastic fiber or plywood, or a combination of these materials. Drums may be provided with rolling hoops pressed or expanded from the body of the drum, or I bars welded to the body. Drums have fixed or removable heads.

Note. Cans are lightweight containers made of metal, paperboard, pulpboard, or a combination of metal and paperboard or pulpboard. Since cans usually are associated with unit packaging, information concerning them is found in FM 38-700.

CLASSIFICATION

Pails and drums are classified as to usage, that is, interior or exterior containers, and reusable and nonreusable containers. They are also classified as to composition--metal and nonmetal.

Interior and Exterior Containers

Interior

Interior containers are covered in FM 38-700.

Exterior

These containers consist of pails, reusable type metal containers, and drums. Exterior containers are designed to withstand rough usage. They may be palletized for convenience in handling.

Reusable And Nonreusable Containers

Reusable

Certain metal containers and drums are designed for reuse. The reusable type is very convenient for the return shipment of repairable items. This feature is particularly advantageous in cases where repairable instruments or accessories can be packed for shipment to the maintenance overhaul activity in the container in which the replacement item was received.

Multiple trip pails and drums may, under certain conditions, be refilled and reused for the shipment of liquid, powdered or granular commodities.

Nonreusable

Single-trip containers usually are discarded after their first use. One type, the strippable drum, is filled with a hot liquid which solidifies after cooling. At destination, the drum is torn away from the enclosed product. Other single-trip containers, designed of light gage metal, are discarded after the first trip because of Department of Transportation (DOT) Regulations, or because the general physical condition of the container would not warrant another trip.

Metal and Nonmetal Containers

Pails and drums are made from metal, although some may be made from fiberboard. The most common metal used for drums is mild steel. Some drums, however, are made of aluminum, nickel, stainless steel, various alloys, or plastics.

USE AND SELECTION FACTORS

Use

A wide range of items and commodities are adaptable for shipping in pails and drums. Liquids, semiliquids, semisolids, granular, flaked, and powdered materials, and solids may be shipped in specified types of these containers. Fragile items and precision instruments may be given the high degree of protection they require by the use of cans or drums. Hazardous materials, such as corrosive liquids, flammable solids, flammable liquids, and acids which cannot be shipped in any other type of container may be shipped in approved types of pails and drums.

Selection

When selecting a pail or drum, it must be remembered that these containers are structurally rigid in design and are dustproof. They may also be waterproof or water-vaporproof. They are easy to mark and afford excellent physical protection of contents during shipment and storage. Pails and drums may be less susceptible to pilferage than some other types of containers. Care must be taken when selecting containers. This is particularly true when selecting a container for shipment of dangerous items; it is also true when selecting the correct container for other items. For example, a square item in a cylindrical container takes about 1-1/2 times the cube required for the same item when packed in a square container. In addition to the loss of valuable cube, excess dunnage is required to fill the voids when a container of the wrong shape is used.

Note. Containers used for shipments of hazardous materials can not be made in accordance with the Department of Transportation (DOT) Specifications after 1 October 1994 and may not be used for shipment after 1 October 1996.

At that time, all containers for Hazardous Materials must be made in accordance with the United Nations Specifications. However, packages filled prior to October 1, 1991, conforming to old requirements, and marked with "INHALATION HAZARD" as appropriate, may be offered for transportation and transported until 1 October 2001.

METAL SHIPPING AND STORAGE DRUMS (MIL-D-6054)

DESCRIPTION

These reusable steel shipping and storage drums are fabricated of 18 to 22 gage steel and incorporate a full removable (recessed or dome style) cover. Bolted-ring or lever lock closures are used to seal the cover onto the drum body (fig 5-1). Gaskets for the covers may be tubular or solid. The covers, gaskets and locking rings are interchangeable within each diameter group. Rolling hoops, which increase the strength, rigidity, and ease of handling, also provide the means of anchoring internal dunnage through the use of split expanding steel rings which fit into the grooves (fig 5-2). When properly sealed, the drums provide a highly effective water-vaporproof container, thus affording a degree of protection suitable for Method 40 and Method 50 preservation.

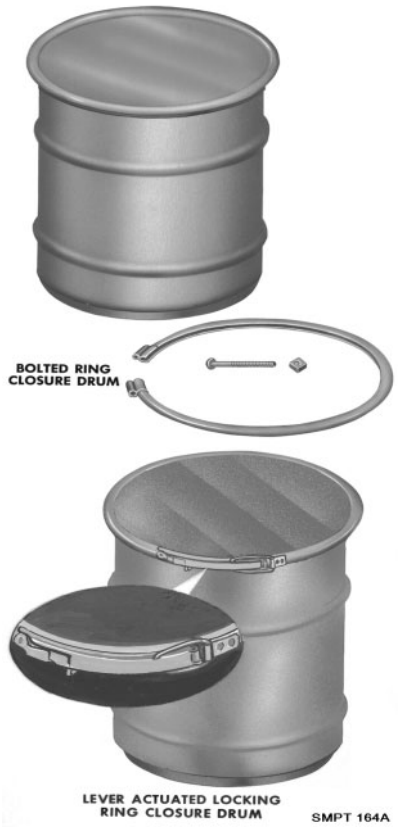


Figure 5-1. Bolted ring and lever actuated type closures (MIL-D-6054).

CLASSIFICATION

The drums are available in various capacities ranging from 3 to 80 gallons, and from 40 to 250 pounds gross weight. The drums are available with inside diameters ranging from 10.5 inches to 30 inches, and inside usable heights ranging from 8.08 to 41.12 inches. The capacities and dimensions, which are available in different combinations, are specified in Military Standards MS27683 and MS27684.

USE

These metal drums are intended to be used for storage and shipment of military material. Drums are required by test to withstand internal pressure of 15.0 pounds per square inch (psi), which will allow them to be used for packing of hazardous materials for transportation by military aircraft. These drums are also used as overpacks for shipments by air of containers which will not meet 15 psi. All size drums are suitable for all methods of preservation where a rigid container is specified. The use of drums are affected by the following factors:

Size and Capacity

There is no specified rule for the selection of a container for a particular item. it is obvious, however, that a container will be selected which will be adequate to contain the item and its blocking and cushioning, yet allow sufficient clearance between the item and the container, or between the blocking and the container walls, to prevent damage to the item when the drum is handled roughly. The container must not be too large, as this will involve the use of extra space and weight. This is a disadvantage when a large number of such drums are to be shipped or stored.

Figure 5-2. Internal locking rings in position (MIL-D-6054).

Internal Locking Rings

The split steel locking ring is designed to fit snugly within the rolling hoop of a metal container and provide a circular flange support for interior blocking (fig 5-3). Care must be used in the design of the interior blocking or other fittings to prevent displacement of the locking ring when loaded. Without some safety device, the locking ring may be loosened by rough handling of the container due to the load imposed on the ring. Figure 5-3 illustrates a safety ring made of plywood. If the item being packed precludes the use of a safety ring, the same function may be performed by using three blocks equally spaced around the internal locking ring and secured to the dunnage by screws. This permits the removal of the blocks for unpacking.

Cup-Type Inserts

The cup-type metal insert was developed primarily as a mount for generators and starters for metal container packing, but it may be adapted to other items. Figure 5-4 shows the metal cup, with plywood fastened to the two ends to aid in blocking while figure 5-5 shows the cup in position, anchored between the locking ring and the container cover. The numerous bolt holes through the cup allow it to be bolted to various items as required.

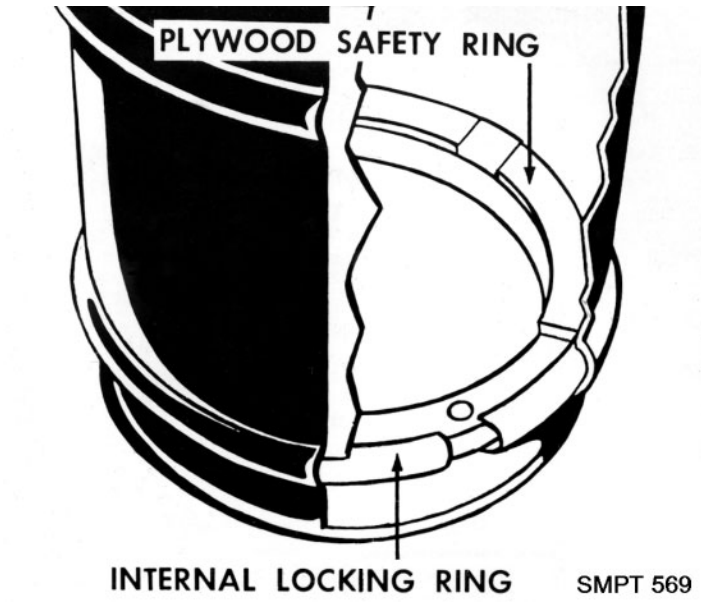
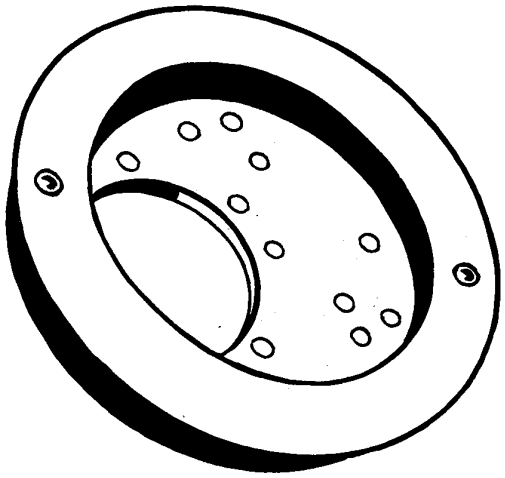


Figure 5-3. Use of internal locking ring (MIL-D-6054).



JMPTC 570

Figure 5-4. Cup-type metal insert (MIL-D-6054).

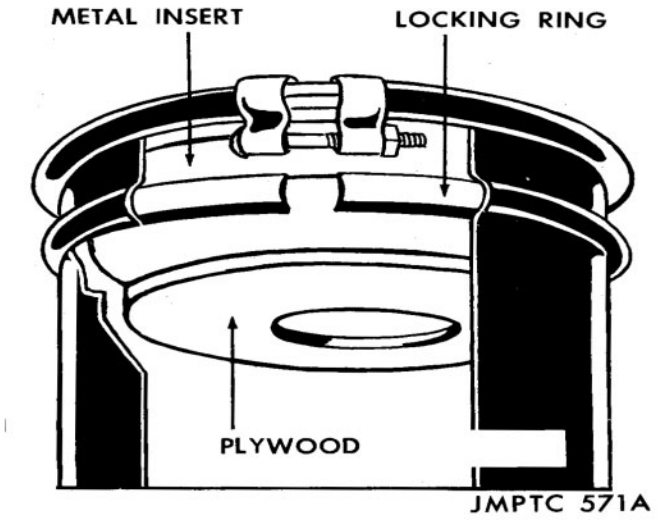


Figure 5-5. Cup-type insert locked in place (MIL-D-6054).

Crate-Type Inserts

The crate-type metal insert is shown in figure 5-6. In use, the item being packed is bolted to two adjacent side members. Plywood disks on the ends of the insert provide some cushioning. The base of the item packed will be insulated from the insert with barrier material conforming to MIL-B-121, Grade A, to prevent the possibility of corrosion from reaction of two dissimilar metals. The maximum weight of the packed item should not exceed 25 pounds for the 10-1/2 inch diameter insert, or 30 pounds for the 13 13/16 inch insert.

Figure 5-6. Item installed in crate-type insert (MIL-D-6054).

Closure

There are two styles of closure for these drums. They are the bolted ring closure and the lever activated locking closure. Closures are made in one of the following manners:

- Bolted-ring closure. The closure may be made in two ways. A device may be used which encircles the locking ring and applies pressure uniformly around the circumference of the ring. The closure is effected by tightening the bolt and nut after uniform pressure is applied at all points around the ring. Care should be taken that the gasket is properly seated in the groove of the cover prior to closure. Alternately, closure may be made by tightening the closure bolt (fig 5-7). The locking ring is tapped at various points about the closure ring while the closure bolt is being tightened. The tightening is continued until at least a minimum torque of 6 foot-pounds plus or minus one-half is applied. In lieu of the specified torque indicating device, closure of an exterior metal container having a slotted-head bolt may be accomplished by using a common screwdriver having an overall length of approximately 17 inches. If this procedure is followed, a spot check of torque with a torque indicating device should be made to assure adequate tensioning. Drums used for shipping commodities by Parcel Post will have the bolt end and protruding edges of the closure ring wrapped, taped, cushioned or otherwise securely covered to prevent damage to postal employees, mail bags, and other containers during shipment. Containers shall be overpacked in fiberboard boxes when this extra precaution is considered necessary. When overpacked, containers shall be secured within the fiberboard box with fiberboard or other suitable dunnage.

Figure 5-7. Tapping locking ring while tightening bolt to insure an effective seal (MIL-D-6054).

- Lever actuated locking closure. When specified in the contract or purchase order a lever actuated type locking ring may be used instead of the nut and bolt type locking ring. Use may be made of a device which encircles the locking ring and applies pressure uniformly about the circumference of the locking ring. The closure is then affected by closing the locking lever and then the wire and lead seal lever which locks the locking lever in position. When the encircling device is not available for use, tension is applied by the locking lever and the ring is tapped repeatedly around the circumference until the ring is seated and the lever is in a locking position. The lever is then locked into place by the wire and lead seal lever lock.

Sealing

Sealing of the container is effected by means of a wire and metal seal which is applied after the closure is complete. Drill 3/32 inch diameter holes in each locking ring lug if they are not already predrilled. The sealing wire is inserted through the holes and the loose ends are twisted together tightly, after which the seal is crimped over the twisted ends of the wire.

Repair and Reuse

The components of the metal shipping and storage drums are repaired and reused as follows:

- Containers, cover, ring, and gasket. Due to the welded construction of an exterior type metal container, dents are considered repairable even though a seam or joint is involved. Dents are removed, painted surfaces retouched, and the container reused or returned to stock. If the container is distorted beyond practical repair, or has a dented or otherwise damaged sealing lip, it is unfit for further use and should be handled accordingly.
- Metal inserts and dunnage. It is not normally considered advisable to repair metal inserts or dunnage, due to the fact that once distorted or deformed, the metal insert would probably be weaker if bent back into the original shape, and thus be incapable of affording the necessary protection. If bent back and reinforced, the spring rate of the material might be greatly changed, thus transmitting any shock directly to the part to be packed and causing damage. However, in an emergency they may be repaired under competent engineering supervision. Immediately upon removal of an item from a metal insert type mount, the interior locking rings and metal inserts must be returned to stock, unless required for immediate reuse. Al inserts and interior locking rings are stocked and handled as separate items, and never as component parts of the container assembly.

METAL DRUMS (STANDARD) (MISCELLANEOUS)

DESCRIPTION

Metal drums are cylindrical, single-wall shipping containers with a capacity which usually ranges from 12 to 110 gallons, 55 gallons being the most common capacity. Metal drums are equipped with rolling hoops which provide additional strength to the side wall and provide for ease of handling. The rolling hoops may be parallel to each other or be offset to facilitate closer nesting for palletization and carloading. Metal drums may have full removable heads or tight heads (fixed) (fig 5-8). A drum with a tight head is

provided with a 2 inch diameter bung and 3/4 inch diameter vent hole for filling and emptying. These openings may be on the drum head or in the drum body. Drums may be unlined or lined with lacquer, varnish, enamel and plastics, rubber, lead, or aluminum.

CLASSIFICATION

The DOD uses many kinds of drums for the shipment of various materials. Listed in table 5-1 is the Federal specification number and title (PPP-D-729) and the DOT specification number and title. Figure 5-8 shows the type of drum classified in Federal Specification PPP-D-729 and the corresponding DOT-5B. DOT designates the DOT 17E and DOT-37A drums as single-trip containers.

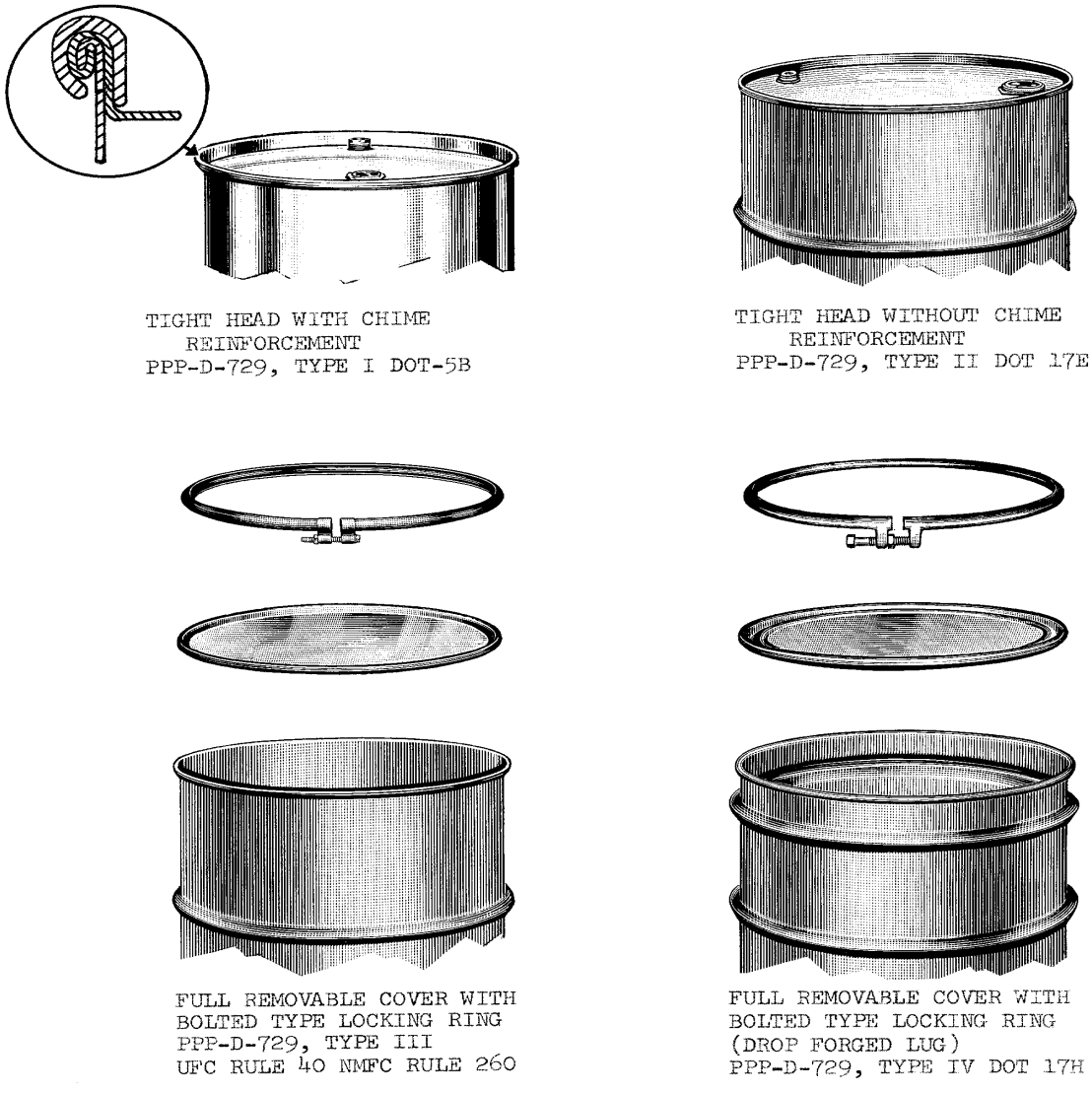


Figure 5-8. Types of drum closures and typical markings for domestic drums (PPP-D-729).

Table 5-1. Specifications and Titles of Metal Drums.

Federal specification number and title	DOT specification, number and title
PPP-D-729 drum, metal, 55 gallon (for shipment of noncorrosive materials)	
Type I..... (Class A-Closehead, Class B-Openhead)	DOT-5B Steel barrels or drums. Removable head containers which will pass all required tests are authorized.
Type II.....	DOT-17E Steel drums, single trip container. Removable head containers not authorized.
Type IV.....	DOT-17H Steel drums, single trip container. Removable head required.
Type V.....	DOT 5A - Straight side, unlined steel for acid and corrosive liquids.
Type VI.....	DOT 5C - Straight side, corrosion-resistant steel for acid and corrosive liquids.
Type VII.....	DOT 5D - Closehead straight side, lined steel for acid and corrosive liquids.

USE

The tight (fixed) head drums are primarily used for the shipment of liquids. Emptying may be through either the filler or vent hole, although the filler hole is most commonly utilized. A spout may be affixed to the threaded portion of the hole to facilitate emptying. A pump, either hand or hydraulically operated, may be utilized in the hole. Greases, dry powdered, flaked or granular materials, etc., may be shipped in a full removable head drum. The full removable head drum provides the easiest access to the contents.

REUSE

Most metal drums are initially filled at the manufacturer's plant and are reusable except for single-trip containers. When empty, the drums may be returned to destination for refilling. If refilling is done by the initial user, care should be taken not to reuse drums which have been used to ship hazardous materials, until such drums are cleaned and tested in accordance with UN recommendations. Failure to do so may create a serious health hazard. When filling drums with dangerous materials, only UN recommended type drums may be used for that commodity. The drum specification number, the name, initial, or symbol of the manufacturer; the letters "US" to indicate that the drum is the property of the Government; the letters "STC" if the drum is a single-trip container; and a numerical indication of the thinnest gage of metal used in the construction, the capacity of the drum in gallons, and the year of manufacture are embossed on the bottom of the drum (fig 5-8). For example, 18-55-74 means that drum is 18 gage metal, 55-gallon capacity, and was made in 1974. When filling the drums, the contents may not exceed the marked capacity minus 2 percent for outage.

FIBER DRUMS (PPP-D-723)

DESCRIPTION

Fiber drums are cylindrical shipping containers with bodies made of fiberboard, either lapped or parallel wound (convolutely) in the form of a hollow cylinder. They may be either single unit or telescopic body type. The heads are of metal, wood, plywood, or fiberboard. There are many characteristics of fiber drums which give them advantages over other types of containers. Included among these are cleanliness, durability, low uniform tare weight, retard temperature fluctuation, easy opening and closing, water and moisture resistance, stackability, easy handling, product protection and wide range of diameters and heights. Fiber drums are easily opened and reclosed.

CLASSIFICATION

Fiber drums are available in the types, grades, and classes shown in table 5-2.

USE

The intended uses are shown in table 5-2. The other factors covered by this paragraph must also be observed.

Domestic Type (Type I)

Fiberboard drums covered by this specification are intended for use as domestic shipping containers. Grade A drums are for dry or solid materials. Class 1 regular construction should normally be used; class 2 foil laminated should be used for highly hygroscopic materials needing a barrier, such as desiccants. Use of grade B drums should be limited to semisolid materials having a consistency similar to asphalt, lubricating grease, petrolatum, refractory cement, caulking compounds, roof coatings, adhesives, textile sizing, and food products such as jellies and fondants. The consistency of asphalt materials and lubricating greases should not exceed 350 units when measured in accordance with method 311.6 of FED-STD-791 (ASTM D 217). Class 2 is normally used when high moisture barrier is required or when the type I, grade A, class 2 is supplemental by the aluminum liners it may be used to deter electrostatic charges and prevent explosion. Grade C drums are for hot-poured materials that solidify on cooling and should be limited to materials poured at temperature not exceeding 400°F. Grade E drums are for nonregulated liquids or articles in liquids.

Type I, Grade D

This is also intended for normal overseas shipment. When substituted for type II drums, the drums shall be marked type II, overseas type (nonweather resistant).

Type II Overseas (Nonweather Resistant)

Fiberboard drums covered by this specification are intended for use for normal overseas shipment where numerous handling and storage at destination are not anticipated.

Type III Overseas (Weather Resistant)

Fiberboard drums covered by this specification are intended for unprotected weather exposure usage for added protection in high humidity or outdoor storage environment.

Exceptional Requirement

Exceptional commodities, especially dangerous articles (hazardous material), may require better material and construction requirements than are covered by this specification.

Compliance Marking

In addition and adjacent to the drum manufacturer's markings required by Uniform Freight Classification, National Motor Freight Classification or DOT rules or regulations, each drum is stamped or printed in black capital letters not less than 3/16 inch in height with information concerning the type, class, grade, specification number, etc. For example, the information for the Type I drum is shown below:

Type I
(DOMESTIC TYPE)
COMPLIES WITH FED. SPEC. PPP-D-723J
FOR DOMESTIC SHIPMENT _____
GRADE_____CLASS_____
MAX. WT. OF CONTENTS_____LBS.
MAX. CAPACITY OF CONTENTS_____GAL.

In addition, Grade D drums shall have stenciled or printed on the cover and side wall in letters not less than 3/4 inch in height, the following precautionary markings:

STAND ON END
KEEP COOL AND DRY

Only contents of the type, grade, and class as indicated in the compliance markings are to be placed in these drums. The weight and capacity must also conform to these requirements.

Table 5-2. PPP-D-723 Fiber drums

Types, grades, and classes. Fiber drums covered by this specification shall be of the following types, grades, and classes, as specified.	
Type I	- Domestic (nonweather resistant)
Type II	- Overseas (nonweather resistant)
Type III	- Overseas (weather resistant)
Grade A	- For dry and solid material (applicable to all types)
Grade B	- For semiliquid material (applicable to all types)
Grade C	- For hot poured materials that solidify on cooling (applicable to types I and II only) - For rolled or cylindrical items (applicable to types I and II only)
Grade D	- For liquids or articles in liquid - nonregulated (applicable to all types)
Grade E	
Class 1	- Regular construction (applicable to only types I and III grade A drums)
Class 2	- Foil laminated construction (applicable to only types I and III grade A drums)
Class 3	- Integral plastic lining (applicable to only grade E drums)
Class 4	- Semi-rigid plastic component (open head loose liner applicable to only grade E drums
Class 5	- Molded rigid one-piece plastic component (closed head liner) applicable to only grade E drums

Closure

The closure of fiber drums must be such that they may be opened and reclosed by hand or simple tools. These are three types of closures which are commonly used. They are the friction-type or telescopic slip on covers, which are secured with pressure sensitive tape, lever-activated locking bands, and the metal clip or lug closure (fig 5-9).

Figure 5-9. Types of fiber drum closures (PPP-D-723).

CHAPTER 6

CRATES

INTRODUCTION TO CRATES

NOMENCLATURE AND RELATED TERMS

Crates are rigid containers constructed of structural members fastened together to protect the contents. Crate design involves numerous names and terms which must be defined if the construction of crates is to be explained without confusion. When the names of the separate components are known, although they differ in various specifications and drawings, their functions and relationship to each other are more easily understood. In order that both general and detail design requirements may be clearly understood, reference to items described in ASTM D 996 and below is recommended.

Nomenclature

Baffle

A piece of plywood, wood, or metal placed over ventilation holes to deflect air or water entering the crate.

Bottom Sheathing

Boards nailed to the bottom surface of the frame members of a sill base. Also known as flooring.

Bridging

Members of the same depth as joists or sills placed at right angles to the intermediate longitudinal or crosswise sills or headers to prevent lateral turning or buckling of the joists or sills.

Cleats

Auxiliary reinforcements for plywood panels placed between vertical struts to strengthen the panel.

Covered Crate

A crate with open-type frame with an outside covering of plywood or paper-overlaid veneer.

Crate Base

The bottom load bearing unit of a crate.

Crate Covering

A lightweight material fastened to the frame of an open crate to give more positive weatherproofing than is offered by an open crate and shroud.

Diagonals

Frame members positioned between parallel frame members and placed at angles of nearly 450 to the latter.

Diagonal Floorboards

Usually 1-inch boards, cut at 450 angle to the skids and placed between the forklift areas.

End Frame Members

Members of the top panel of an open crate, placed crosswise at each end of the top.

End Sills

Members forming the ends of a sill frame.

Filler Strips

Boards placed across the ends of thin, nonload bearing floorboards which fill the space below the lower frame member of the sides.

Floor Members

Boards and timbers nailed or bolted to the top of the skids forming a platform for the contents and a bottom closure for the crates.

Forklift Area

Area extending 42 inches in from each end of the crate, usually floored with 2-inch boards.

Frame Members

Those wood members which form the fundamental structure of the crate.

Gusset Plate

A square piece, usually plywood, placed at the junction of the diagonals for reinforcement.

Hanger, Metal

Metal strapping formed in a manner to support intermediate sills on a sill-type crate or joists of the top.

Headers or End Cross Members (Open Crate)

Cross members attached at the end of the skids which hold the skids together. Also longitudinal members at each end of top joists.

Horizontal Braces

Members positioned between struts and parallel to upper and lower frame members of the sides or ends.

Horizontal Top Bracing Joist Support

Horizontal member attached to the frame members in which the top joists rest.

Intermediate Crosswise Sills

Full length members located between the end sills and parallel to them.

Intermediate Frame Members

Members of the top panel of an open crate located between and parallel to the side frames of the top.

Intermediate Longitudinal Sills

Full length members located between the side sills and parallel to them.

Intermediate Skids

Full length beams located between and parallel to the skids.

Joists

Members extending across the crate that support the top and prevent crushing when grab hooks are used.

Joists Supports

Members, usually 2 x 4, nailed to the frame under each joist and extending to the floor.

Kick Blocks

Short members attached at the junction of the corner post and upper or lower edge member. They are used on end panels having no braces or those with a single diagonal brace.

Lag Bolt Reinforcing Strap

Galvanized strapping drilled to take lag bolts and nailed to the inner face of the sheathing at the center line of the skid and header.

Load Bearing Floor Members

Heavier or reinforced floorboards used to hold the concentrated weight of the crate load.

Lower Frame Member

Horizontal frame member at the lower edge of the side and end panels. Formerly called lower edge member.

Open Crate

A crate formed of frame members only, without exterior sheathing attached.

Reinforced Straps

Metal strapping applied at the corners or base corners to reinforce and fasten the panels together.

Rubbing Strips

Boards nailed to the underside of skids or bottom sheathing.

Sheathed Crate

A crate in which the frame members are completely covered with sheathing.

Sheathing

Material such as plywood, lumber, or fiberboard nailed to the frame of a crate across all openings to add strength to the crate, or to prevent loss of contents, pilferage, or entry of dirt, water, etc., into the crate.

Side Frame Members

Members of the top panel of an open crate, placed lengthwise of each side of the top.

Side Sills

The members forming the sides of a sill base crate.

Sills

The continuous frame members of a sill base.

Sill Base

A crate which has its frame members (sills) built on the inside of the crate to which the bottom sheathing is attached.

Sill Bridging

Members of the same depth as the sills placed at right angles to the intermediate lengthwise or crosswise sills of a sill base to prevent twisting or buckling.

Skids

The outside longer beams of a skid base which support the weight of the crate and contents.

Skid Base

A crate base which has its longer beams on the outside.

Sleeper

Reinforcing members secured to the underside of the floorboards, at right angles to the floorboards to provide secure anchorage for the item.

Spacers

Members which position the ends of joist or sills.

Spreaders

Members placed at right angles to the floorboards, between the item and the floorboards, to distribute the load over a wider area.

Sling Notches

Open spaces between the ends of the rubbing strips and the ends of the crate, or cutaway sections at the ends of the skids.

Struts

Vertical frame members between the upper and lower frame members.

Top Joist Spacers

Short members nailed between the top joists, to the inside face of the upper frame members, which act as end bridging.

Top Sheathing

Board or plywood forming the closure of the top.

Upper Frame Member or Upper Edge Member

Horizontal frame member at the upper edge of the side and end panels.

Related Terms

Actual Size Lumber

The true dimension of a piece of lumber as measured with a scale.

Center of Balance

The point along the length of a crate at which it would balance on a fulcrum, placed at right angles to the skids of sills.

End Grain Nailing

Nails driven parallel to the grain of the wood.

Gross Weight

Total weight of the crate and its contents when ready for shipment.

Holddowns

Devices constructed of wood or metal, used to secure the item to the base of the crate.

Liner

Waterproof barrier material placed between the frame and the sheathing.

Net Weight

The weight of the item alone, excluding dunnage, wrappings, or containers.

Nominal Size Lumber

Dimension of lumber before it is dressed.

Overdriving

Driving nails into wood so that the heads sink below the surface of the wood.

Side Grain Nailing

Nails driven at right angles to the grain of the wood.

Tare Weight

The weight of the crate, including dunnage, holddowns, and packing materials.

Underdriving

Driving nails into wood so that the heads protrude above the surface of the wood.

CLASSIFICATION OF CRATES

Crates are grouped into several categories. They may be open or sheathed (fig 6-1). Crates may be nondemountable, single trip crates of nailed construction, or bolted, reusable, demountable crates. Crates may be designed for domestic use only, or for both domestic and oversea shipments. Some crates are designed for general use and others are constructed in accordance with a specification for a particular item. Of course, the classification of a crate may include a combination of several of the above factors.

Open Crates

An open crate is a container formed of frame members only, without exterior sheathing attached. When plywood or paper-overlaid veneer is used to provide additional weather protection, they may be called covered crates as opposed to sheathed crates. The open crates discussed in this section are the most widely used (fig 6-2, 6-3, and 6-4).

Small Open Crates

Small open crates may be subdivided into the following categories:

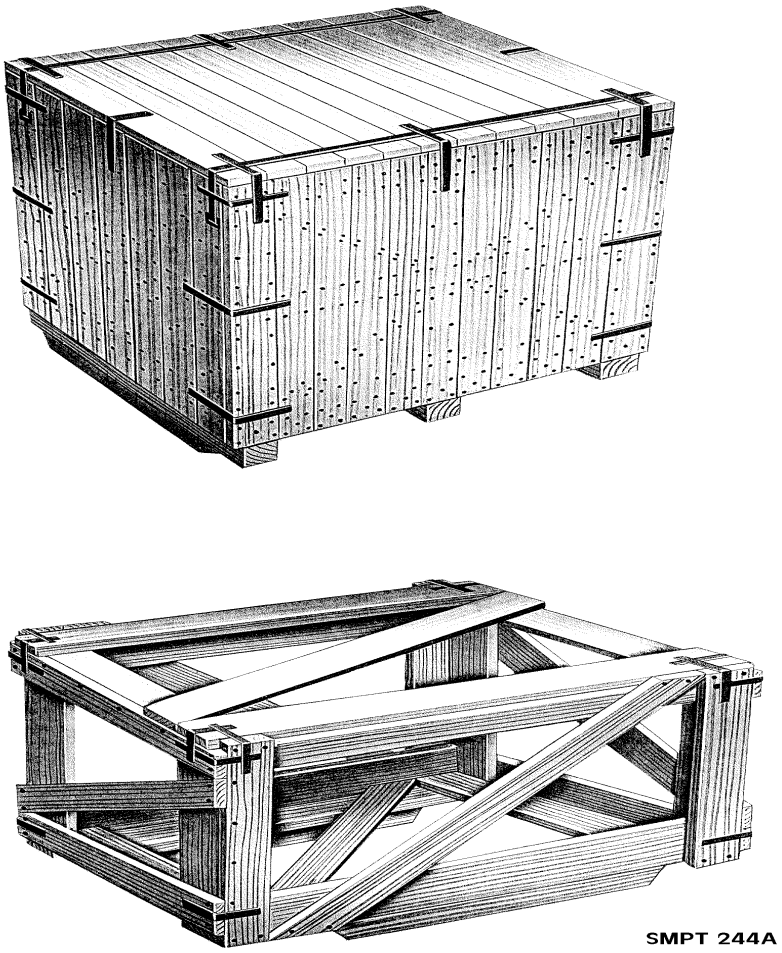


Figure 6-1. Open and sheathed crates.

Shallow Crates

These crates are normally not more than 12 feet in length, 4 feet in width, and 2 feet in height, as illustrated in figure 6-2. The net weight of contents should not exceed 1,000 pounds. However, there are exceptions to these requirements which are explained in the footnote of table 6-3.

Lightweight Crates

These crates are designed for net weight of contents not exceeding 250 pounds. The size is limited to 4 feet in length, 3 feet in width, and 3 feet in height (fig 6-2 and 6-3).

Medium Weight Crates

Crates in this classification are normally designed for a net weight of contents not exceeding 1,000 pounds. The size is limited to 6 feet in length, 4 feet in height, and 4 feet in width (fig 6-2).

Heavy Weight Crates

These crates are normally designed for a net weight not exceeding 4,000 pounds. The size is limited to 32 feet in length, 6 feet in width, and 10 feet in height (fig 6-2, and 6-3, Type V).

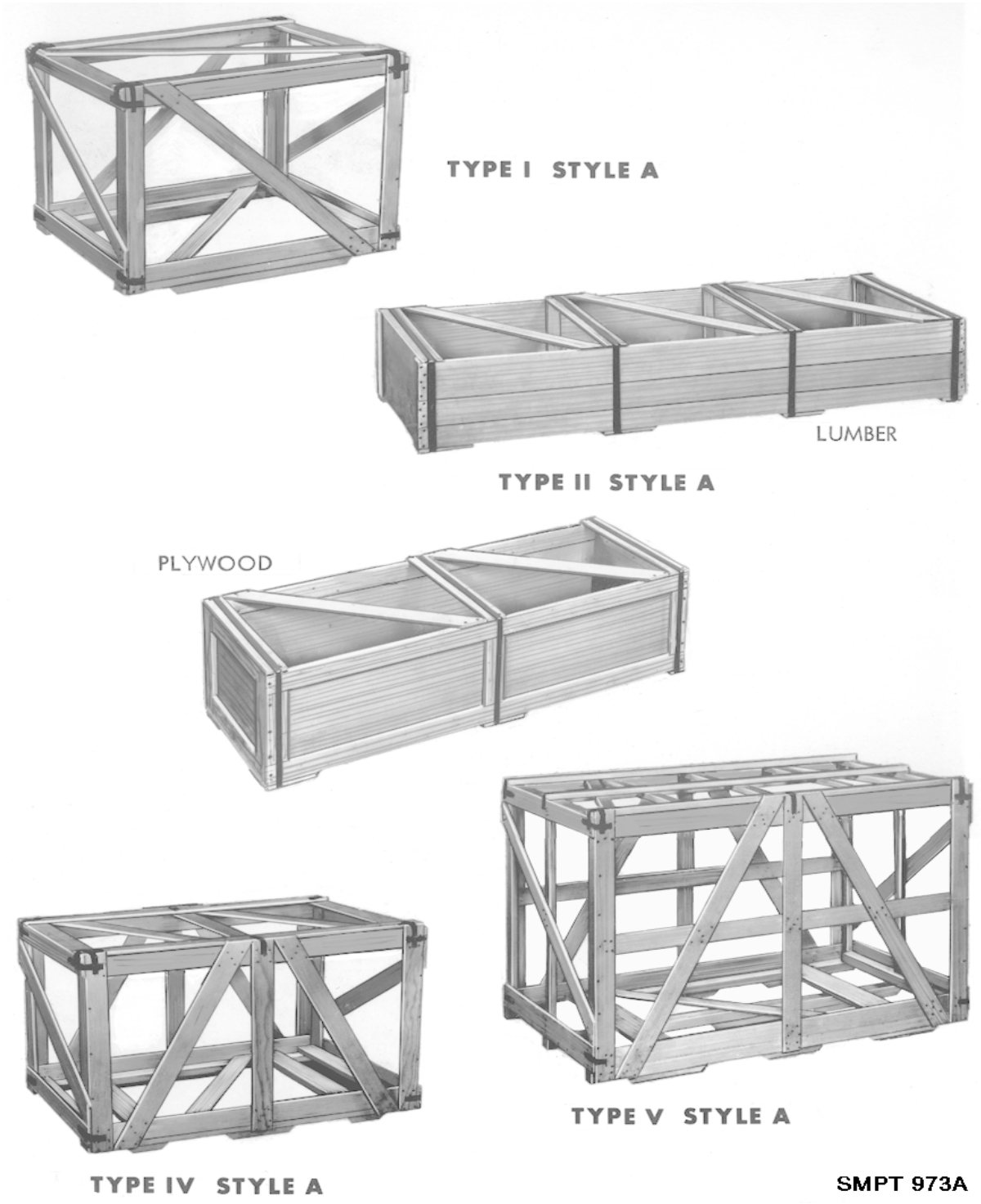


Figure 6-2. Styles of open crates (MIL-C-52950).

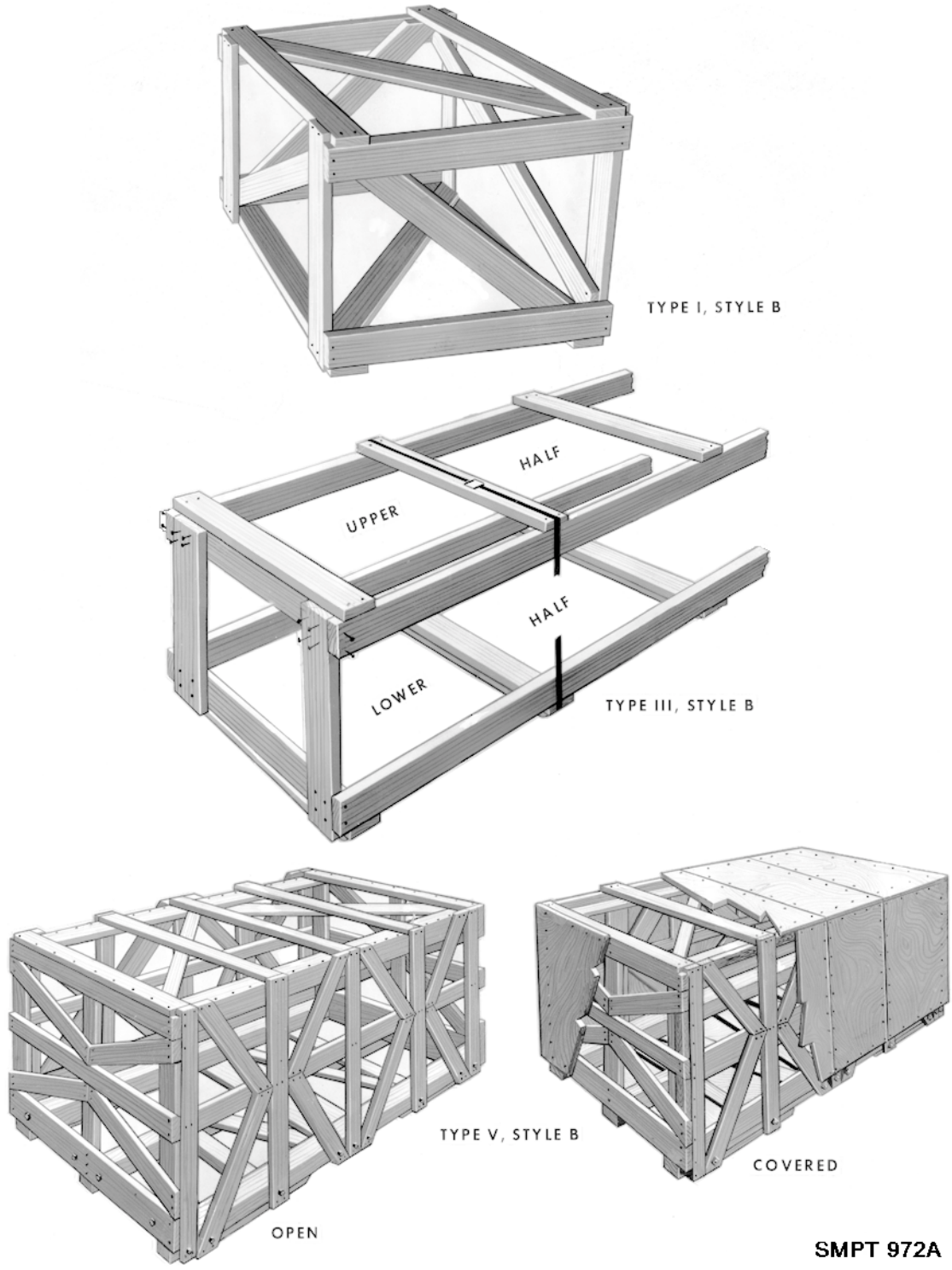


Figure 6-3. Styles of open crates (MIL-C-52950).

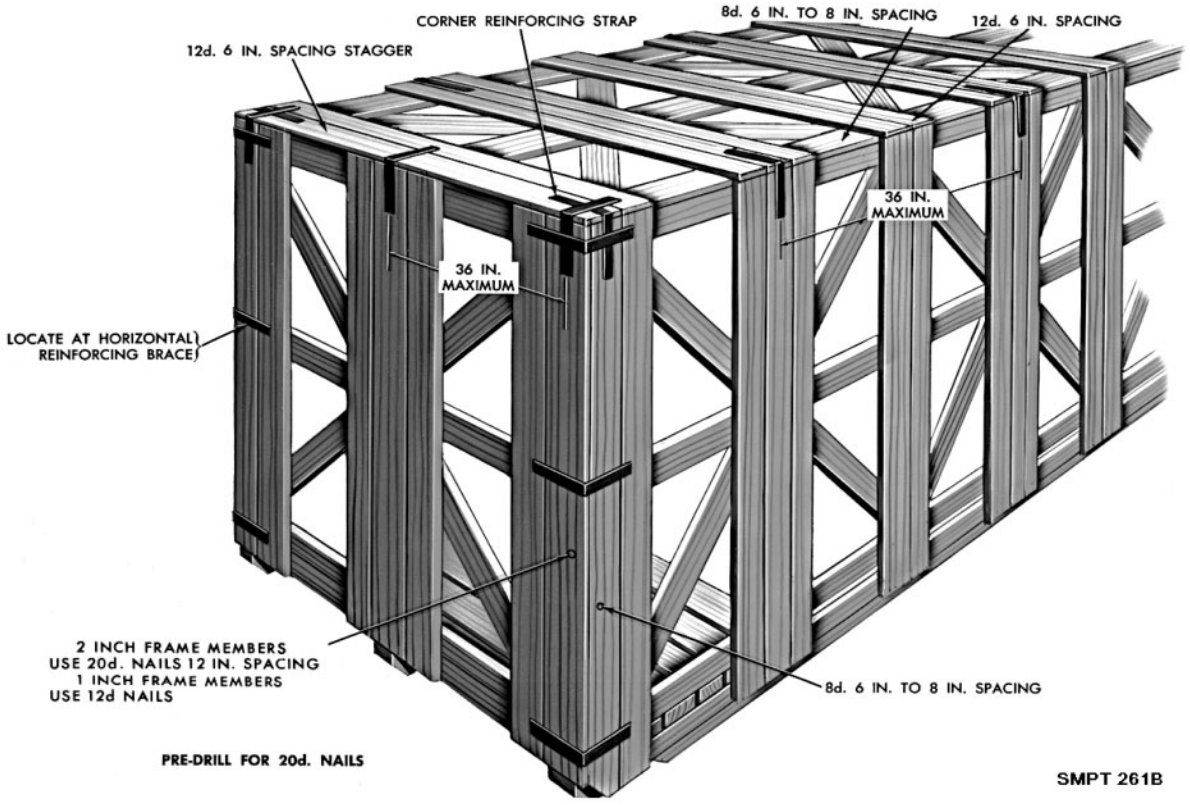


Figure 6-4. Assembly of open nailed crate (MIL-C-3774).

Large Open Crates

For military use, there are two kinds.

Nailed Crates

These crates are designed for a net weight ranging up to 12,000 pounds. The maximum size limit is not to exceed 16 feet in length, 8 feet in width, and 8 feet in height (fig 6-4).

Bolted Crates

These crates are designed for reuse with net weight ranging up to 16,000 pounds. These crates are designed with a size limit not to exceed 40 feet in length, 8 feet in width, and 16 feet in height (fig 6-5).

Sheathed crates

A sheathed crate is similar to an open crate except that the frame members are completely covered with sheathing material, such as lumber or plywood, fastened to the frame. This adds strength to the crate, prevents loss of contents, reduces pilferage, and prevents the direct entry of dirt, water, etc. The main difference between a nailed wood box and a sheathed crate is that the top, bottom, and side faceboards of a nailed wood box provides the main structural strength, whereas in a crate, the frame members sustain the load and provide the strength, Many sheathed crate designs exist in our military system; however, the designs selected for this section are considered to be the most widely and generally used (fig 6-6).

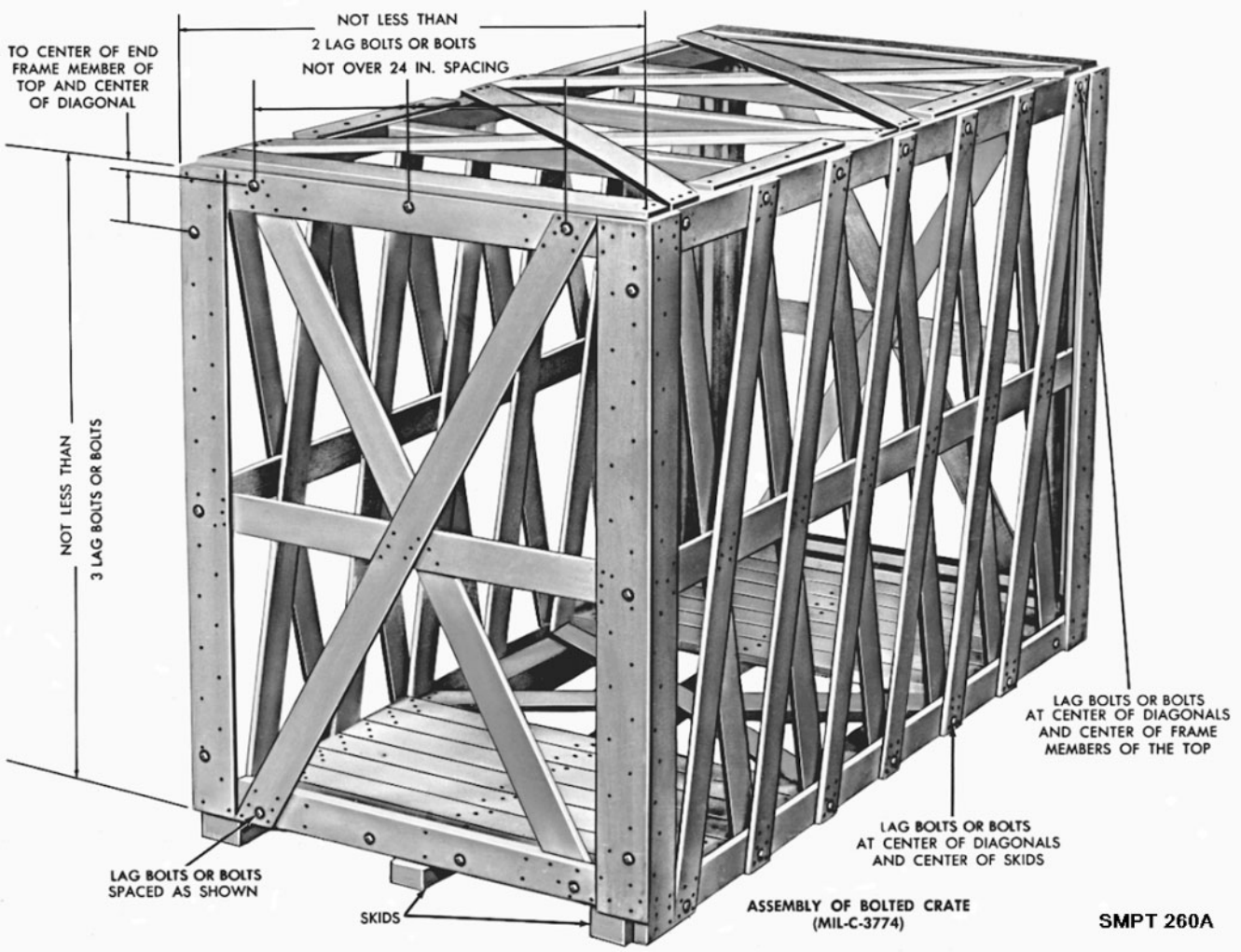


Figure 6-5. Assembly of open bolted crate (MIL-C-3774).

Sheathed Nailed Crates

These crates are not designed for reuse and are constructed in the same manner as bolted crates with minor exceptions. The crates should not exceed 30 feet in length, 9 feet in width, and 10 feet in height. The net weight of contents may range up to 30,000 pounds. These limitations may be exceeded, however, when the size and weight of the item require a larger crate.

Sheathed Bolted Crates

All bolted crates are designed for reuse. The size and weight limitations are the same as for the nailed crates.

Special Use Crates

Crates in this classification are of special design for specific items. These crates may be fabricated of metal or wood, either open, sheathed, nailed, or bolted. Crate dimensions and weight will vary depending upon the size, weight, and characteristics of the contents. Examples of special crates are illustrated in figure 6-7. The slotted angle crate (ASTM D6255) is an example of special metal crate which may be either open (Type I) or sheathed (Type II with either plywood, paper-overlaid veneer, or fiberboard. It may be fabricated without skids (Style A), or with skid blocks or skids with rubbing

strips (Style B). Both the open and sheathed Style A slotted angle crates are restricted to items not to exceed 200 pounds, with dimensions not to exceed 80 inches in length, 30 inches in width, and 48 inches in height, except when a specific design has been approved by the contracting activity. Both the open and the sheathed Style B carry up to 3,000 pounds and are limited to not over 30 feet in length, 4 feet in width, and 7 feet in height.

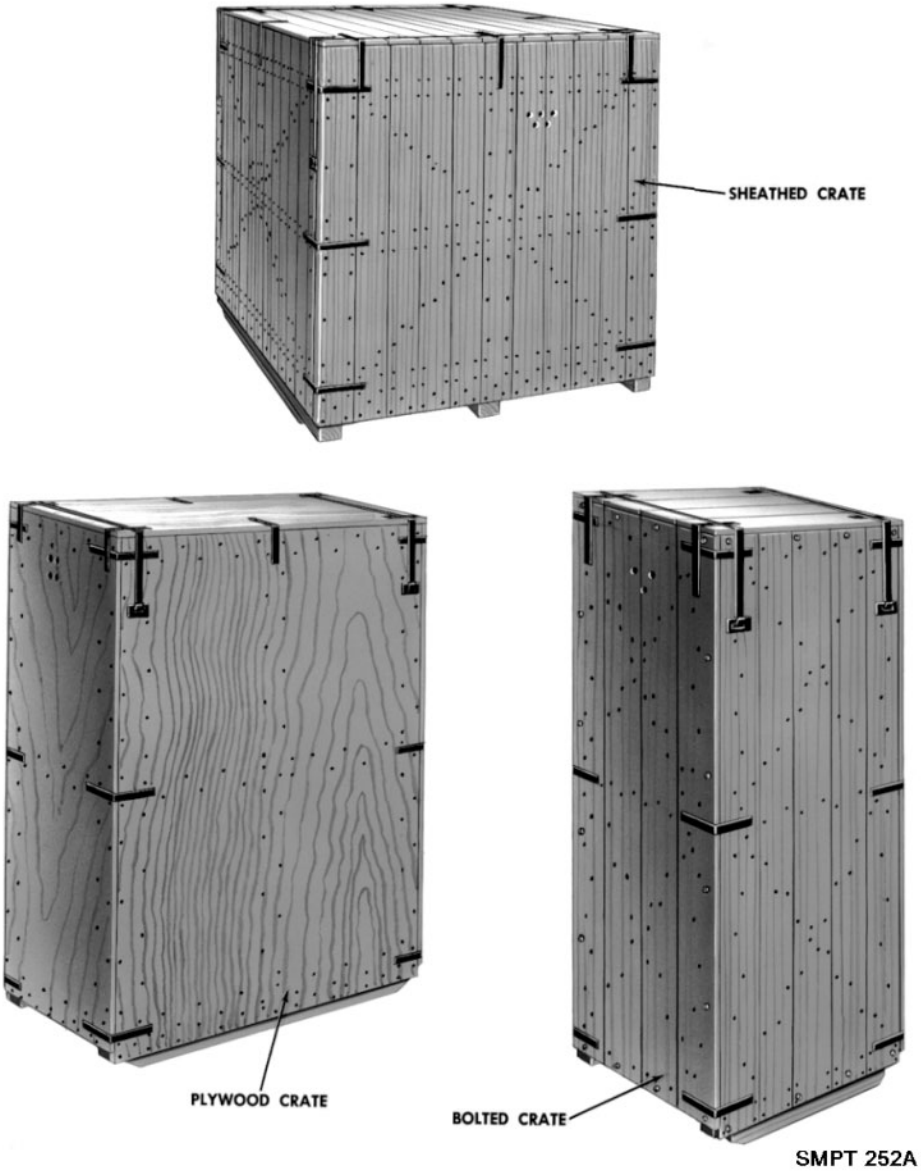


Figure 6-6. Sheathed crates.

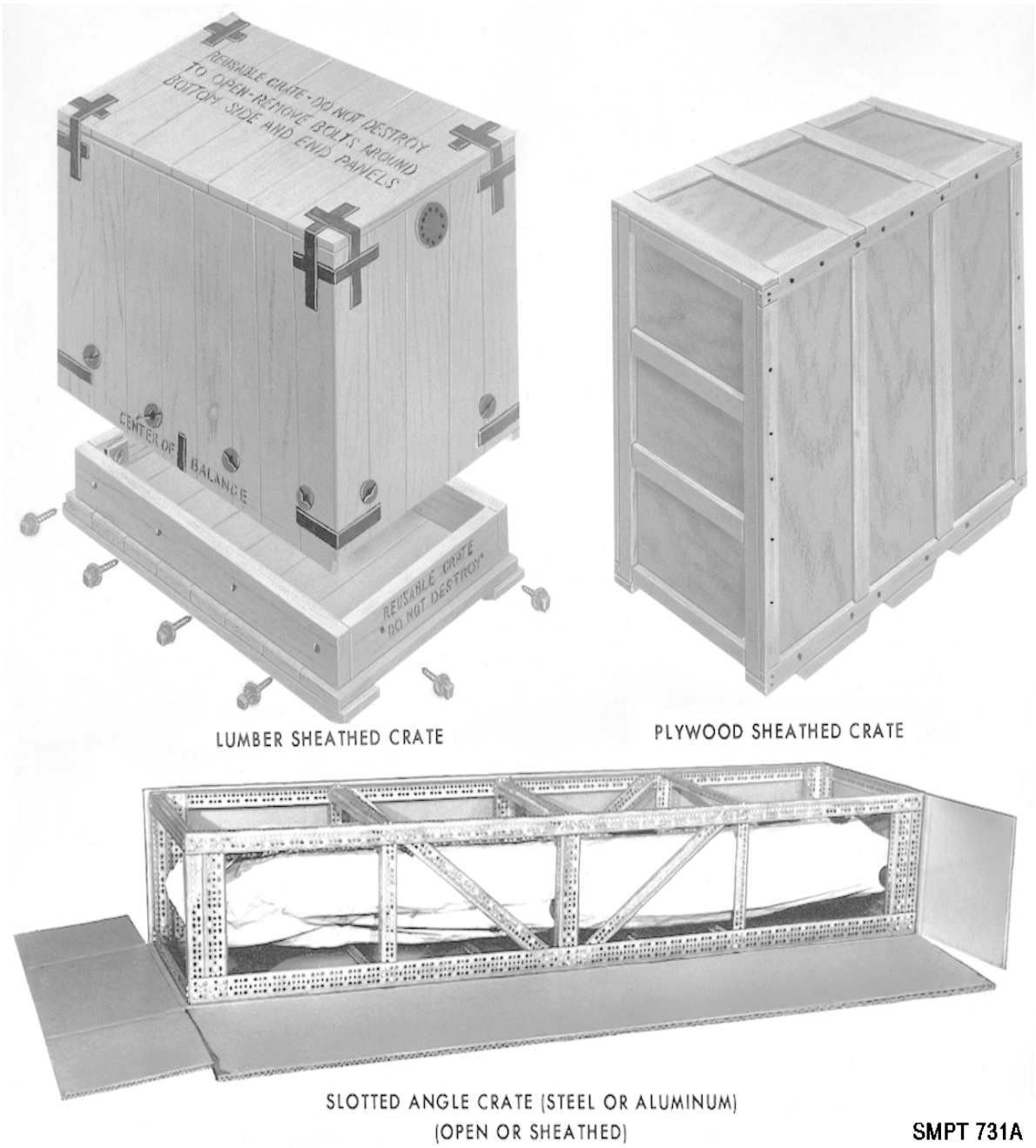


Figure 6-7. Special use crates.

Criteria for Crate Design

Crates are selected instead of boxes for several reasons. The item may be too large to be shipped in a box. The weight of the item may exceed the weight limitations of a box specification. The item may not require complete enclosure for protection, yet it may require crating to facilitate storage and handling. Crates provide better facilities for clearances, blocking, bracing, and anchoring of the item. To select the proper crate for the item or items to be packed, it is necessary to consider certain basic factors that may influence the selection.

Size and Weight

Basically, it is desirable to design a crate not to exceed 30 feet in length, 9 feet in width, and 10 feet in height, with a weight limitation not to exceed 11,200 pounds. This maximum size and weight is indicated because the length of 30 feet will permit lowering the crate through the average ship's hatch without excessive tilting. The 9-foot width and 10-foot height is designed for the average width and clearance limits for transporting by rail on a standard flat car. Taking the weight factor into consideration will permit ease of handling by the average ship's hoisting facilities.

Degree of Disassembly

When determining the size, weight, shape, and strength, considerations should be given to partial disassembly of the item or its components to reduce the overall size of the crate. However, do not disassemble the item to the point where special tools or personnel are needed to reassemble it.

Weight Distribution

In designing crates over 5 feet in length, weight distribution becomes an important factor. Whenever possible, the center of gravity of the contents should coincide with the geometrical center (center of balance) of the loaded crate.

Anchoring of the Contents

A thorough study of the contents should be made in order to insure that provisions are made for anchoring the contents within the crate to prevent damage during handling and shipment. When necessary, use cushioning and padding at points on the item where blocking, bracing, or strapping is used to prevent movement. Bolts, steel strapping, iron bands, rods and lumber holddowns are acceptable methods for anchoring and supporting the contents (fig 6-8). Some items are designed with packing and shipping in mind and are provided with holddown features. If the item does not have these characteristics, utilize the stronger areas of the item for anchoring.

Clearance

Normally, a minimum of one-inch clearance is required between the contents and the nearest framing member of the sides, ends, and top. This clearance allows for the distortion and vibration to which the crate may be subjected during rough handling and transit. Items that are fragile in nature, or items within floating bag barriers (submethods 53 and 43) require from 2 to 4 inches of clearance. Additional clearance may be required for shock mounted items. Through careful design, it is often possible to allow protruding points of the item to extend between the joists, or the joists may be spaced, within specified limits, to accommodate these protrusions.

Types of Bases

The selection of a skid or a sill base will depend on the physical characteristics of the item to be crated.

Sill Bases

Sill bases (fig 6-9) are designed for items that can be supported above their lowest point. Examples are transmission housing engines and vehicles with brake drums projecting below the frame or axles.

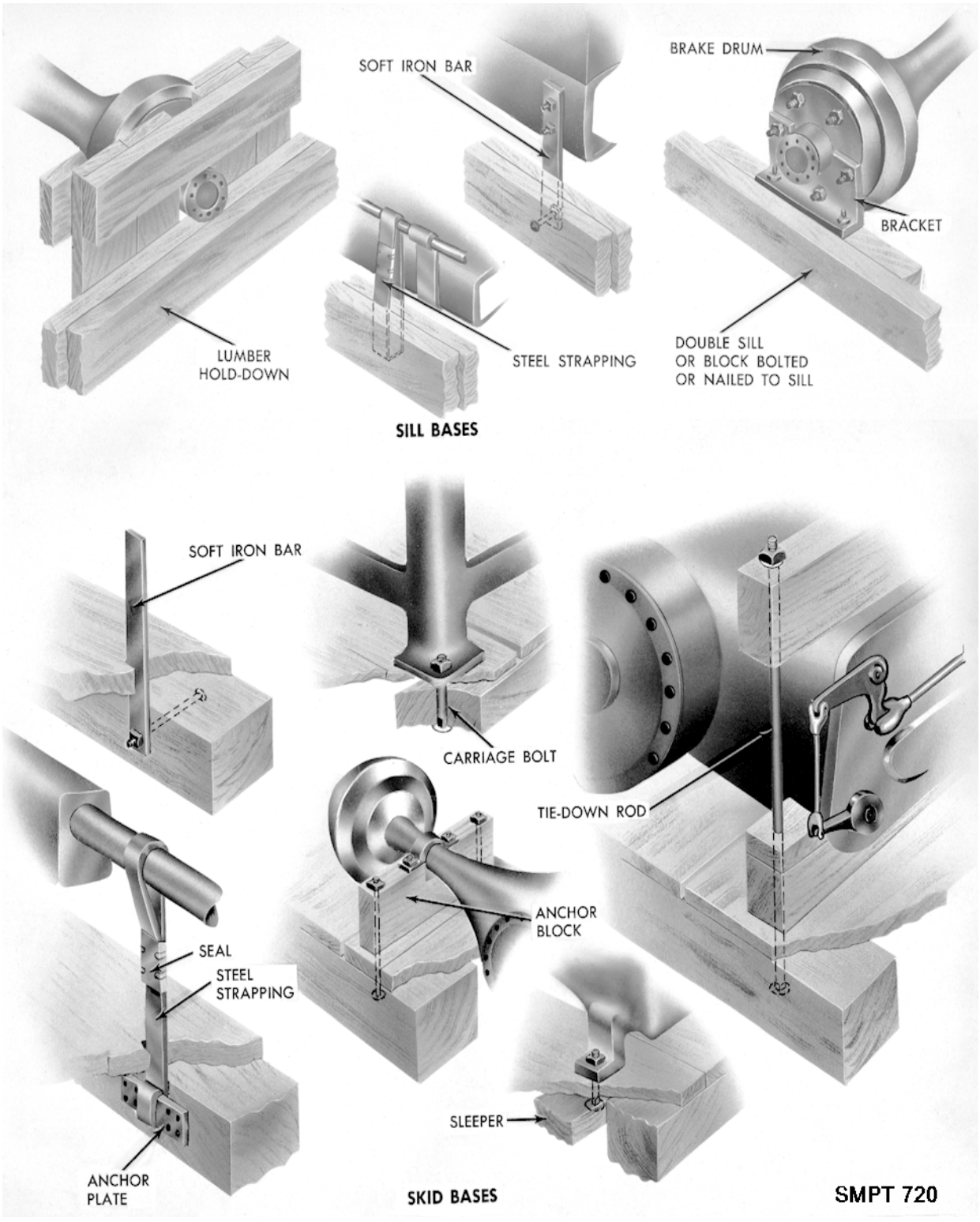


Figure 6-8. Methods of anchoring contents in crates.

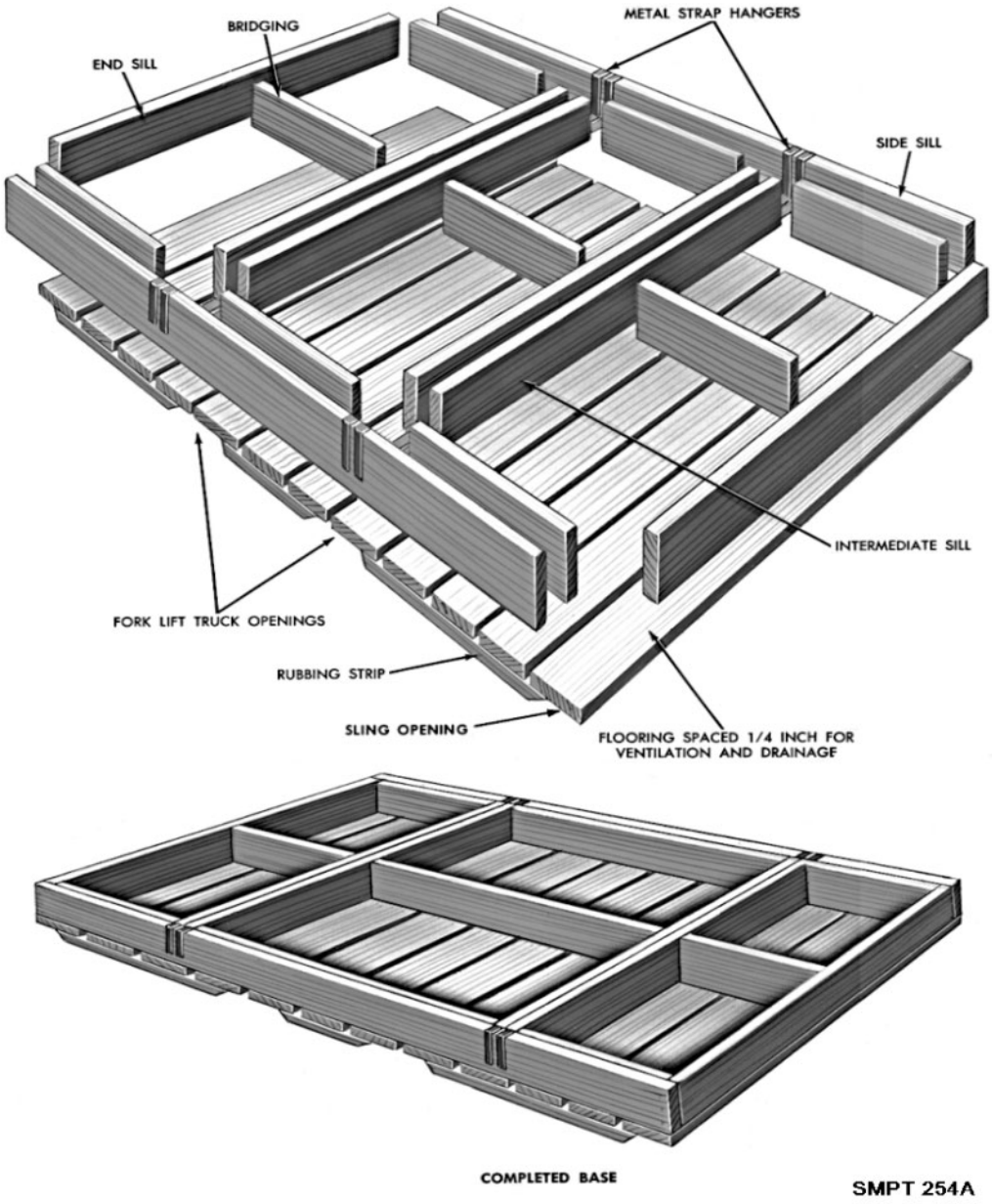


Figure 6-9. Sill base.

Skid Bases

Skid bases are designed to accommodate loads that can be supported on their lowest portion, or items that are made to rest flat on their bases. Skid-type bases are preferred in most cases; however, when the item must be supported above its lowest point, the use of a sill base will reduce the overall height of the crate. Savings in height should be more than 6 inches before substituting a sill base for a skid base (fig 6-10).

Engineering Factors in Crate Design

A crate is an engineered container. The use of sound engineering principles and actual tests of crates with contents has resulted in the following design requirements.

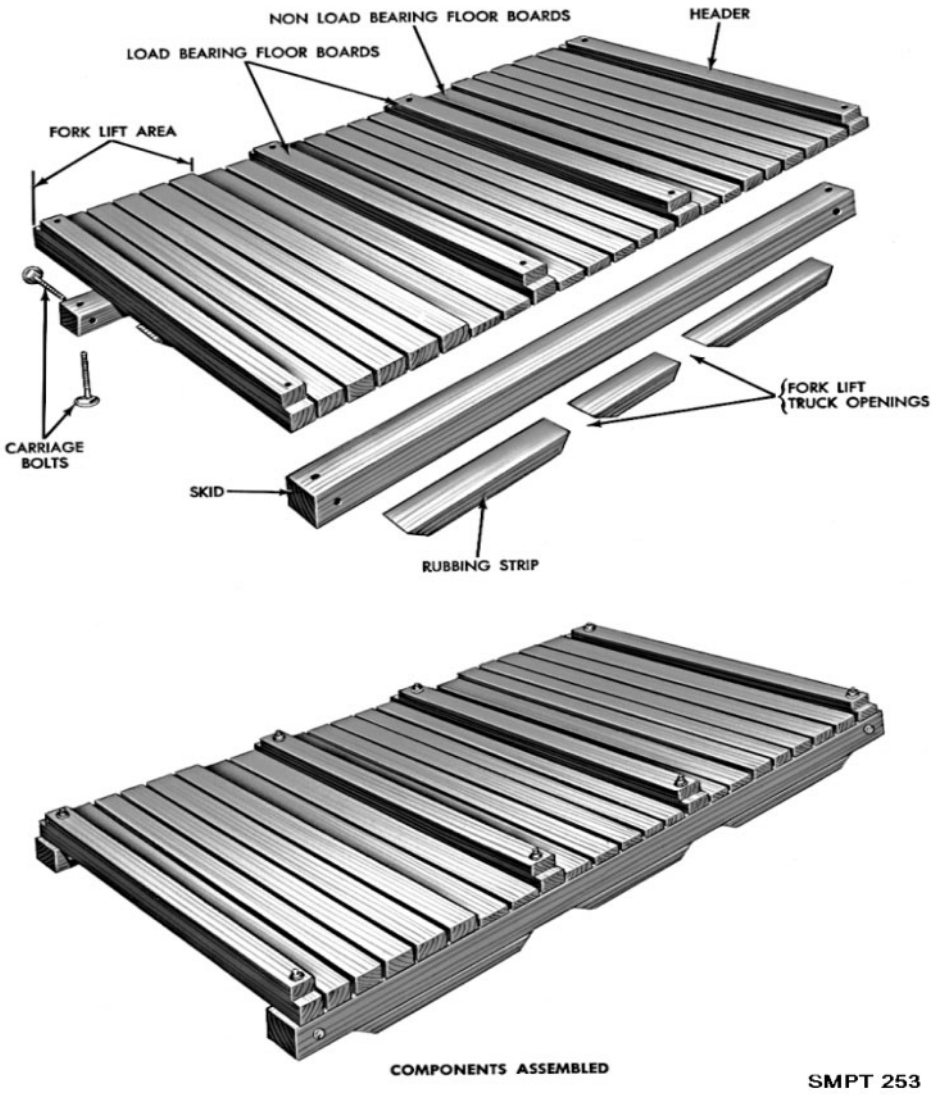


Figure 6-10. Skid base.

Tops

The top of a sheathed crate is designed to carry a uniform, well-distributed, superimposed load of 50 pounds per square foot. Top loading plus the span or width of the crate will determine the kind of top and the size of joist required to transfer the load to the sides.

Sides and Ends

For crate design, the side and end panels of sheathed crates are considered as trusses. The selection and size of members for the sides and ends are calculated on the bases of the span, height, and the amount of stress each member can withstand. These crate design factors are for sides having top loads, with dunnage, in the amount of 200 pounds per square foot, for net loads to 10,000 pounds. In addition, they may be designed for 400 pounds per square foot, for net loads over 10,000 pounds.

Bases

The base is treated as a unit and is designed to support the contents. In the engineering analysis, the skids of the base are considered as part of the lower frame members of the sides. The lower frame members and skids act together when the crate is lifted as a unit. This analysis allows the reduction of skid sizes, thereby saving materials and cube, but does not allow the handling of a loaded crate without the sides and ends in place. Skid sizes should be increased if it becomes necessary to raise or move the loaded crate without the sides and ends in place.

Load Factors and Handling and Storage Hazards

In addition to the external forces of superimposed loads and those imposed by the weight of the contents, crates are subjected to other hazards during handling and shipping. Crates are designed to be handled by forklift trucks, slings, and grabhooks (fig 6-11). In order to prevent crushing, the grabhook areas should be reinforced with additional material. For handling with forklift trucks, provisions are made to enter from the sides and ends without damaging the floorboards and contents. Forklift entry from the ends places stress on the headers, load bearing floorboards, and forklift members. Therefore, these members should be well secured with nails or bolts (fig 6-9 and 6-10).

Modes of Transportation

Crates may be shipped by rail, truck, plane, or ship. Some of the hazards involved in shipment are shock stresses and impact stresses resulting from sudden stops and starts. Vibration is also a shipping hazard. Crates shipped on open cars shall always be fastened securely to prevent any movement. In closed cars, there are several preferred methods of loading, some of which allow movement under controlled conditions. The preferred methods are the snubbed load, the floating load, and the rigid braced load. The method selected depends upon the fragility, size and shape of the item, and the center of gravity of the loaded crate. The snubbed load utilizes antiskid plates, while the floating load depends entirely upon the friction between the crate and the car floor. These loads are designed for items with a low center of gravity. The rigid braced loads utilize lumber and metal straps. This material should be applied in such a manner as to eliminate all movement. Shiploading involves stacking load stresses. Dunnage should be placed on top of crates, which have been designed to carry such loads.

Exposure and Storage

Sheathed crates will provide for long-term protection in exposed storage conditions. Open crates are designed for items that require very little protection from the elements. Sites selected for outside storage should be well drained in order to prevent water and moisture form entering the crate. Well constructed tops, proper drainage, and ventilation should prevent damage to the contents when stored under adverse conditions. Stacking stresses of superimposed loads are of major importance in storage. Open crates are designed to withstand superimposed loads in storage with additional dunnage placed on the top, transferring the load to the sides.

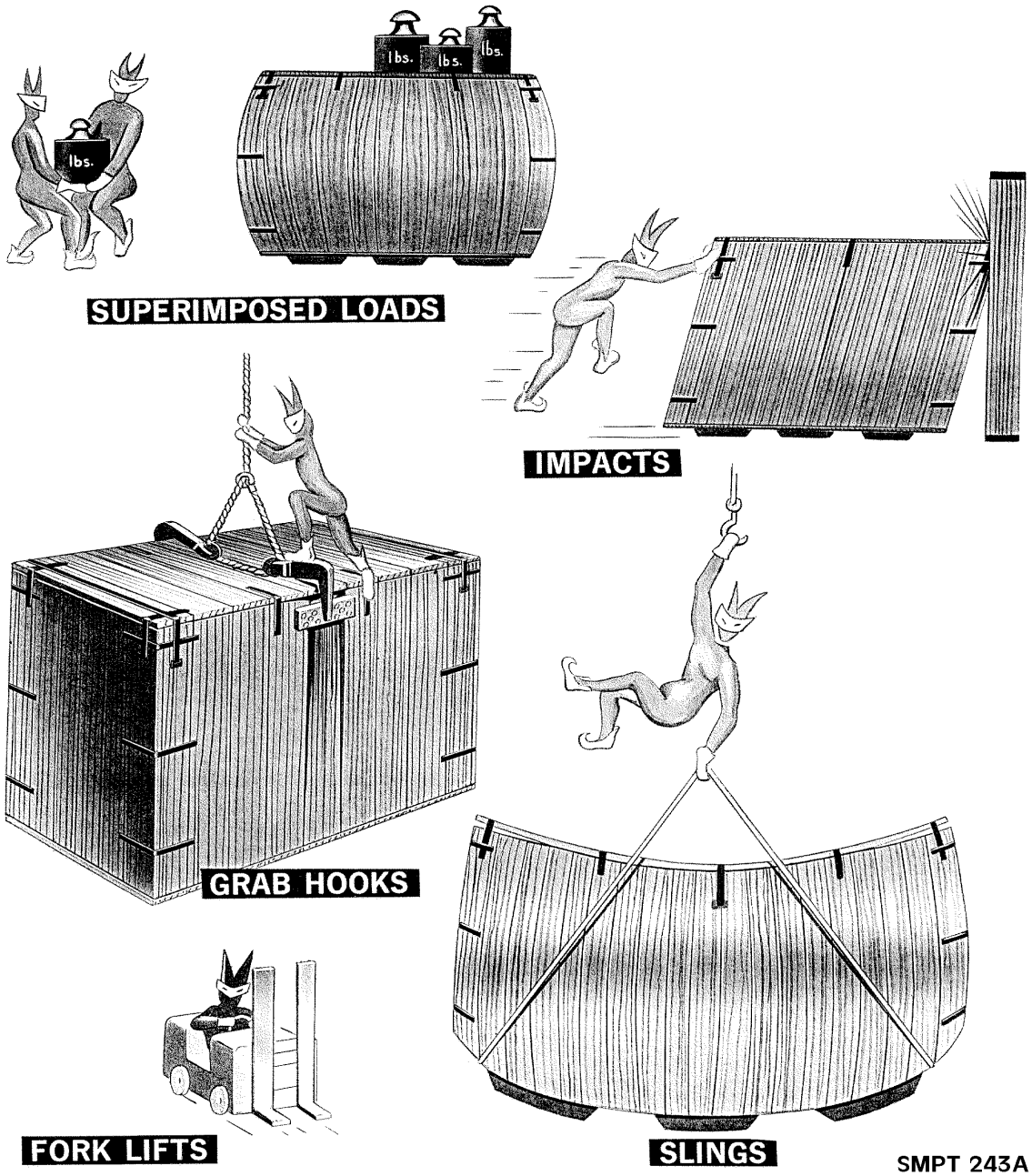


Figure 6-11. Resistance to forces.

CRATE MATERIALS

LUMBER

Lumber used in crate construction must meet the same rigid requirements as for other wooden containers. Lumber used in crate construction shall be free of defects that would materially weaken the container. Knots and divergence of grain (cross-grain) are probably the most common defects in lumber used for framing members, and will affect the strength of these members more than the sheathing boards. Knots or knot clusters that exceed one-fourth the

width of a structural member or that exceed one-third the width of a sheathing board, are prohibited.

Moisture content of lumber is an important factor and shall be not less than 12 percent nor more than 19 percent of its oven dry weight. Otherwise, shrinkage may occur and nail holding power may be reduced.

Divergence of grain (cross-grain) more than 1 inch in 10 inches in the length of a piece is prohibited.

The width and thickness of lumber used in fabricating crates are always minimum from a design standpoint. When nominal sizes are given in a crate specification, the actual minimum sizes will be as indicated in table 6-1.

Note. All lumber dimensions referenced in this section are nominal. Actual dimensions are so indicated when actual sizes are required.

Table 6-1. Minimum Thickness and Width of Lumber

Thickness in inches (smaller dimension)		Width in inches (larger dimensions)	
Nominal size	Minimum (actual)	Nominal size	Minimum (actual)
1	3/4	2	1-1/2
		3	2-1/2
2	1-1/2	4	3-1/2
3	2-1/2	5	4-1/2
4	3-1/2	6	5-1/2
5	4-1/2	8	7-1/2
6	5-1/2	10	9-1/2
7	6-1/2	12	11-1/2

Plywood (A-A-55057)

Plywood is used in crate construction for sheathing, for nonload bearing flooring, for tops, and gusset plates. While plywood is usually more expensive than lumber, it required no diagonals or crate liner material when used as sheathing, and a lighter, more economical crate may result from its use. Tests have shown that plywood is actually stronger than lumber, the dimensions being the same. When using plywood, select the standard size sheet stock that conforms closest to the crate dimensions, otherwise waste of material will result. The type of plywood selected will be on the basis of its intended use. Where prolonged exposure to the elements or attack by micro-organisms (mold, fungi, etc.) is expected, materials, must be selected that will withstand the extreme conditions.

Nails (ASTM F 1667-95)

Nails are used in the fabrication of the components for both nailed and bolted crates. They are also used in the assembly of nailed crates. The preferred types of nails used for crate assembly are the sinker, corker, or common. If these nails are not available, coolers or standard box nails may be used. Nails used for fastening plywood should be 14-gage with heads no less than 7/32-inch diameter.

Staples (ASTM F 1667-95)

Staples are sometimes used to fasten plywood sheathing to the framing members. When used for this purpose, staples should be made of 16-gage wire with a crown not less than one-half inch.

Bolts, Nuts, and Washers

Many types of bolts are used in crate construction. The most common types used are standard steel carriage, step, and machine bolts (fig 6-12). Bolt holes should be drilled the same size as the shank of the bolt. Plain washers should be used under the heads of the machine bolts and under all nuts. Special holding plates have been designed for use under the heads of square shank bolts to prevent turning. The use of plates is not mandatory. Countersinking of bolt heads is prohibited. The bolt threads projecting beyond the nut after tightening should be painted with hard drying preservative, unthinned paint or other similar material to prevent loosening.

Lag Bolts

Lag bolts are sometimes referred to as "lag screws". There are three types of lag bolts, Gimlet Point; Cone Point; and Cone Point, Fetter Drive (fig 6-12). There are two different types of heads, Hex head and Square head. Lag bolts are used to assemble the sides, ends, an tops of demountable crates. These bolts are prohibited for use as holddowns or to tie the headers and the floorboards to the skids. When using lag bolts for assembly, drill the lead hole to the same diameter as the shank, although the threaded portion may be larger than the shank. The size of the lead hole for the threaded portion will depend upon the group of wood used. When using lag bolts in soft woods, make smaller lead holes. Use plain washers under the heads and tighten firmly against the washer (table 6-2).

Note. Lag bolts should never be driven with a hammer. When power wrench is used, care must be taken that the bolts are not overdriven.

Nut Sleeve Assembly

A nut sleeve assembly, as illustrated in figure 6-13, may be used as an alternate for lag bolts in demountable crates. These bolts must be the same size as the fasteners they replace and are spaced the same distance apart.

Metal Strapping (ASTM D 3953 and ASTM D 4169)

Metal strapping is used for reinforcing crate corners, sill bases, securing tops, as lag bolts reinforcing straps for demountable crates, and for strengthening sill and load bearing headers for sill-type bases. It is also used to reinforce crate corners and the tops of open crates. Metal straps used for this purpose shall be Class 1 Type I or II, and not less than 3/4 x 0.028-inch (fig 6-14).

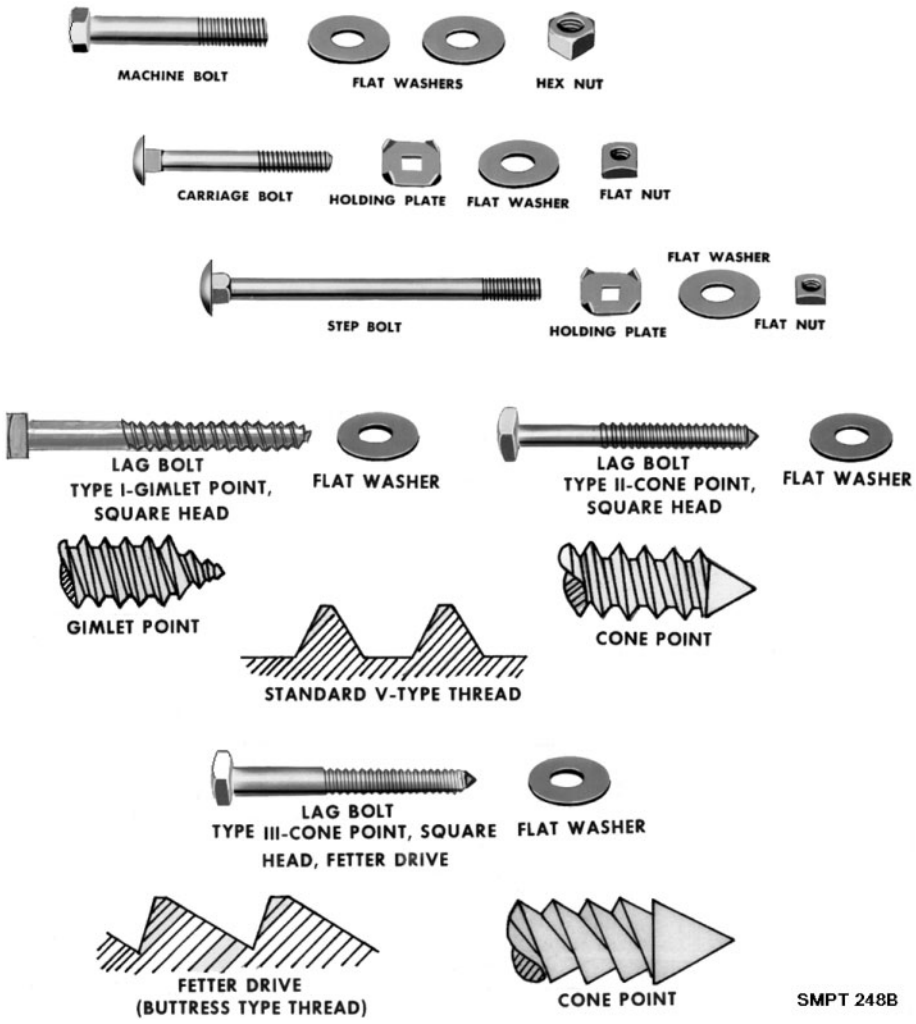


Figure 6-12. Bolts, screws, and accessories.

Table 6-2. Application of Lag bolts

Diameter of threaded portion of lag bolts	Diameter of lead hole	
	Groups I, II and III wood	Group IV wood
Inch	*Inch*	*Inch*
1/4.....	3/16	3/16
5/16.....	1/4	1/4
3/8.....	1/4	5/16
1/2.....	3/8	7/16
5/8.....	3/8	1/2
3/4.....	1/2	5/8

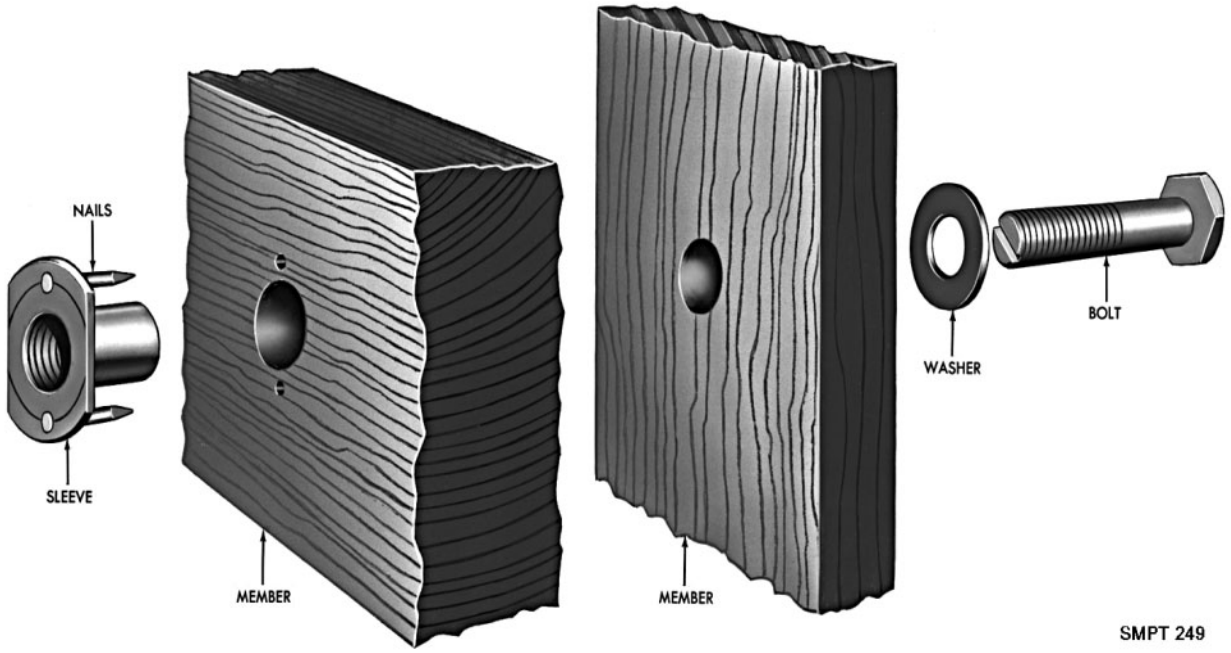


Figure 6-13. Nut sleeve assembly.

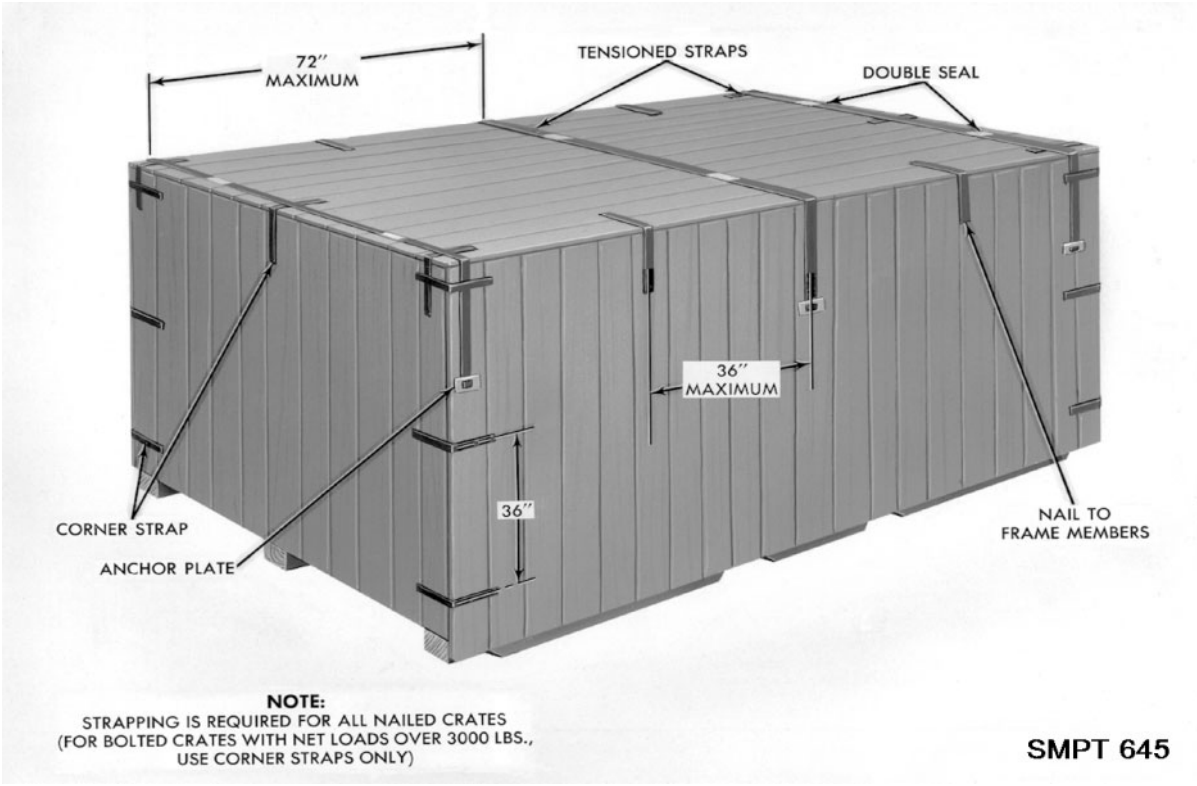


Figure 6-14. Tension and corner strapping.

Corner Straps

Metal strapping used for reinforcing tops, corners, and sill-type bases is usually annealed and predrilled for ease of application. This type of strapping is used on all nailed crates and on bolted crates with net loads over 3,000 pounds. The legs of the corner straps are usually 8 inches in length. They are nailed to the frame members with a minimum of three galvanized roofing nails, 1 1/4 to 1 1/2 inches long. The straps are spaced no more than 36 inches apart.

Tension Straps

Tensions straps are used to secure the top to the sides of the crate by anchor plates, which are nailed to the frame members. The straps are drawn tight with a tensioning device and held in tension with two seals. Tensions straps are spaced no more than 6 feet apart.

Lag Bolt Reinforcing Straps

This strap is fabricated from galvanized steel and is used on the side and end panels of many demountable crates to prevent the lag screws from tearing through the sheathing as the crate is lifted. The strapping material is prepunched or predrilled. Lag bolts 3/8 inch in length require 1 1/4 X 0.035 inch straps. For 1/2 inch and 5/8 inch lag screws, 2 X 0.050 inch straps are needed. Nail these straps to the lower inner face of the sheathing between the lower edge of the bottom frame member and the bottom of the sheathing. Locate them to coincide with the center of the skids and headers. Use clout or similar nails to secure the strapping. Space the nails a maximum of 2 inches on center and clinch at least three-fourths of an inch (fig 6-15).

Metal Hanger

Metal hangers are used for reinforcing joists of tops, load bearing headers, and intermediate sills on sill-type bases. Hangers are fabricated from steel straps 1 1/4 X 0.035-inch. The strapping material is prepunched or predrilled. When used to reinforce load bearing headers or intermediate sills, eightpenny nails are used to secure straps in place, followed by driving from two to four twentypenny nails into the end-grain of the holding member (fig 6-16).

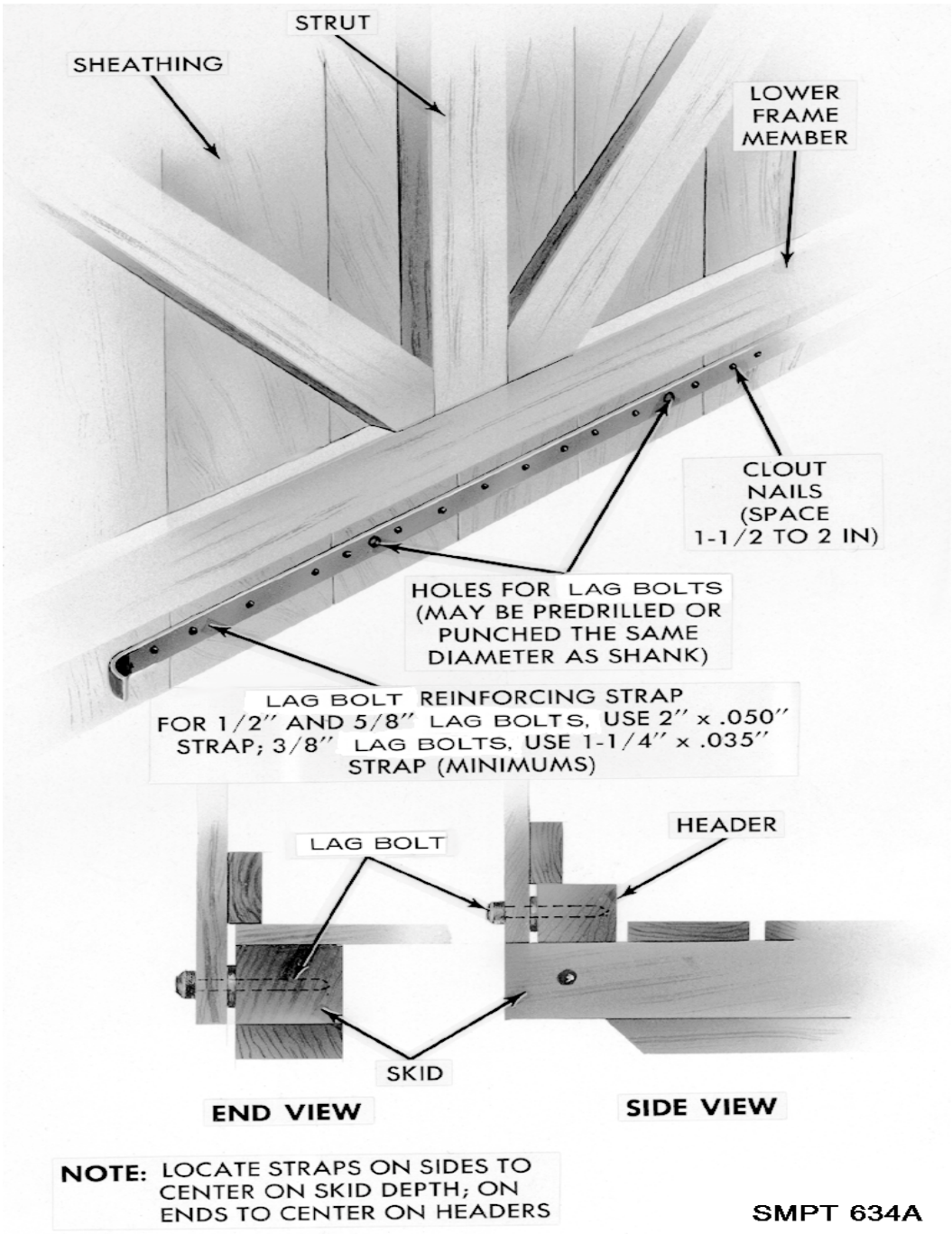


Figure 6-15. Lag bolt reinforcing strap.

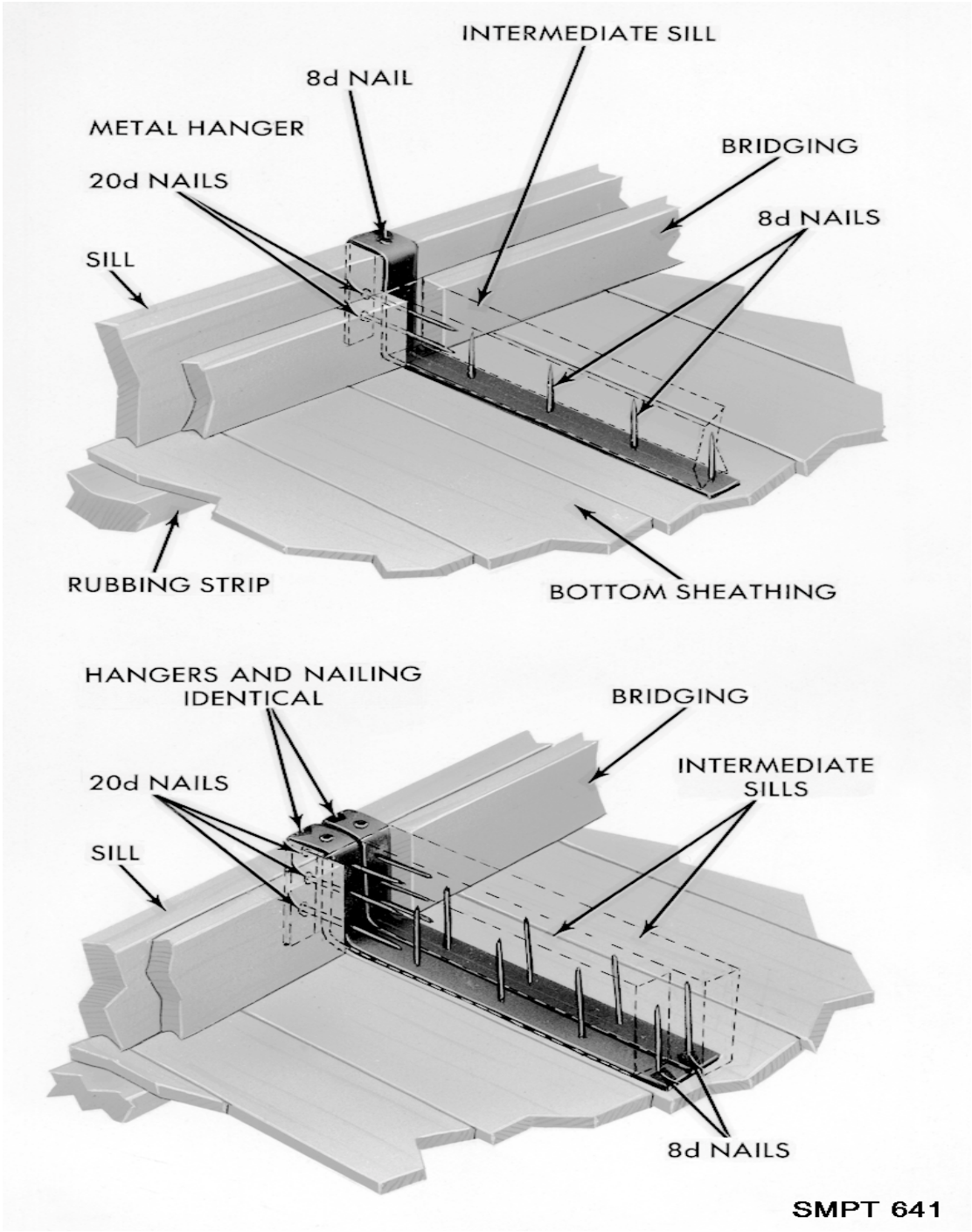


Figure 6-16. Use of metal hangers.

Sill Base Straps

In addition to the straps applied to other areas of the crate, sill bases must be reinforced with 3/4 X 0.028-inch metal straps (fig 6-17). Use a minimum of three galvanized roofing nails 1 1/4 to 1 1/2-inch long in each leg of the strap. Locate all nails to penetrate a framing member.

Waterproof Liners and Shrouds (PPP-B-1055)

This waterproof barrier material is made by laminating layers of kraft paper with asphalt. Seven different classes of materials may be used for crate liners. The most common classes used are E-1, E-2, and C-2. This material, when used as a liner, is placed horizontally between the sheathing and the frame members of the sides and ends. If more than one width of material is required, use a minimum of 4-inch shingle lap for proper drainage. The barrier should cover the entire framed area (fig 6-18) and 6-19). When vertical joints are required, the 4 inch lap will be located at a vertical member. Liners are not required for plywood sheathed crates. Interior shrouds, large bags, or envelopes fabricated from waterproof barrier material are used in open crates to cover items which require additional protection. All sharp projections of the item should be cushioned or padded to prevent puncturing the material. The class of material to use is optional, although the most common class is E-2. All joints in the material are made by using MMM-A-260 adhesive. Shrouds should hang free of the item to provide proper ventilation and should extend to within 6 inches of the bottom of crate. Material conforming to Specification L-P-378 may also be used for interior shrouds. This material is constructed of polyethylene and does not contain asphalt (fig 6-18 and 6-19).

Roofing Felt

Roofing felt is used in the construction of tops for sheathed crates. This material should have a smooth uncoated surface with a minimum weight of 45 pounds per square (a square is an area of 10 feet by 10 feet, or 100 square feet). The material is placed between the outer lumber sheathing and inner plywood sheathing of the top as illustrated in figure 6-60. When a joint is required, overlap the felt 4 inches and seal with a non-hardening caulk or mastic compound. As an alternative, polyethylene film, not less than 4 mils thick, may be used in place of roofing felt.

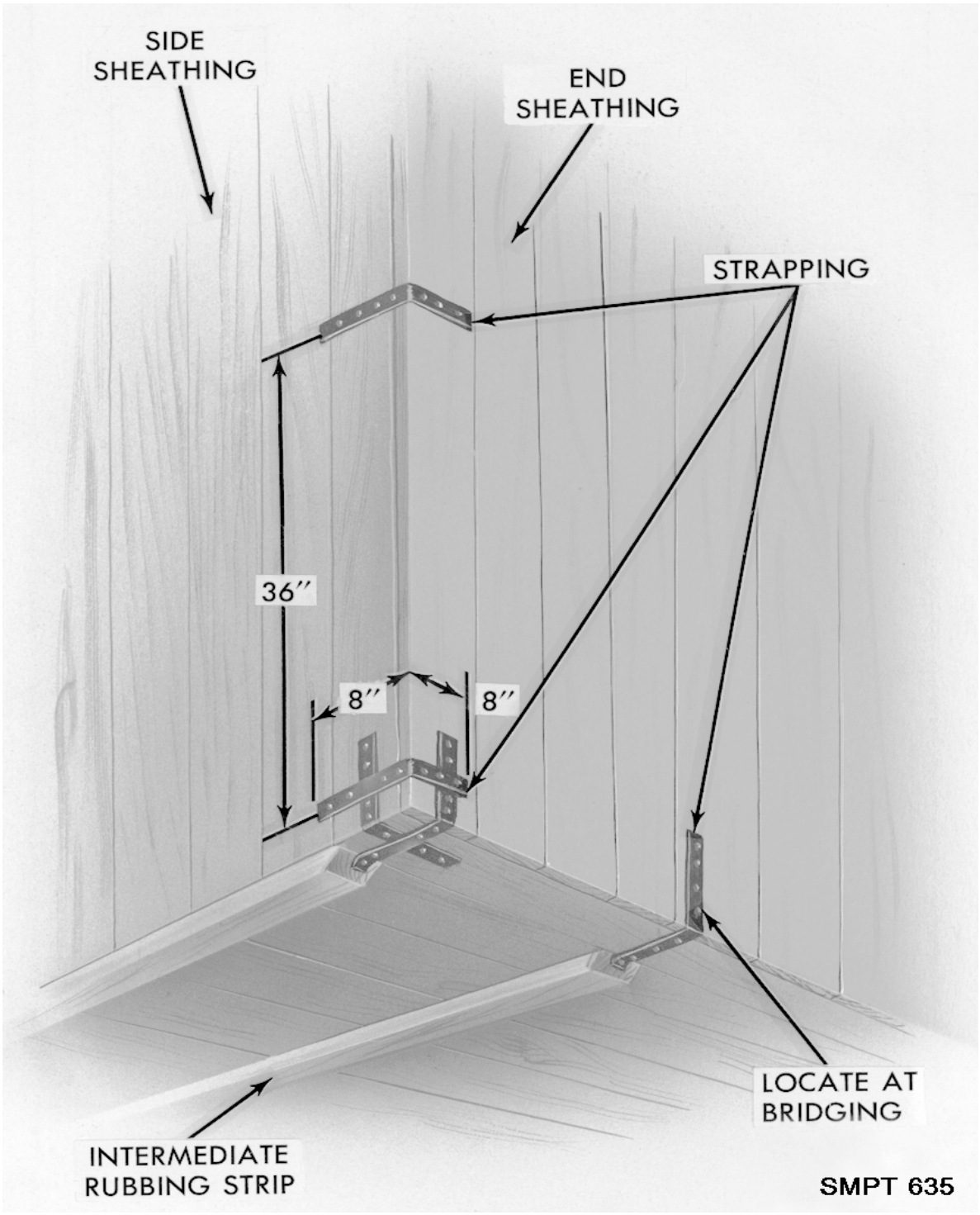


Figure 6-17. Application of strapping (sill base).

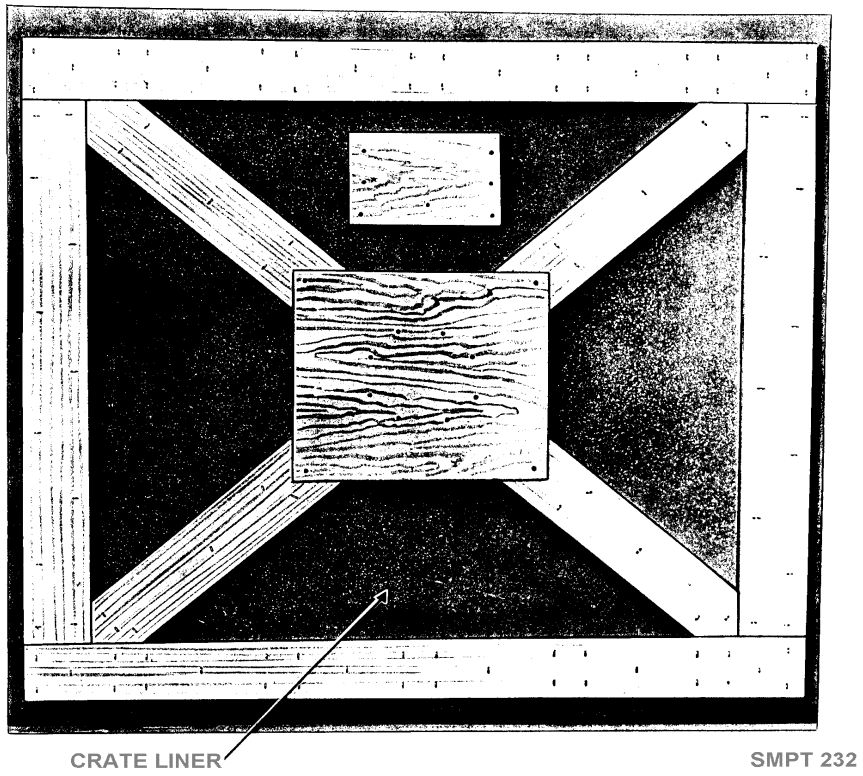


Figure 6-18. Crate liner.

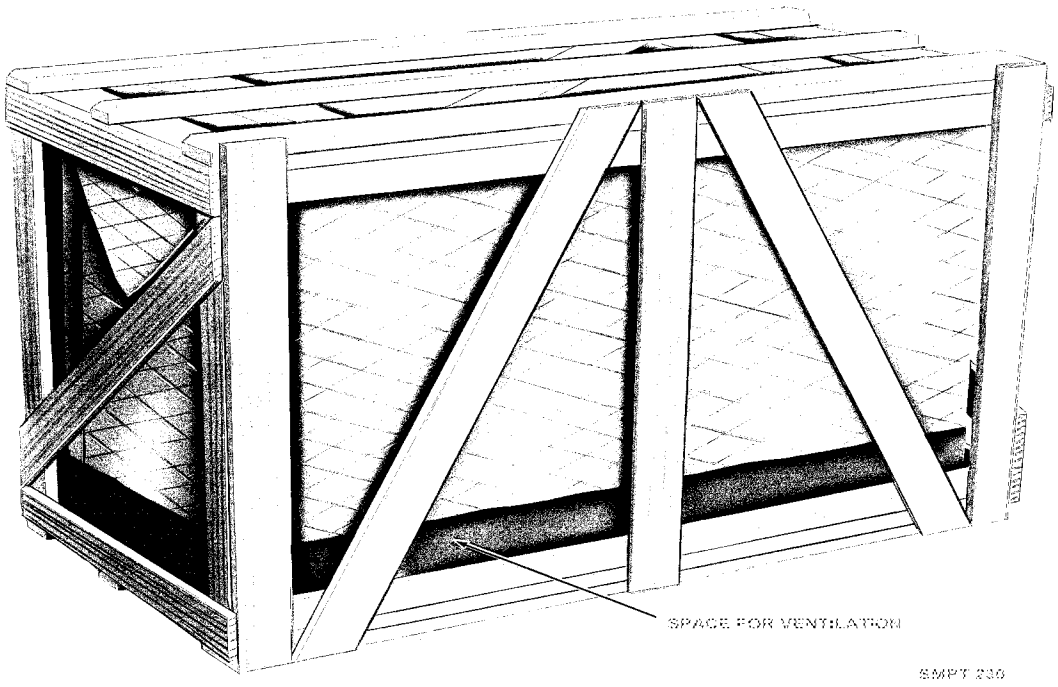


Figure 6-19. Interior shroud.

Screens and Ventilators

Screens are fabricated from heavy rust-resisting wire of 1/4 or 3/8 inch mesh and used over ventilating and drainage holes to prevent entry of birds, insects, rodents, or other animals. Ventilators fabricated from metal are sometimes used over ventilating holes. Some of the most common methods are illustrated in figure 6-49.

Inspection Doors

When inspection doors are required, they are made without cutting into the framing members. Doors are fabricated form the same material as the sheathing. Hinge at the top and fasten with lag bolts or wood screws at the sides and bottom (fig 6-20). Make cleats and stops from 1-inch material. Drill holes through the door and adjacent frame member to provide for a seal wire and lead seal bearing the inspector's stamp. The size and location of the doors will vary with the nature of the item.

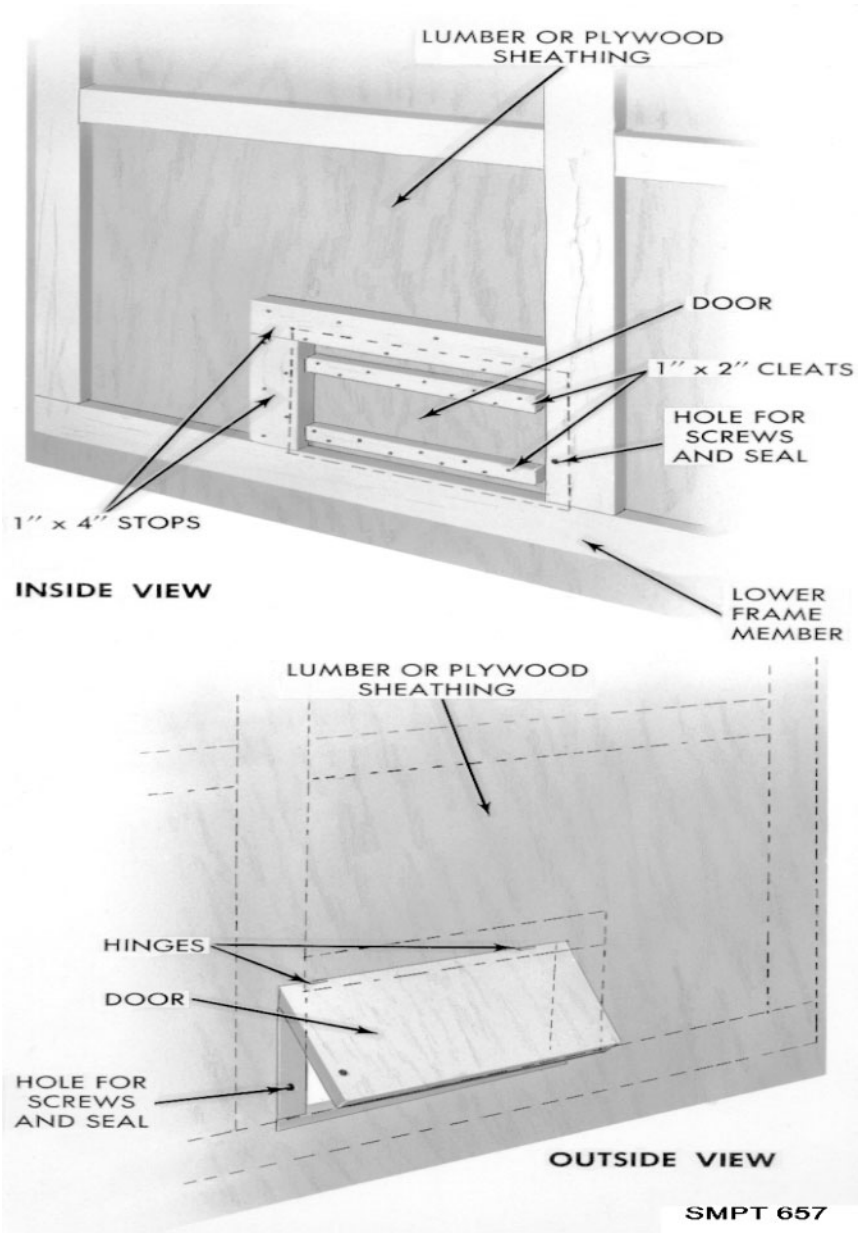


Figure 6-20. Crate inspection door.

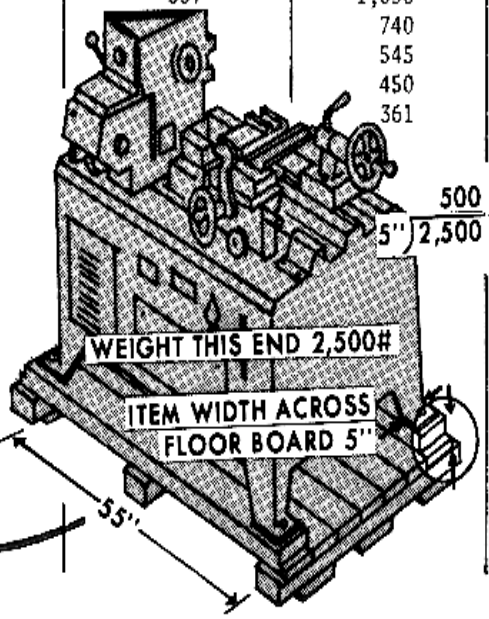
WOOD CRATES, OPEN AND COVERED, MIL-C-52950 (GENERAL)

CRATE DESIGN

Open wood crates described in this section are designed for general use and are employed for both domestic and oversea shipments. Only items which are not readily damaged from outside forces and which require limited protection should be shipped in open crates. Usually, items which are designed for outdoor use or of rugged construction are shipped in open crates. When there are a variety of items to be shipped, each crate will be designed for each item with the necessary clearance for blocking, bracing, and cushioning (fig 6-21).

ALLOWABLE LOAD PER INCH OF FLOORBOARD
WIDTH OF GROUPS I AND II WOODS (MIL-C-52590)

LENGTH BETWEEN SKIDS (IN.)	THICKNESS OF LOAD BEARING FLOORBOARDS (IN.)				
	1"	3"	4"	(6")	8"
	pound	pounds	pounds	pounds	pounds
12	50	557	1,090	2,690	4,680
18	34		740	1,790	3,140
24	25		545	1,350	2,330
30	20		450	1,150	1,870
36	17		361	895	1,560
42	15			767	1,335
48	12			671	1,170
54	11			596	1,039
(60)	10			(537)	936
66	9			488	850



[1]If group IV woods are used, the above allowable loads may be increased by 20 percent.
[2]Wood thicknesses shown are actual nominal thicknesses.

JMPTC 2983

Figure 6-21. Use of table to determine thickness of load bearing floorboards.

Classification

Crates fabricated or procured under MIL-C-52950 on the basis of weight, size, and construction features, as indicated in table 6-3.

Wood Requirements

The divergence of grain (cross-grain) should not exceed one inch in ten inches of length. Plywood, when used, will conform to A-A-55057.

Nails and Nailing

Nails used shall be sinkers, coolers, corkers, or common. For fastening covering materials to members, nails shall be not less than 1 inch long but shall not exceed the sum of the thickness of the covering material and member. Nails sizes specified for the fabrication of the various crates are based on Groups I and II woods.

When group III or IV woods are used, nail sizes may be onepenny size smaller than those specified. The patterns to be used for the nailing of two flat pieces of lumber shall conform to the details shown in figure 6-22. Unless otherwise specified herein, the following requirements shall determine size, placement, and quantity of nails.

- All adjacent crate members shall be securely fastened to each other, either directly or by means of the covering.
- All nails that are not to be clinched shall be cement coated or mechanically deformed (spiral or round threaded).
- Nails shall be driven through thinner member into the thicker member wherever possible.
- When the flat faces of pieces of lumber are nailed together and the combined thickness is 3 inches or less (except for top joints and covering material), nails shall be long enough to pass through both thicknesses and shall be clinched not less than 1/4 inch nor more than 3/8 inch.
- When the flat faces of lumber are nailed together and the combined thickness is more than 3 inches or when the flat face of one or more pieces is nailed to the edge or end face of another, nails shall not be clinched. The portion of the nail in the thicker piece shall not be less than 2 times the length of the nail in the thinner pieces for tenpenny nails and smaller, and not less than 1 1/2 inches for twelvepenny nails and larger.

    - When splitting occurs with the use of diamond point nails, the nails shall be slightly blunted. When blunting does not prevent the splitting, holes slightly smaller than the diameter of the nail shall be drilled for each nail.
    - Nails shall be driven so that neither the head nor the point projects above the surface of the wood. Occasional overdriving will be permitted, but nails shall not be over-driven more than one-eighth the thickness of the piece holding the head.

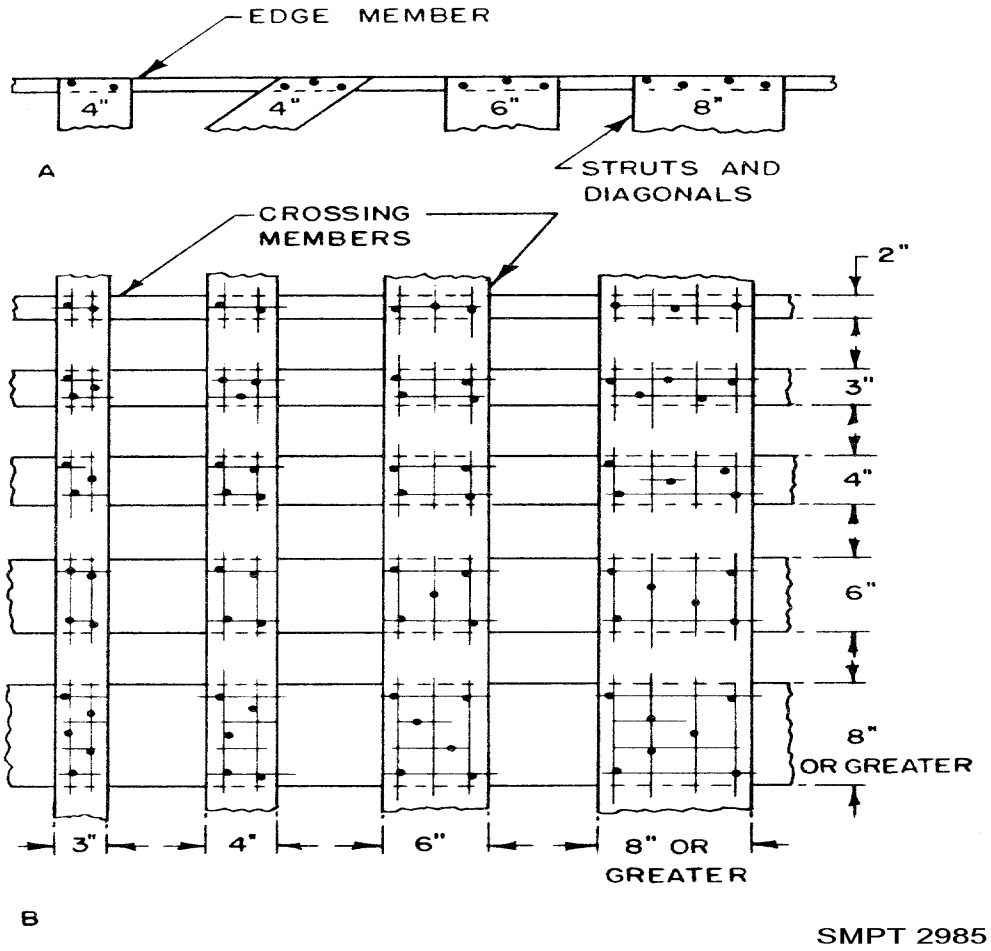


Figure 6-22. Nailing patterns. (All widths nominal). Similar patterns shall be used when boards cross at angles other than 900.

Table 6-3. Classification of MIL-C-52950 Crates

Type	Style A - Heavy Duty				Style B - Light Duty			
	Maximum net load	Maximum Inside Dimensions			Maximum net load	Maximum Inside Dimensions		
		Length	Width	Height		Length	Width	Height
	(pounds)	*(feet)*	*(feet)*	*(feet)*	*(pounds)*	*(feet)*	*(feet)*	*(feet)*
I	250	4	3	3	200	4	3	3
II[1]	1000	12	4	2	NO STYLE B			
III	NO STYLE A				No load or size restriction except as limited by handling methods.			
IV	1000	6	4	4	NO STYLE B			
V[2]	2500	12	6	6	4000	32	6	10

[1]Items such as ladders, tubing, and extrusions weighing less than 200 pounds and not exceeding 20 feet long, 3 feet wide, and 2 feet high may be packed in Type II crates.
[2]Type V, Styles A and B crates shall be further classified as being nondemountable or demountable. Type V, Style B crates may be open or covered.

- Nails shall be positioned not less than the thickness of the piece from the side end nor less than one-half the thickness of the piece from the edge of the lumber whenever possible. Nails driven into the side edge of the lumber shall be centered on the side edge.
- When two members having parallel grain are attached, the number of rows of nails shall be determined by the nominal width of the surfaces in contact, one row for widths up to and including 2 inches, two rows for widths greater than 2 inches but not greater than 6 inches, and three rows for widths over 6 inches.
- When plywood is nailed to cleats, nails shall be spaced not more than 4 inches apart on centers placed in staggered rows which are less than 1 3/4 inches apart or less than 3/4 inches from the edge of the cleat.

Staples

The crown of the staples used for fastening covering materials for frame members shall be not less than 3/8 inch. The length of the staples shall not exceed the sum of the thicknesses of the covering materials and the frame member; however, staples shall be not less than 1 inch in length.

Bolt application

Holes shall be prebored to receive carriage bolts and shall be the exact diameter of the bolt. The lead holes for lag bolts shall be the same diameter as the shank, even though the threaded portion may have a greater diameter than the shank.

Splices

Splices and butt joints made in frame members and skids of long crates shall be as shown in figure 6-23.

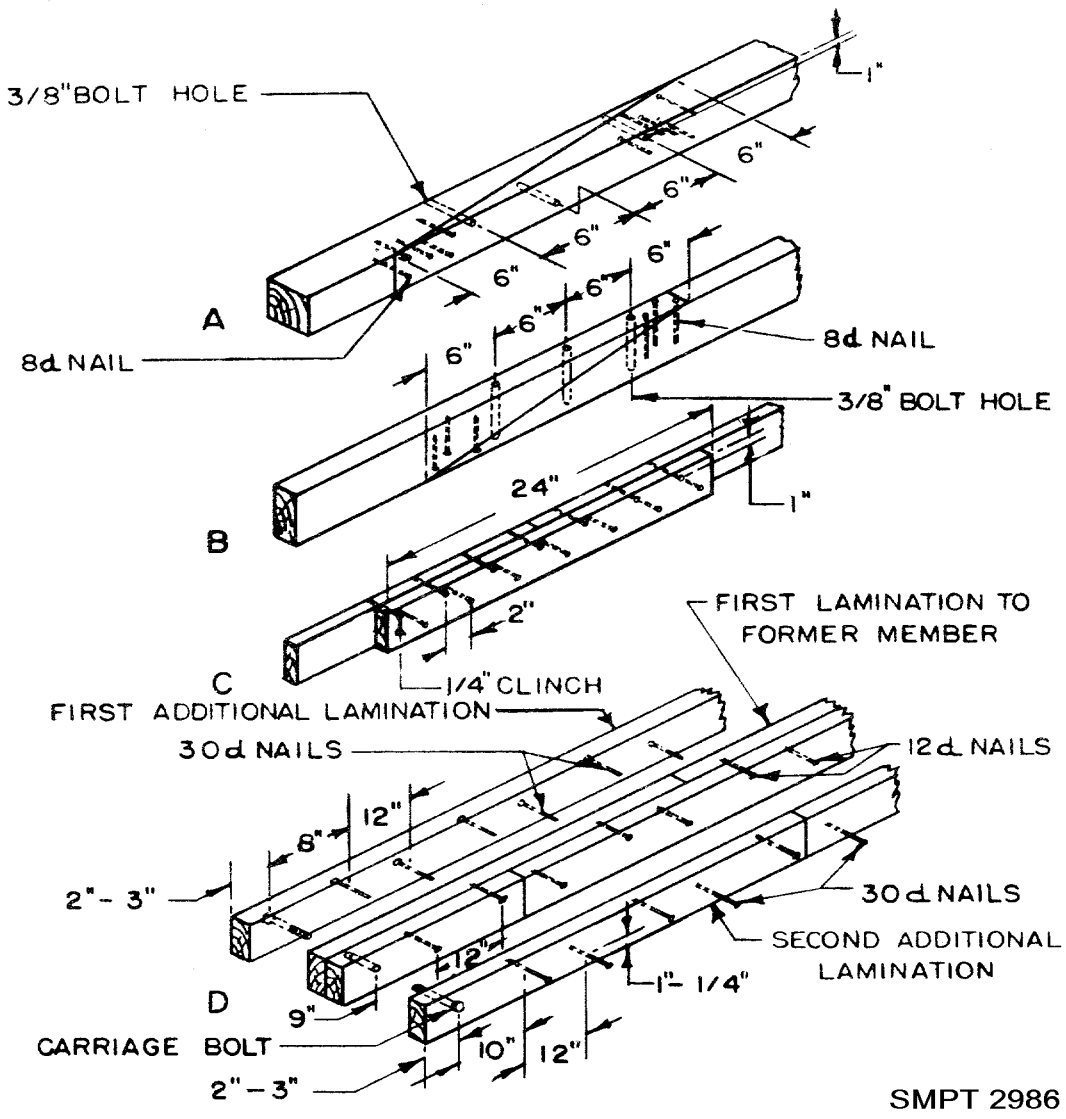


Figure 6-23. Splicing of members: A, splice of 4 x 4 inch or 4 X 6 inch skids; B, splice of 2 inch member; C, splice of 1 inch member; D, lamination of skid.

TYPE I, STYLE A - HEAVY DUTY CRATE (MIL-C-52950)

DESIGN REQUIREMENTS

Load and Size Limitations

Limitations shall be as specified in table 6-3.

Style A crates shall be used only for items forming a Type I load and weighing not more than 250 pounds.

Base

Skids

The skids shall be 2 by 4 inch lumber.

Diagonals

Diagonals shall be 1 by 4 inches in size.

End Floor Members

End floor members shall be the same thickness and width as the skids except when used as loadbearing members; their size shall be as specified in table 6-4. End floor members shall be bolted to each skid with 3/8-inch diameter carriage bolts.

Rubbing Strips

Single piece rubbing strips used on each skid shall be a minimum 3 by 4 inches in size and beveled at each end at an angle of 45 degrees for at least one-half their thickness. The length shall be less than the skid length to allow open space at each end for sling and fork lift handling. The open space shall be not less than 4 inches and not more than 10 inches long. On crates over 36 inches long, the rubbing strip length shall be adjusted to provide a distance of not more than 28 inches between end openings.

Side, End and Top Panels

All members of the side, end and top panels shall be 1 by 4 inch lumber. Nailing patterns shall be as specified in figure 6-22.

ASSEMBLY

Assembly of the crates shall be as shown in figure 6-24 and as specified herein. The sides shall be fastened to the base by nailing the extensions of the vertical struts and diagonals to the skids with eightpenny nails. The ends shall be fastened to the base by nailing the lower edge member of the panels to the end floor member with eightpenny nails spaced 6 to 8 inches apart. The sides shall be fastened to the ends by nailing the end vertical struts of the sides to the vertical struts of the ends with eightpenny nails spaced 8 to 10 inches apart. The sides shall be fastened to the top nailing the extensions of the diagonals and vertical struts of the sides to the longitudinal members of the top with eigthpenny nails. The top shall be fastened to the ends by nailing the extensions of the longitudinal and diagonal members of the top to the upper edge member of the ends with eightpenny sinker nails. The upper edge members of the ends shall be nailed to the edge lateral members of the top with eightpenny sinker nails spaced 8 to 10 inches apart.

TYPE I, STYLE B--LIGHT DUTY CRATE (MIL-C-52950)

DESIGN REQUIREMENTS

Load and Size Limitations

Limitations shall be as specified in table 6-3.

Style B crates shall be used only for items forming a type I load and weighing not more than 200 pounds.

Frame Member Size

All frame members shall be 1 by 3 inches in size for net loads up to 100 pounds by 1 by 4 inches in size for loads between 100 to 200 pounds.

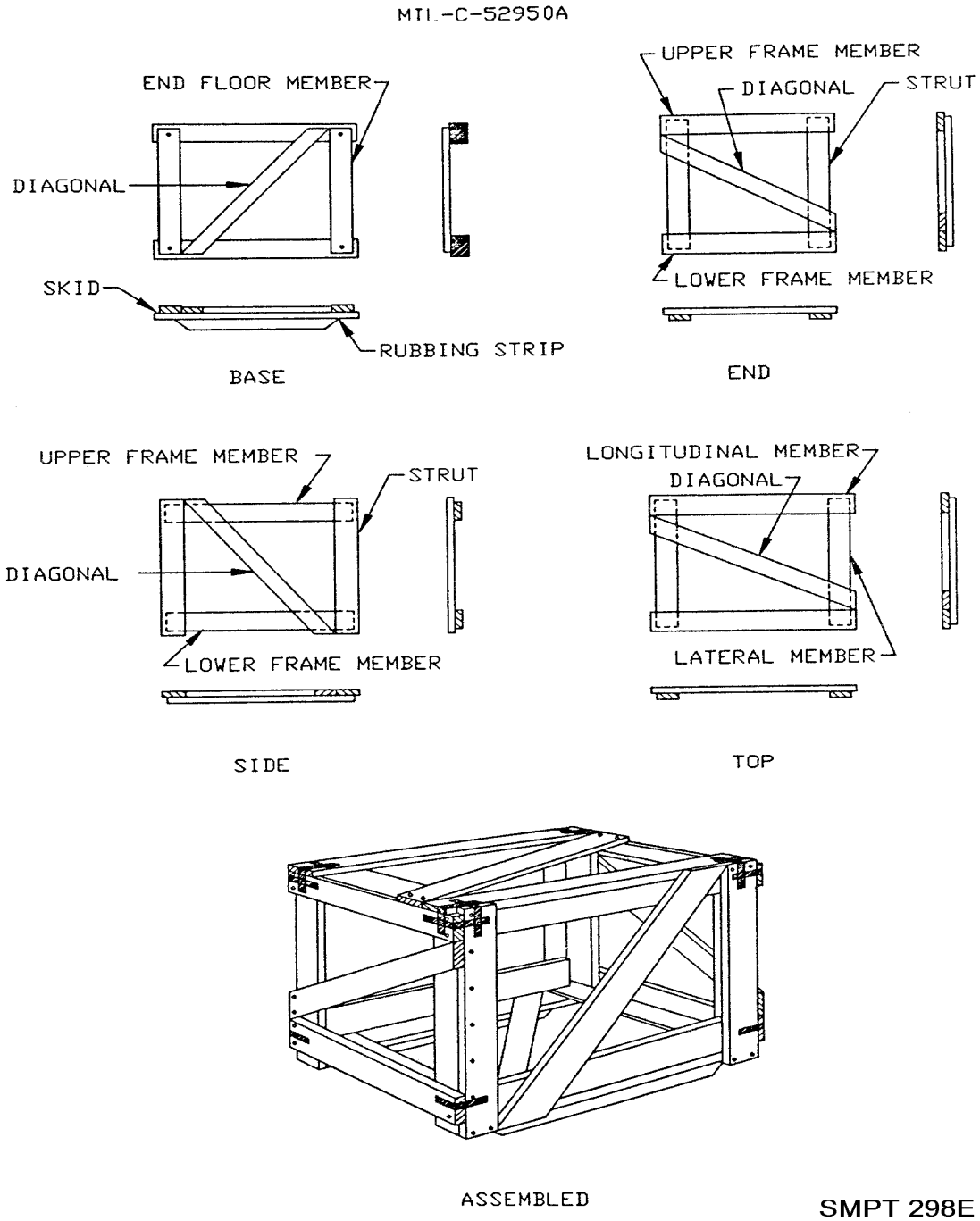


Figure 6-24. Type I, style A crate assembly (MIL-C-52950).

Assembly

Assembly of the crates shall be as shown in figure 6-25. Diagonals, struts, cross members, and longitudinal members shall be nailed together in patterns as shown in figure 6-22 with sixpenny nails.

MIL-C-52950A

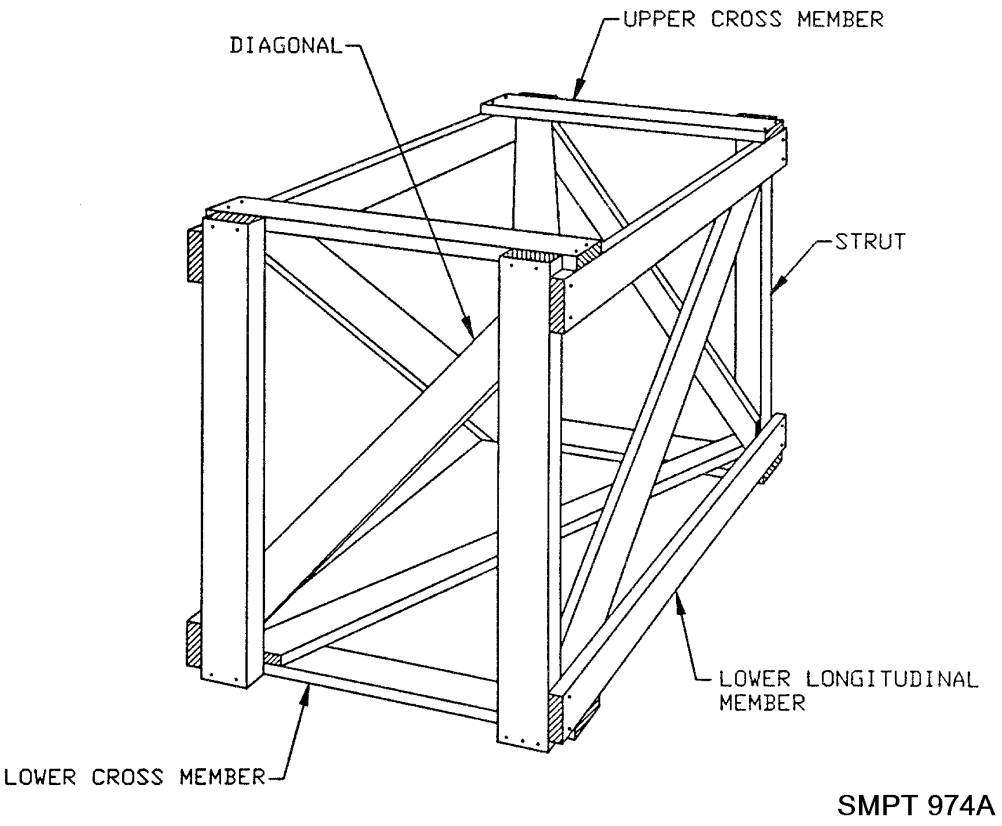


Figure 6-25. Type I, style B crate assembly (MIL-C-52950).

TYPE II, STYLE A--HEAVY DUTY CRATE (MIL-C-52950)

DESIGN REQUIREMENTS

Load and Size Limitations

Limitations shall be as specified in table 6-3.

Ends

The ends shall be of lumber or cleated-plywood as shown in figure 6-26. The cleats shall be fastened to the end boards or to the plywood with two rows of nails spaced 4 inches apart in each row, staggered and clinched. The minimum thickness of the end boards and plywood and the size of the end cleats shall be as shown in table 6-5. Additional vertical filler cleats shall be used in the ends when the unsupported span between outside cleats is greater than 3 feet.

Sides

The sides of the crates shall be of lumber or cleated-plywood as shown in figure 6-26.

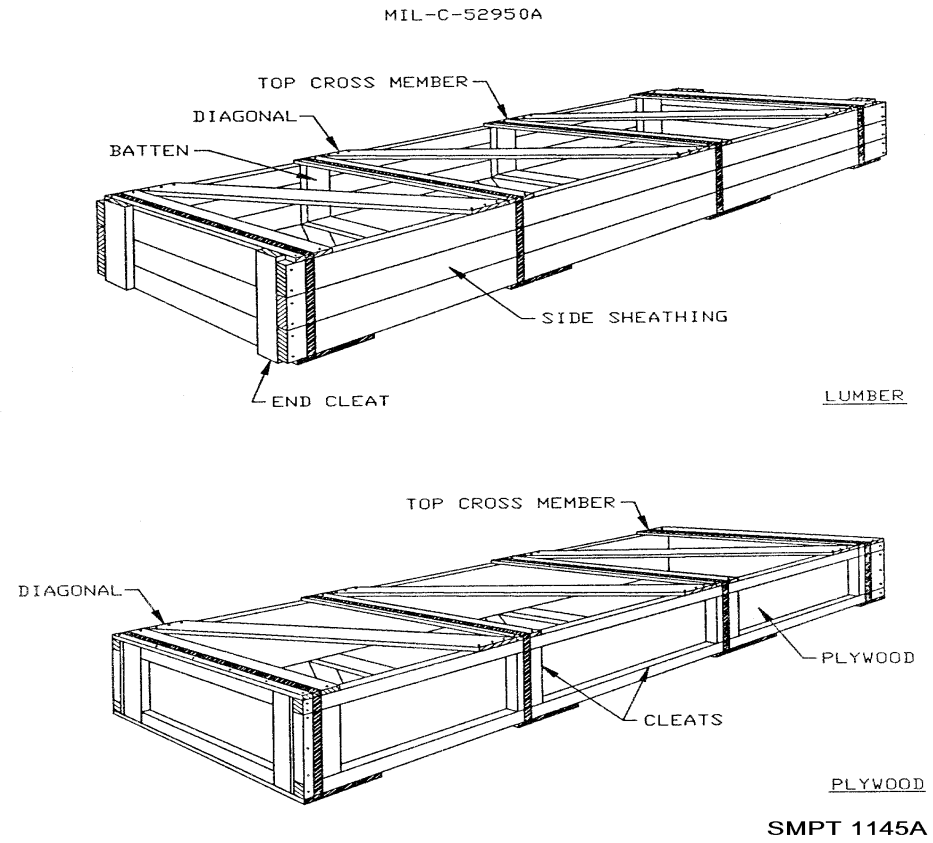


Figure 6-26. Type II, style A crate assembly (MIL-C-52950).

Table 6-4. Allowable Load Per Inch of Load-bearing Floorboard Width of Groups I and II Woods

Distance between skids	Nominal Thickness of Floorboards (inches)					
	1	2	3	4	6	8
12	50	200	557	1090	2690	4680
18	34	134	370	740	1790	3140
24	25	100	280	545	1350	2330
30	20	80	222	450	1150	1870
36	17	66	185	361	895	1560
42	15	57	158	311	767	1335
48	12	50	139	272	671	1170
54	11	45	124	242	596	1039
60	10	40	111	218	537	936
66	9	37	104	198	488	850

NOTE: When Group IV woods are used, the above allowable loads may be increased by 20 percent.

Table 6-5. Thickness of Ends

Maximum Net Load	Plywood	Lumber	Size of end cleats
(pounds)	(*inch)*	*(inches)*	*(inches)*
100	¼	3/4	3/4 by 2-3/4
250	3/8	3/4	3/4 by 3-1/2
500	½	1-1/6	1-1/16 by 3-1/2
1000	½	1-5/16	1-1/2 by 3-1/2

Table 6-6. Thickness of Sides

Maximum Net Load	Plywood	Lumber	Size of Cleats for Plywood Sides
(pounds)	*(inch)*	*(inches)*	*(inches)*
100	1/4	3/4	3/4 by 2-3/4
250	3/8	3/4	3/4 by 2-3/4
500	1/2	1-1/16	7/8 by 3-1/2
1000	1/2	1-5/16	7/8 by 3-1/2

When lumber is used, the sides shall be constructed of not more than 3 pieces for heights of 1 foot 3 inches or more, not more than 2 pieces for heights between 7 1/2 inches and 1 foot 3 inches, and one piece for heights 7 1/2 inches or less.

The minimum thickness of lumber and plywood, and the minimum size of cleats for plywood sides shall be as shown in table 6-6.

When lumber sides are composed of two or more pieces, cleats that are the same thickness and width as the top and bottom crossmembers shall extend the full depth of the side and shall be fastened to the inside surfaces of the sides as shown in figure 6-26. The cleats on the sides shall be placed to coincide with the crossmembers of the top, and spacing shall be no greater than 3 feet. Cleats shall be fastened to the side boards or plywood with two rows of nails spaced 4 inches apart in each row, staggered, and clinched. When the overall length of the crate exceeds 14 feet, pieces of lumber used in the construction of the sides shall be either the required full length or shall be made up of two pieces which together make up the full length. The joint of such pieces shall abut on a full depth cleat, and both pieces shall be nailed to the bottom.

When plywood is used, the sides shall be constructed on one-piece material for width requirements. Butt jointing of plywood at an intermediate cleat location will be permitted when two lengths of plywood are required for crates in excess of 8 feet in length.

Crates may be one of the following combinations of sides and end panels, as specified:

- Lumber ends and sides.
- Cleated-plywood ends and sides.
- Lumber ends and cleat-plywood sides.

Top and Bottom Members

The top and bottom members shall be 1 X 4-inch lumber for all crates up to and including 2 feet 6 inches in width and 1 X 6 inch lumber for crates more than 2 feet 6 inches in width. The angle between diagonals and side shall be between 300 and 600, but crossmembers shall be placed not more than 3 feet apart in line with battens or cleats of the sides. The crossmembers of the top and bottom shall be directly opposite each other and the bottom diagonals shall be in reverse direction with the top diagonals as shown in figure 6-26.

Exterior Side Cleats

When specified, for gross weights exceeding 200 pounds, exterior side cleats shall be used to facilitate fork lift handling of crates on their sides. On lumber sides, the exterior cleats shall replace the interior side battens. On plywood sides, filler pieces shall be used under the exterior side cleats; filler pieces shall pass between the horizontal cleats and shall be the same width as exterior side cleats. Spacing of cleats shall be as shown in figure 6-27. Size of exterior side cleats shall be 3 X 4 inches. Exterior side cleats shall be secured to the side sheathing with nails as specified for battens. Short one-panel crates with lumber ends shall have end cleats a nominal 3 inches thick in lieu of exterior side cleats.

ASSEMBLY

Sides to Ends

The sides shall be nailed with sinker or corker nails to the ends as specified in table 6-7.

Top and Bottom Members to Sides

The top and bottom crossmembers and diagonals shall be nailed to the cleats of the sides or to the lumber sides with eightpenny sinker nails when the side cleats or sides are less than 1 inch in thickness and ninepenny sinker nails when side members are 1 inch or more in thickness. The end top and bottom crossmembers shall also be nailed to the end sheathing or cleats if the ends are lumber or plywood, respectively. The nailing patterns, location of nails, and nailing procedures shall be as shown in figures 6-22 and 6-26.

TYPE III, STYLE B--LIGHT DUTY CRATE (MIL-C-52950)

DESIGN REQUIREMENTS

Style B

Style B crates shall be as shown in figure 6-28. There shall be no size or load restrictions for this crate except as limited by handling methods. The size and spacing of members shall be as specified in table 6-8. Vertical end cleats shall be long enough to permit full nailing to the upper horizontal end cleats when the crate is assembled.

Nailing

The upper and lower halves of the crate shall be fabricated with sixpenny nails; the vertical end cleats shall be fastened to the lower half with clinched nails to the lower horizontal end cleats. Two nails shall be used in each end of 3 and 4 inch wide longitudinal members and three nails shall be used in 6 inch wide longitudinal members.

MIL-C-52950A

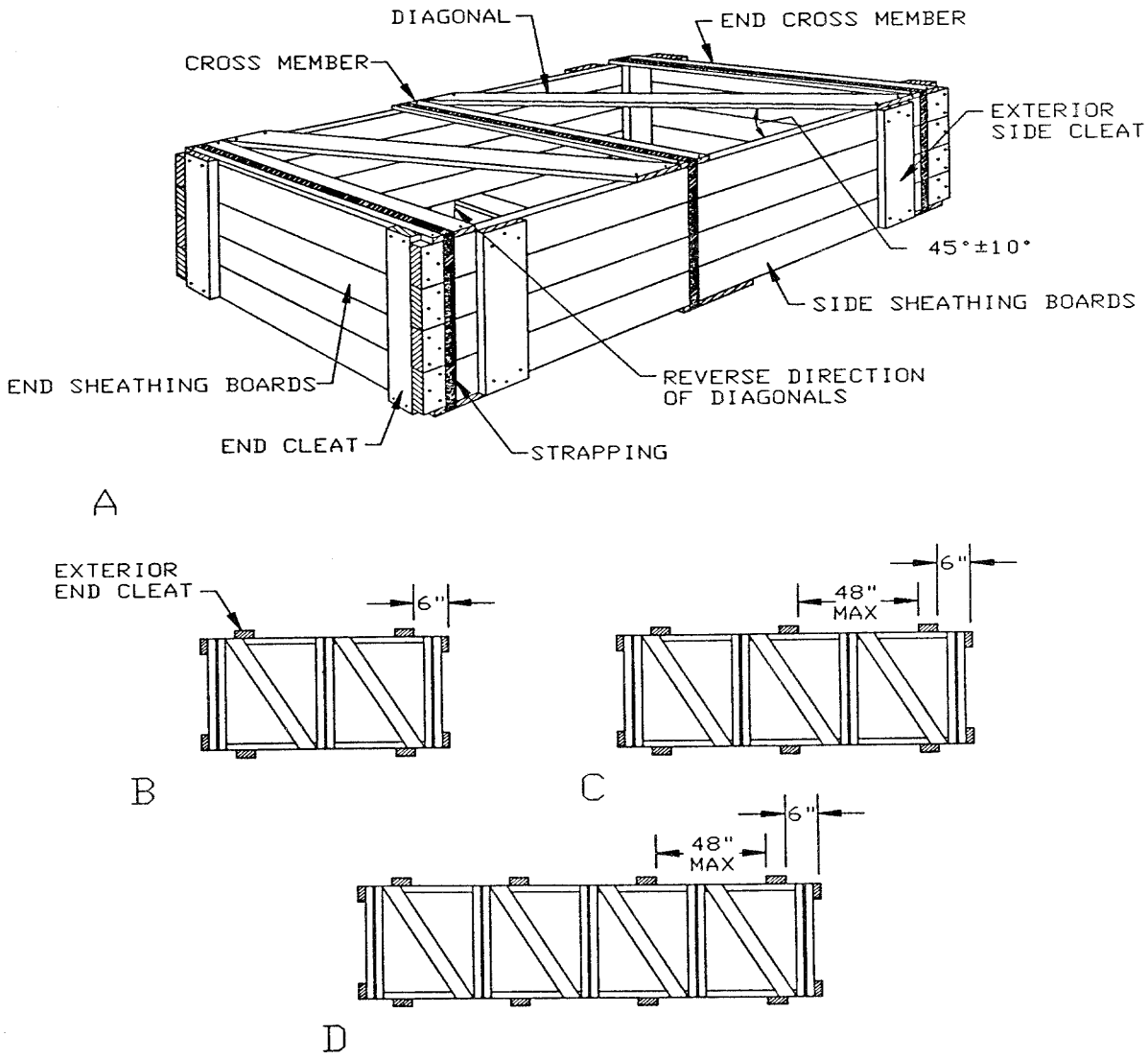


Figure 6-27. Type II, crate with exterior side cleats. (A- complete crate, B- two panel, C- three panel, and D- four panel.

Rubbing Strips

Beveled rubbing strips, of sizes shown in table 6-8, shall be attached to the undersurface of each lower crossmember to facilitate fork truck handling. Rubbing strips shall be fastened to the crossmembers with sixteenpenny nails placed in two rows and spaced 5 inches apart applied to each row and clinched. Rubbing strips shall be applied at time of crate packing after strapping has been secured to crossmembers.

Assembly

Assembly of the crates shall be as shown in figure 6-28. After items have been nested in the lower half of the crate, the upper half shall be positioned and strapping shall be applied. The upper ends of the vertical end cleats shall be nailed to the upper horizontal end cleats with fourpenny nails. The upper longitudinal members of the sides shall be nailed to the vertical end cleats with eightpenny nails.

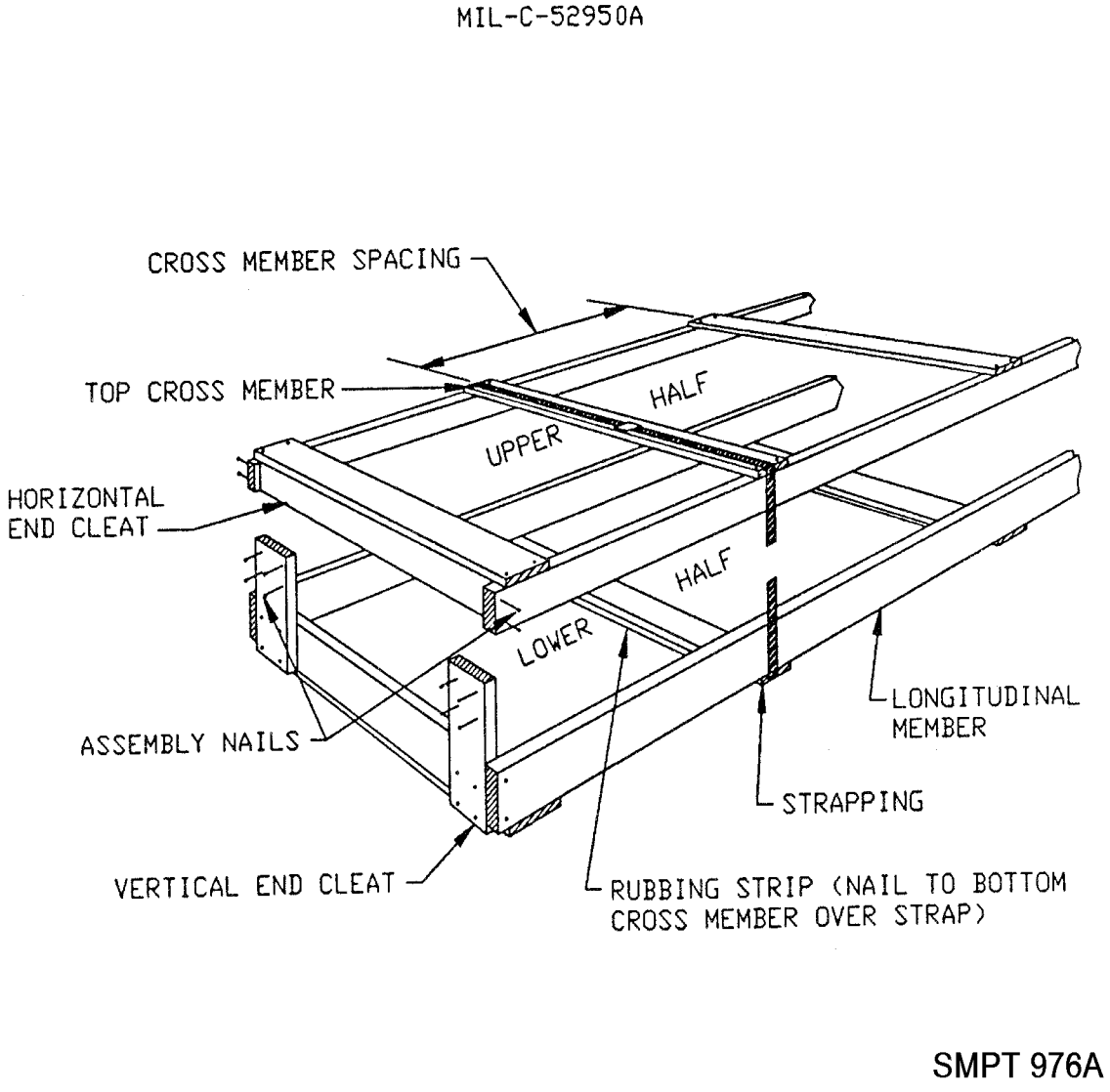


Figure 6-28. Type III, style B crate assembly (MIL-C-52950).

Table 6-7. Nailing Schedule for Assembly to Type II, Style A Crates

Cleated-Plywood Sides to Plywood or Lumber Ends[1]			Lumber Sides to Lumber Ends[1]		
Plywood thickness	Nail size	Nail spacing	Thickness of sides	Nail size	Nails spacing
1/4	8	3	3/4	8	2-1/2
3/8	10	3-1/4	1-1/16	10	2-3/4
1/2	12	3-1/2	1-5/16	12	3

NOTE: 1/ Nails shall be staggered when ends are lumber.

TYPE IV, STYLE A - HEAVY DUTY CRATE (MIL-C-52950)

DESIGN REQUIREMENTS

Load and Size Requirements

The limitations shall be as specified in table 6-3.

Base

Skids shall be 2 X 4 inch lumber for loads through 500 pounds and 2 X 6 inch lumber for over 500 pounds.

The size of the load-bearing floor member shall be as specified in table 6-4. Floorboards over 2 inches in nominal thickness shall be bolted to the skids with 3/8-inch diameter carriage bolts. Diagonals shall be 1 X 6 inches.

The placement of end floor members and rubbing strips shall be as shown in figure 6-29. On crates over 5 feet long, the rubbing strips shall be in three pieces, with the center piece 16 inches long, the fork openings 12 inches long, and the end pieces of a length which will allow end sling openings of 4 inches.

Side, End, and Top Panels

All the members of the side, end and top panels shall be 1 X 6 inch lumber. Three vertical struts shall be used in the side panels when the length of the crate is greater than 4 feet or greater than 1 1/2 times the height. The lateral members of the top panel shall coincide with the vertical struts of the side panels and shall be equal in number. Nailing patterns shall be as shown in figure 6-22.

Assembly

Assembly of the crates shall be as shown in figure 6-29. The longitudinal members of the top shall bear on the upper frame members of the sides and the end lateral members of the top shall be adjacent to the upper member of the ends.

TYPE V, STYLE A - HEAVY DUTY (MIL-C-52950)

DESIGN REQUIREMENTS

Load and Size Limitations

The limitations shall be as specified in table 6-3.

Nailing shall be as shown in figure 6-22.

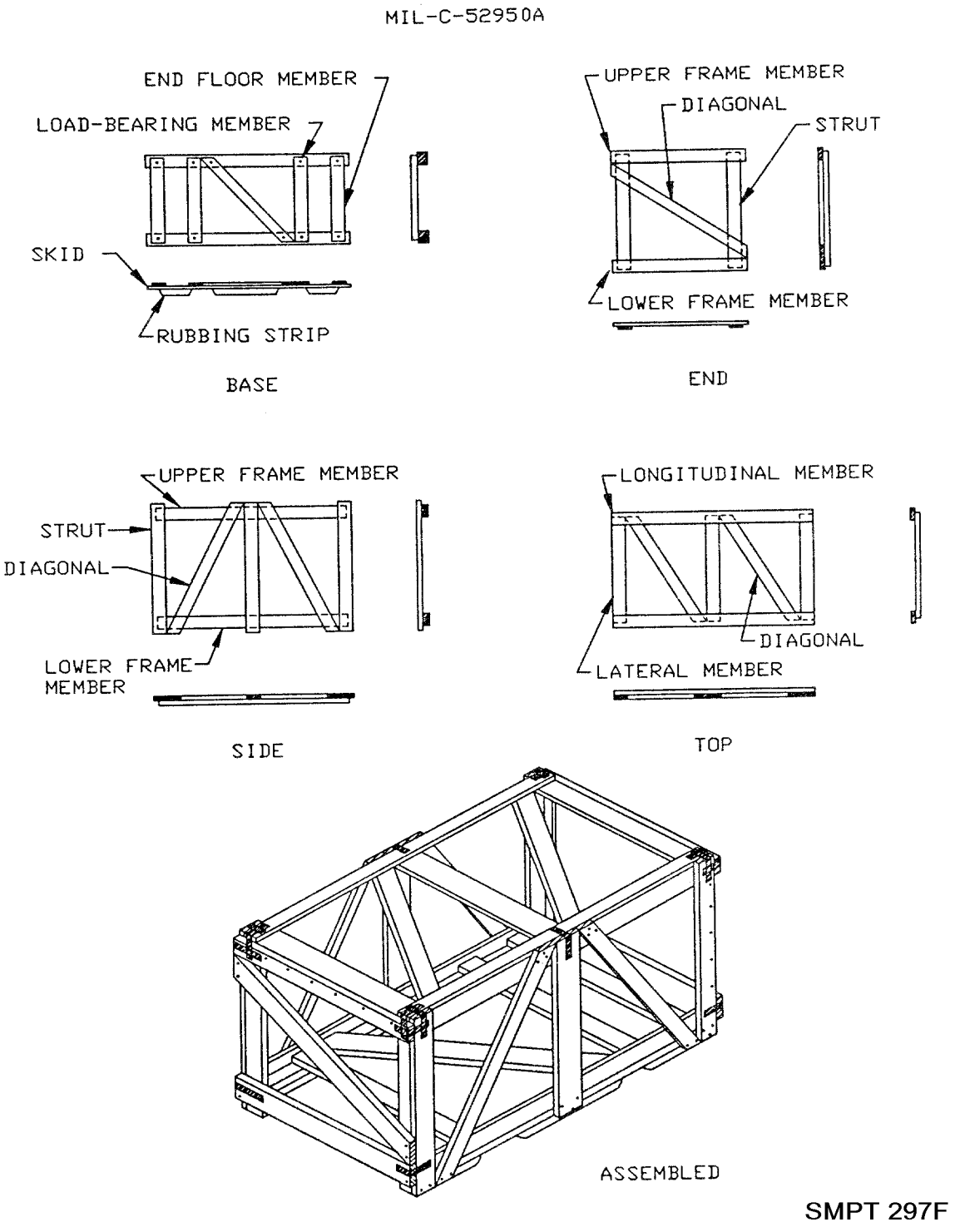


Figure 6-29. Type IV, style A crate assembly (MIL-C-52950).

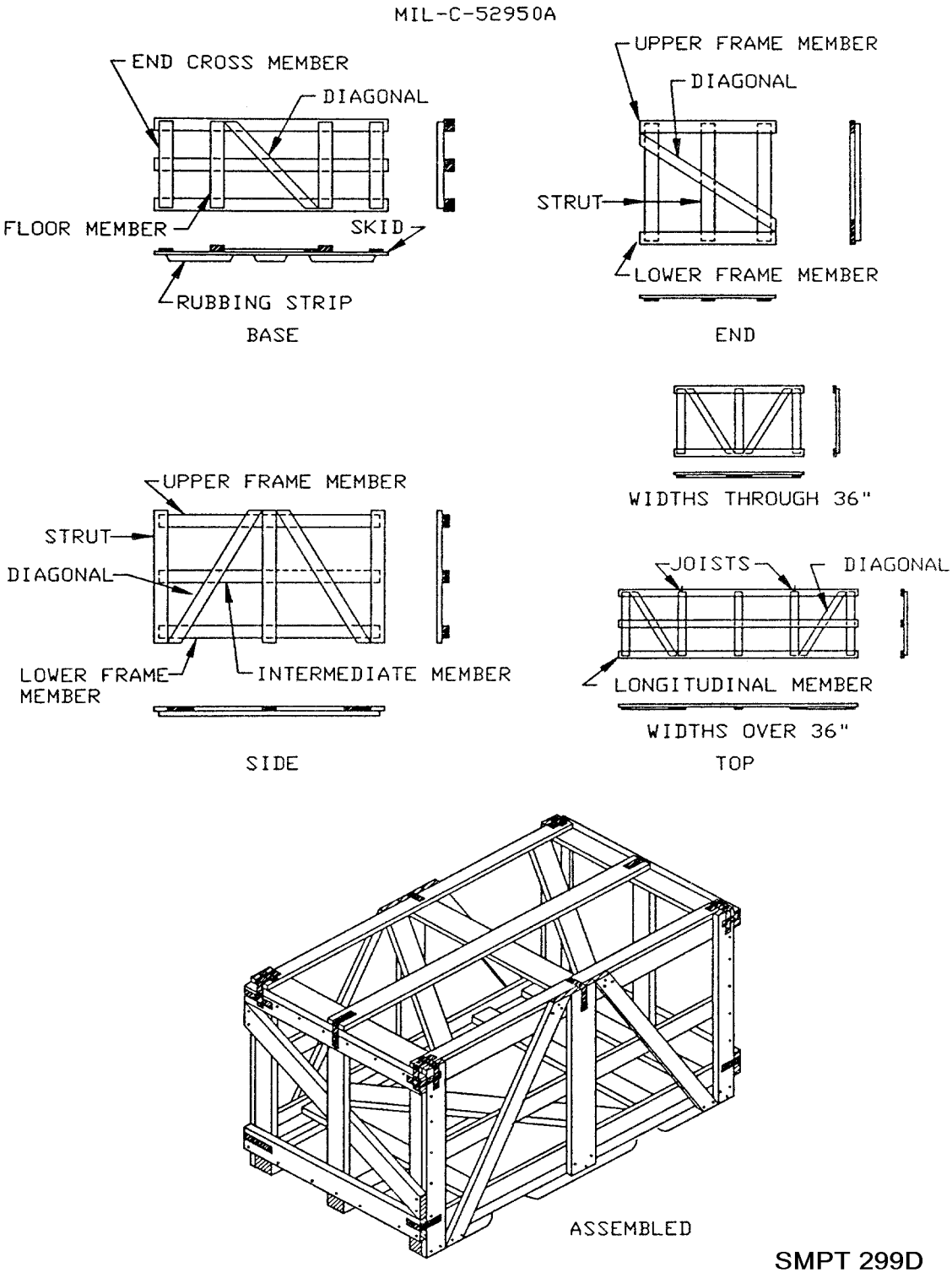


Figure 6-30. Type V, style A crate assembly (MIL-C-52950).

Base

Skids

The skids shall consist of 4 X 4 inch lumber. An intermediate 4 X 4 inch skid shall be used when the distance between the outer skids is greater than 36 inches.

Load-bearing Floor Members

The size of the load-bearing floor members shall be as specified in table 6-4. Floorboards over 2 inches in nominal thickness shall be bolted to each outside skid with 3/8 inch carriage bolts.

Diagonals

The diagonals shall be 1 X 6 inch lumber and the angle between the skid and the diagonal shall be between 30 degrees and 60 degrees, except that when the angle of a single diagonal is less than 30 degrees, two diagonals and a 1 X 6 inch center crossmember shall be used.

Crossmembers

End crossmembers shall be 2 X 6 inch lumber for crates not greater than 4 feet in width and 4 X 4 inch lumber for crates over 4 feet in width. End crossmembers shall be bolted to each skid with 3/8-inch diameter carriage bolts.

Rubbing Strips

Rubbing strips shall be as described previously.

Ends

Vertical struts shall be 2 X 4 inch lumber. An intermediate strut shall be used when the width of the crate is greater than 3 feet. All struts shall coincide with the skids and shall bear upon the end crossmembers of the base. The upper and lower frame members of the ends shall be 1 X 6 inch lumber except the a 1 X 8 inch lower member shall be used when the end crossmembers of the base are 4 X 4 inches. The diagonals of the ends shall be 1- X 6-inch lumber.

Sides

All side framing members, struts, and diagonals shall be 1 X 6 inch lumber. Intermediate struts shall be placed so that diagonals form an angle of between 30 and 60 degrees with the lower frame member. Struts shall have a maximum spacing of 42 inches. A horizontal intermediate frame member is required when the height of the side exceeds 4 feet. Diagonals shall be used between each two adjacent struts.

Top

All members of the top shall be 2 X 4 inch lumber. The longitudinal members shall coincide with the vertical struts of the ends. An intermediate longitudinal member is required when the width of the crate is greater than 3 feet and shall coincide with the intermediate struts of the ends. The joists shall be placed flat. Joists shall coincide with each strut of the side but shall be spaced not more than 40 inches apart for crates up to 3 feet wide and not more than 30 inches apart for crates more than 3 feet wide. The diagonals shall be nailed to the longitudinal members. When more than three joists are used, only each end panel of the top assembly shall be braced as shown in figure 6-30.

Non-demountable Crate Assembly

The assembly shall be reinforced by the application of metal straps as shown in figure 6-30.

Sides to Base

The sides shall be fastened to the base by nailing the overlap of the vertical struts and diagonals to the skids with twelvepenny nails. The nailing patterns shall follow those shown in figure 6-22.

Ends to Base

The ends shall be fastened to the base by nailing the lower frame member of the end panels to the end crossmembers of the base with twelvepenny sinker nails spaced 6 to 8 inches apart.

Sides to Ends and Ends to Sides

The edge struts of the sides shall be fastened to the edge struts of the ends with eightpenny sinker nails spaced 8 to 10 inches apart. The extensions of the upper and lower frame members and the diagonals of the end shall be nailed to the edge struts of the side with eightpenny sinker nails as shown in figure 6-22.

Top to Sides and Ends

The top shall be fastened to the sides and ends by nailing the upper frame members of the ends and the extensions of the vertical struts and diagonals of the sides to the adjacent edge members of the top with eightpenny sinker nails as shown in figure 6-22.

Demountable Crate Assembly

All demountable crates shall be assembled with lag bolts. Lead holes shall be used for all lag bolts. When specified as an alternate, the top, side, and end panels may be nailed to each other and the unit may be fastened to the skids and end crossmembers of the base by means of lag bolts for demountable crates.

Sides to Base

Lag bolts, 3/4 by 3 1/2 inches, shall be used to fasten the sides to the skids. Diagonals shall be arranged to provide the maximum number of fastening points to the base near the center of the skids. The minimum number of lag bolts shall correspond to the following tabulation. Not less than one edge bolt shall be placed in each strut and diagonal.

Gross Load (crate and contents) (pounds)	Minimum Number of 3/8-inch Lag bolts for each side of crate
1000	4
2000	5
3000	8

Ends to Base, sides to Ends, and Ends to Top

Lag bolts, 5/16 by 3 inches, spaced 12 to 14 inches apart, shall be used to fasten: the lower edge members of the ends to the end crossmembers of the base; the end vertical struts of the sides to the edge struts of the ends; and the upper edge members of the end to the edge joists of the top.

Sides to Top

One 5/16 by 3-inch lag bolt shall be used to fasten each strut and diagonal of the sides to the edge longitudinal member of the top.

TYPE V, STYLE B--LIGHT DUTY CRATE (MIL-C-52950)

DESIGN REQUIREMENTS

Load and size Limitations

The limitations shall be as specified in table 6-3. They shall be open, or covered, and demountable or non-demountable as specified. Nailing shall be as shown in figure 6-22, and as specified herein.

Base

Skids

Skid sizes shall conform to the following:

	Skid Size (Nominal)	
Net load (pounds)	2 Skids (inches)	3 Skids (inches)
Up to 500	2 X 4 (flat)	2 X 4 (flat)
501 to 2000	3 X 4 (flat)	3 X 4 (flat)
2001 to 3000	4 X 4	3 X 4 (flat)
3001 to 4000	4 X 4	4 X 4

Crates Over 42 Inches Wide Shall Have Three Skids

Splices shall be located no further from the ends than one-third of the length of the skids, and splice locations shall be alternated in adjacent skids. All 4 X 4 members may also consist of two 2 X 4's placed on edge and laminated in accordance with figure 6-23.

Rubbing Strips

Rubbing strips shall be a minimum of 3 X 4 inches in size. The strips shall be positioned as shown in figure 6-31. They shall be nailed to the skids with two rows of nails spaced 1 foot apart in each row in a staggered pattern; nail sizes shall be sixteenpenny when skids are 2 X 4 inches and twentypenny for 3 X 4 and 4 X 4 inch skids.

End Headers

Two headers spaced 2 feet apart shall be bolted to each end of the skids as shown in figure 6-31 with 3/8-inch diameter carriage bolts. The end headers shall be the same cross section as the skids. When crate ends have 2 X 4 inch struts, bolts in the outer headers shall be placed to clear the struts.

Load-bearing Floorboards

When concentrated loads occur, load-bearing floorboards shall be used to transfer the load to skids. The sizes shall be as specified in table 6-4. When end headers are used as load-bearing member, the end header size shall be chosen from the load-bearing floorboard width specified in table 6-4. Floorboards 2 inches or less in thickness shall be nailed to each skid in patterns as shown in figure 6-22 and floorboards over 2 inches thick shall be bolted to each skid with 3/8-inch diameter carriage bolts. Two bolts shall be used for floorboards over 6 inches wide.

Diagonals and Floorboards

Diagonals shall be used between headers and load-bearing floorboards or other crossmembers and shall be placed at an angle as close to 45 degrees as possible. Diagonals and floorboards other than load-bearing floorboards shall be 1- by 4-inch members for net loads up to 500 pounds and outside widths not exceeding 3 feet, and shall be 1- by 6-inch members for all other conditions.

Sides

Sides shall be as shown in figures 6-32, 6-33, and 6-34 Single-panel sides shall be used for heights over 6 feet. An intermediate longitudinal member shall be added for heights over 4 feet. Double-panel sides shall be used for heights over 6 feet and through 8 feet. Triple-panel sides shall be used for heights over 8 feet. Longitudinal members shall be in single pieces for lengths not exceeding 16 feet, and may be spliced as shown in figure 6-24 for lengths greater than 16 feet. Splice locations shall be alternated. Member sizes and spacing shall be as specified in table 6-9.

Ends

Ends shall be as shown in figures 6-35 and 6-36. All members shall be 1 by 4 inches in size for net loads up to 500 pounds, and 1 by 6 inches for net loads over 500 pounds, with the following exceptions.

Struts shall be 2 by 4 inches in size when the crate height is over 5 feet.

The lower frame member shall be 1 by 6 inches in size when the end headers of the base are 2-inch thick members and 1 by 8 inches in size when larger end headers are used.

Top

The top shall be as shown in figure 6-37. The spacing of the crossmembers shall be the same as the spacing of the side struts. Diagonals shall be nailed to the inner faces of the crossmembers. The longitudinal members shall be 1 by 4 inches in size for loads up to 500 pounds and widths to 4 feet, and 1 by 6 inches for all other conditions Crossmembers and diagonals shall be 1 by 4 inches for loads to 1,000 pounds and widths to 4 feet, and 1 by 6 inches for all other conditions. Splicing of longitudinal members shall be as shown in figure 6-23.

Top Reinforcing Joists

When the gross weight of the crate is over 500 pounds or the inside width is over 3 feet 6 inches, a 2- by 4-inch top-reinforcing joist shall be nailed to the top at the loaded center of balance as shown in figure 6-37 to prevent the top of the crate from being crushed when the crate is lifted with a single set of grabhooks. The joist shall be placed flat and the ends shall contact the inner face of the upper longitudinal members of the side when the crate is assembled. The joist shall be fastened to the longitudinal and diagonal members of the top with sevenpenny nails placed as shown in figure 6-22 and to the upper longitudinal members of the sides with two tenpenny nails in each end.

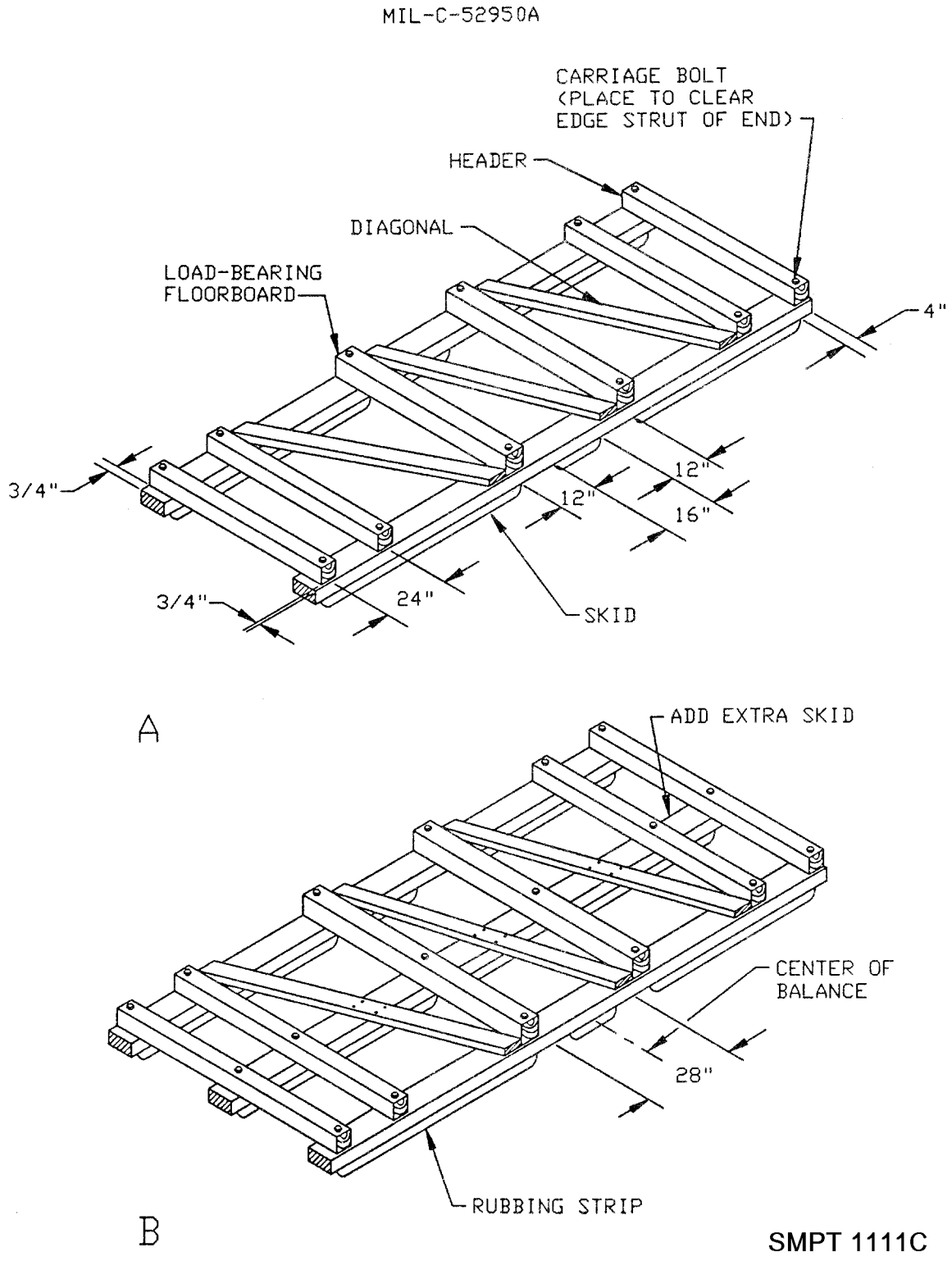


Figure 6-31. Bases for Type V, style B crates (MIL-C-52950).

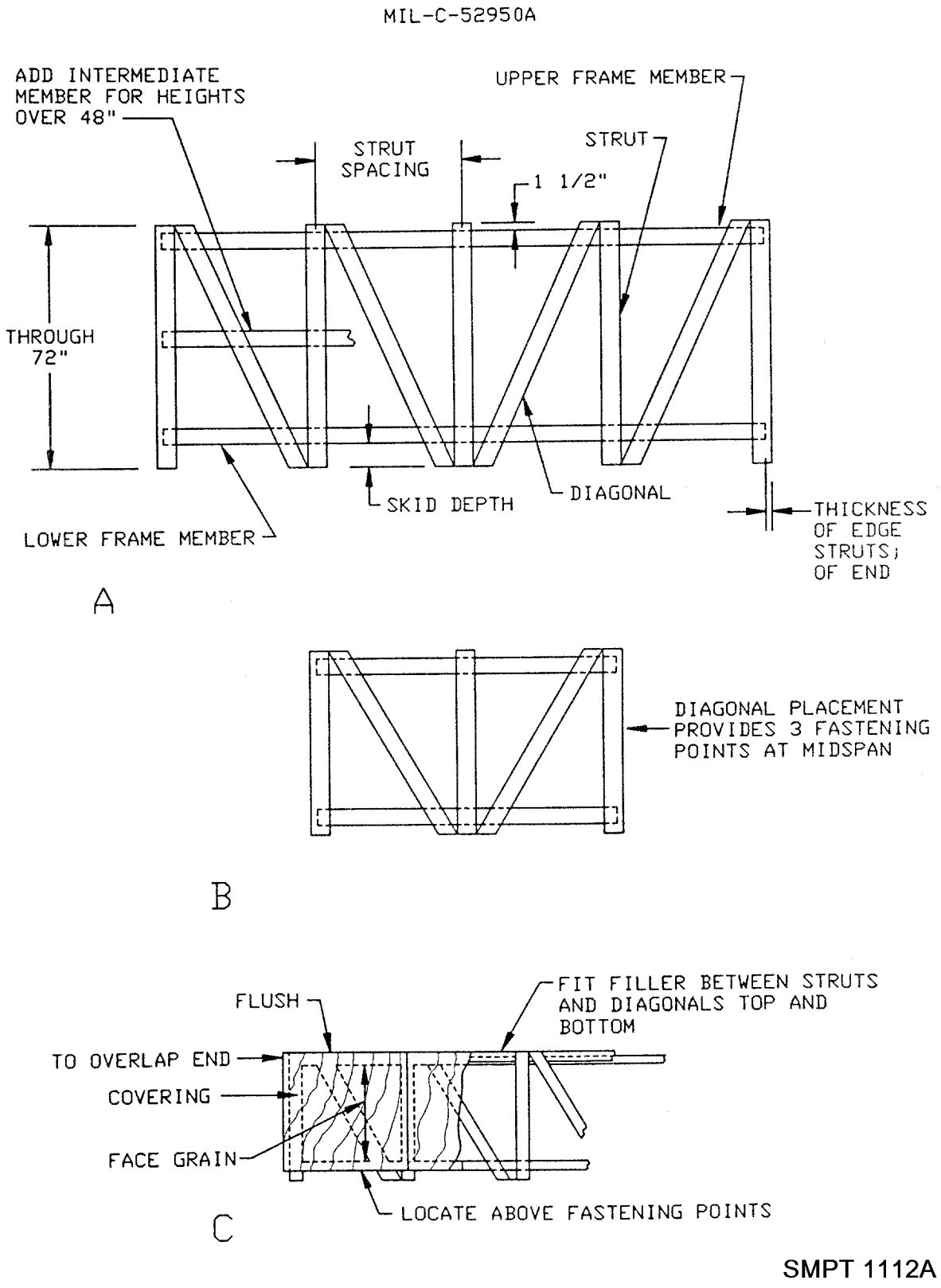


Figure 6-32. Simple panel sides for Type V, style B crates (MIL-C-52950): A, side of long crate; B, side of short crate; C, covered side.

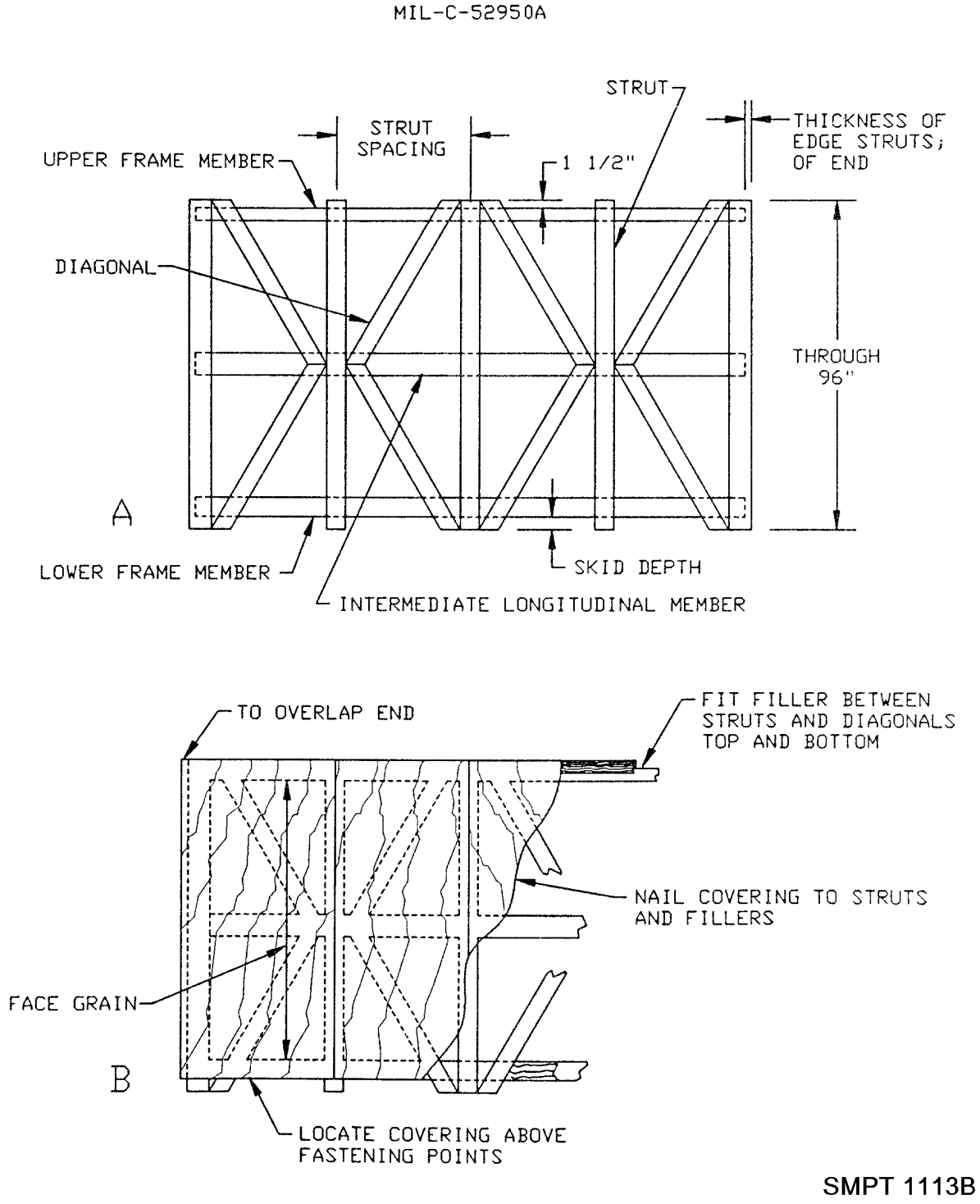


Figure 6-33. Double panel sides for Type V, style B crates for heights up to 96 inches (MIL-C-52950): A, open side; B, covered side.

MIL-C-52950A

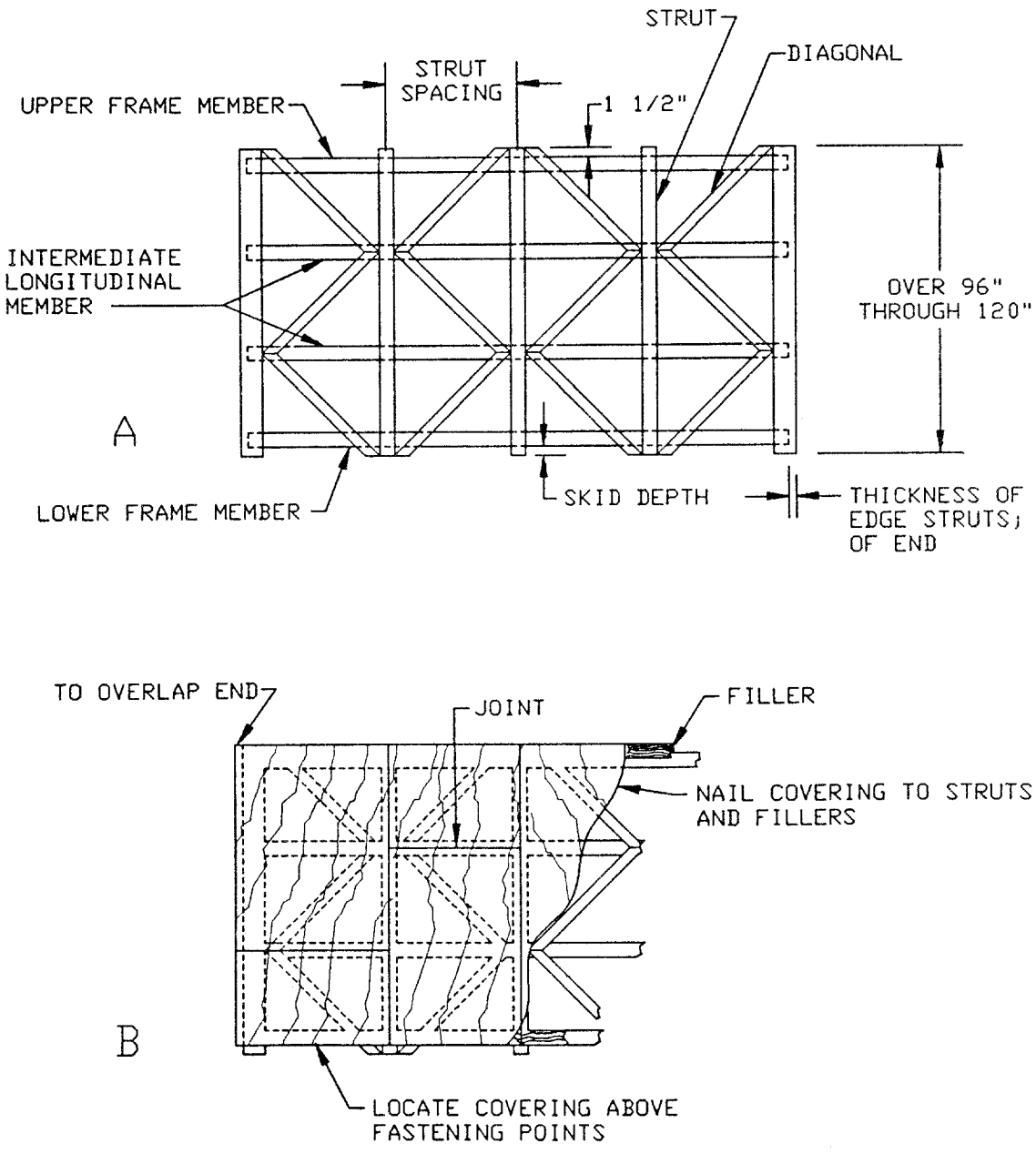


Figure 6-34. Triple panel sides for Type V, style B crates for heights over 96 inches (MIL-C-52950): A, open side; B, covered side.

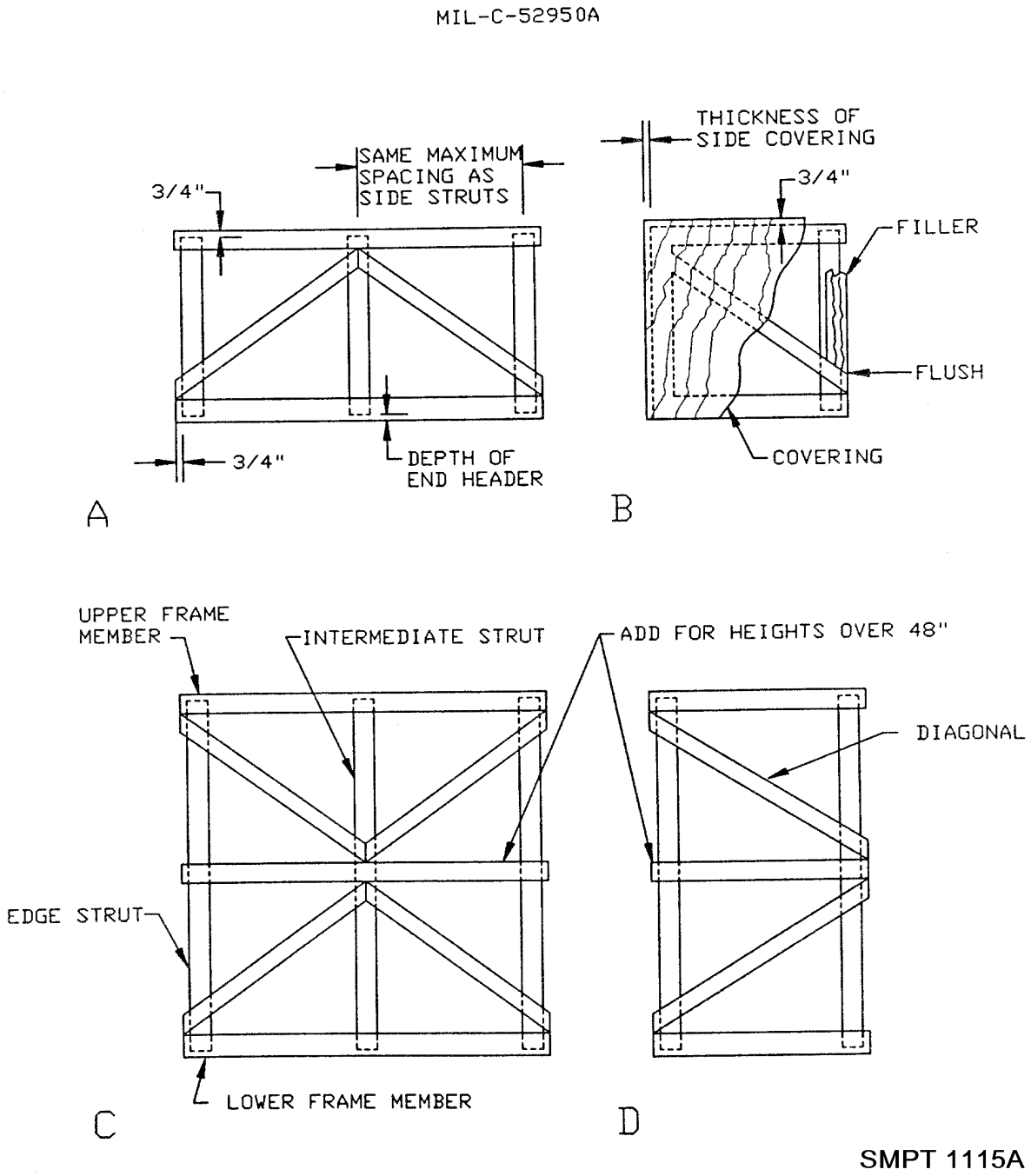


Figure 6-35. Ends for Type V, style B crates (MIL-C-52950): A, two panel horizontal; B, single panel covered; C, four panel; D, two panel vertical.

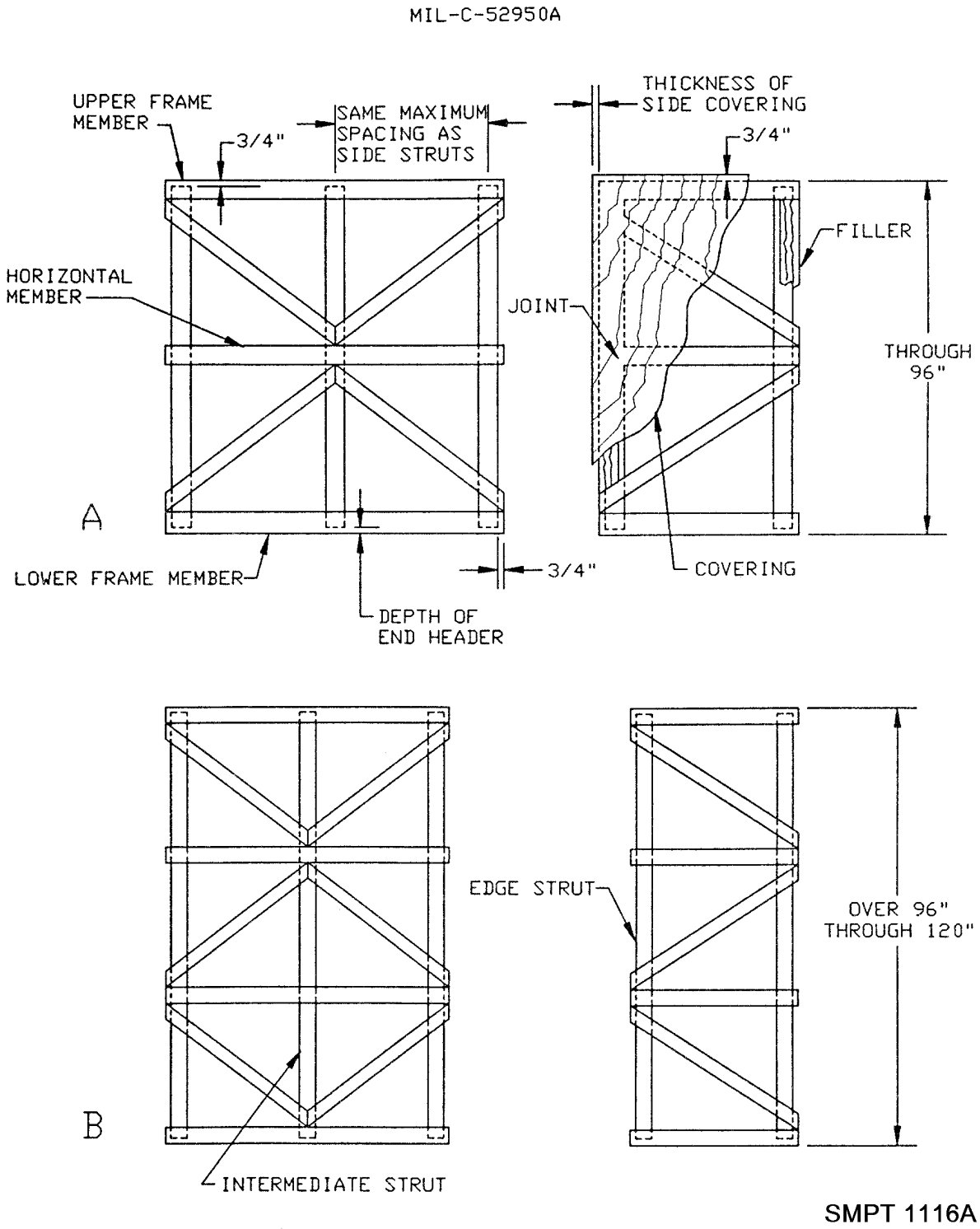


Figure 6-36. Ends for Type V, style B crates (MIL-C-52950): A, wide and narrow double-panel ends; B, wide and narrow triple-panel ends.

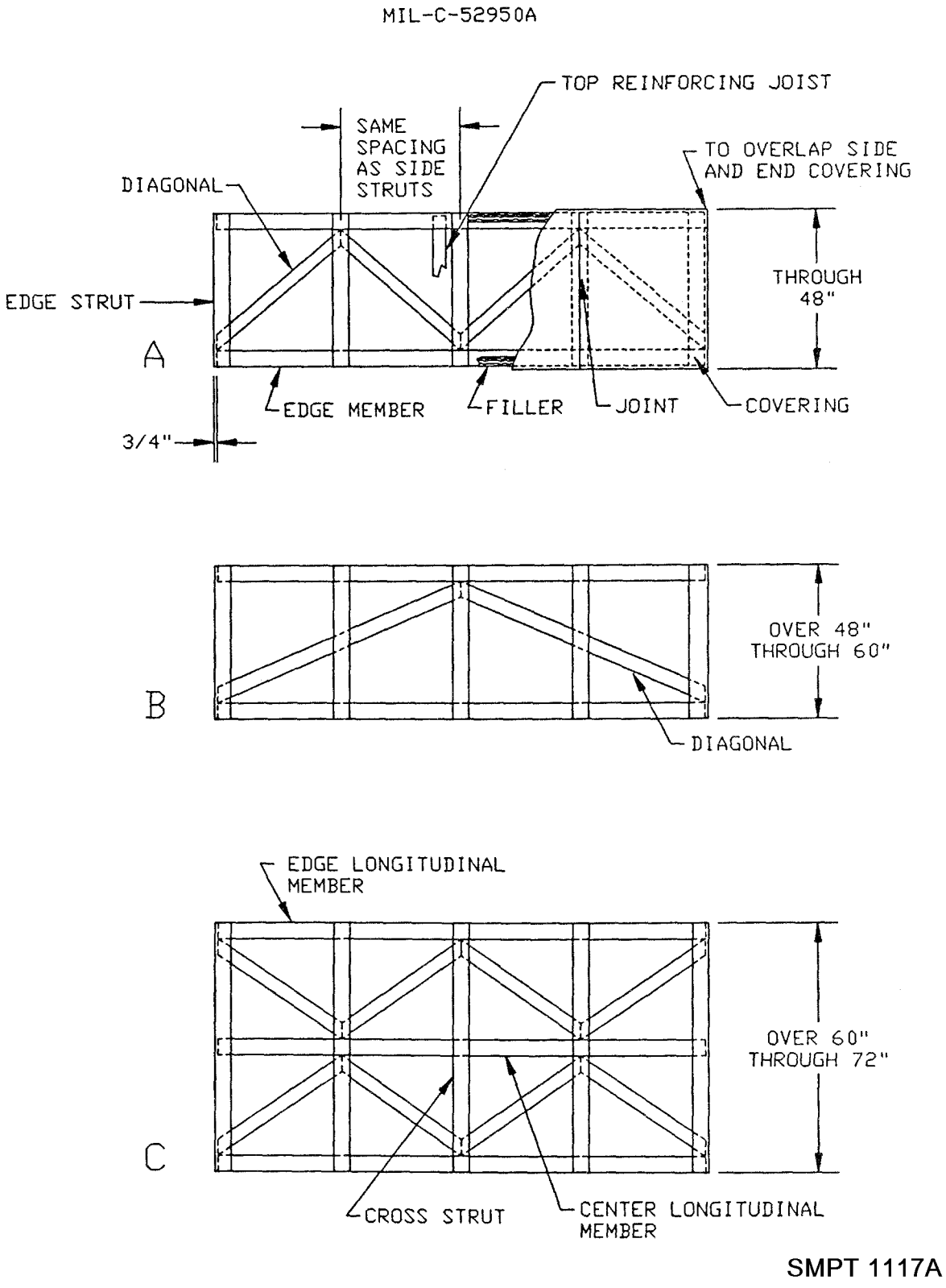


Figure 6-37. Tops for type V, style B crates (MIL-C-52950): A, narrow top; B, medium top; C, wide top.

Assembly

Unless demountability is specified, the crate shall be assembled by nailing. When demountability is specified, the sides, ends, and top as a unit shall be secured to the base with lag bolts. Eightpenny nails, spaced 8 to 10 inches apart, shall be used to fasten:

- the edge struts of the sides to the sides to the edge struts of the ends;
- the longitudinal members of the top to the upper frame members of the sides;
- the end crossmembers of the top to the upper frame members of the ends; and,
- the lower frame members of the ends to the end header of the base.

Eightpenny nails as shown in figure 6-22 nailing patterns shall be used to fasten:

- the upper ends of the side struts and diagonals to the longitudinal members of the top; and
- the ends of upper and lower frame members, horizontal members, and diagonals of the ends to the edge struts of the sides.

The bottom ends of struts and diagonals of the sides shall be secured to the skids with eightpenny nails as follows: A minimum of three nails shall be used for each 3 and 4 inch wide member, four nails for each 6 inch wide member, and five nails for each 8 inch and wider member. Nails shall be staggered and shall be placed in two rows whenever possible. For demountable crates, each strut and diagonal of the sides shall be fastened to the skids with a minimum of one lag bolt. The size of lag bolts and the total number required shall be not less than that specified in table 6-10. When more than one lag bolt is required in each strut or diagonal, the additional lag bolts shall be placed in the wider members, near the load-bearing points, and in a staggered pattern when possible. One-half the total number of lag bolts required shall be used for each side. For demountable crates, the lower frame members of the ends shall be fastened to the end headers of the base with 5/16 X 3 inch lag bolts, spaced 12 inches apart.

Covered Crates

The structural framework of the covered crates shall be as shown in figure 6-32 and 6-33. The covered crates shall also be as shown in figures 6-32 through 6-38. Unless otherwise specified, the covering shall consist of plywood or paper-overlaid veneer with a minimum thickness of 1/8 inch. When joints are required in the covering they shall butt over the centerline of struts or crossmembers. Covering shall be fastened with two rows of nails or staples, spaced 8 inches apart in each row, staggered, and clinched. Filler pieces between struts, diagonals, and crossmembers of sides, ends, and top shall be fastened with two rows of nails, spaced 10 inches apart in each row, staggered, and clinched. Filler pieces shall be the same thickness as adjacent panel framing members.

Sides

Four-inch wide filler pieces shall be fastened to the upper and lower frame members between the struts and diagonals. Filler shall extend beyond the edge of the upper frame member so as to be flush with the ends of the struts and diagonals. The lower edges of the fillers shall be flush with the bottom edge of the lower frame member.

Ends

Three-inch wide filler pieces shall be nailed to the edge struts as shown in figures 6-35 and 6-36. When specified, end ventilation shall be provided in accordance with MIL-C-104.

Tops

Two-inch wide filler pieces shall be fastened to the longitudinal members. The covering of the top shall be extended to overlap the covering of the sides and ends. During nailing, a 4-inch wide strip of waterproof barrier material conforming to PPP-B-1055, class suitable for crate liners, shall be placed under each covering joint. The strip shall extend across the full width of the top.

Covered Crate Assembly

The assembly of covered Type V, style B crates shall be as shown in figure 6-38. Ninepenny nails, spaced 8 to 10 inches apart, shall be used through the covering to fasten the edge struts of the sides to the edge struts of the ends; the struts, diagonals, an fillers of the sides to the edge longitudinal members of the top; the end crossmembers of the top to the upper frame members of the ends; the upper, lower, and horizontal members, diagonals, and fillers of the ends to the edge struts of the sides; the lower frame members of the ends to the end headers of the base; and, the struts, diagonals, and fillers at the lower edge of the sides to the skids of the base. The covering of the top shall be nailed to the filler of the sides with fourpenny nails spaced 4 to 6 inches apart. When demountability is specified, the sides and ends shall be fastened to the base with lag bolts.

ASSEMBLY INSTRUCTIONS (MIL-C-52950)

When specified, the contractor shall furnish applicable assembly instructions.

Tolerances

A tolerance of plus or minus 1/8 inch is allowable on the overall length and width of individual crate panels. Out-of-square deviations of individual panels shall be not more than 3/16 inch (3/8 inch different in diagonals).

Workmanship

Crate panels shall be clean and free of slivers and protruding nail points. Crate panels be square and free of cracks, splits, or other damage which would prevent easy and correct assembly.

Table 6-8. Member Sizes and Spacing for Type III, Style B Crates

	Member Size					Member spacing		
	Depth of Crate			Width of Crate		Length of Crate		
Member	0-8 inches	Over 8 to 12 inches	Over 12 inches	0 to 24 inches	over 24 inches	0 to 10 feet	Over 10 to 20 feet	Over 20 feet
	(inches)	*(inches)*	*(inches)*	*(inches)*	*(inches)*	*(feet)*	*(feet-inches)*	*(feet)*
Longitudinal members	1 X 3	1 X 4	1 X 6					
Vertical end cleats	1 X 3	1 X 4	1 X 6					
Horizontal end cleats	1 X 3	1 X 4	1 X 6					
Top and bottom crossmembers				1 X 4	1 X 6	2	2-6	3
Rubbing strips				3 X 4	3 X 6			

Table 6-9. Frame Member Sizes for sides of Type V, Style B Crates

Limits of Dimensions and Net Loads				Member Sizes (nominal)				
		Max. Strut. Spacing (on center)		Longitudinals				
Length	Net Load	Single Panel	Double & Triple Panel	Upper	Lower	Intermediate	Struts	Diagonals
(foot)	*(pound)*	*(inch)*	*(inch)*	*(inch)*	*(inch)*	*(inch)*	*(inch)*	*(inch)*
12	300	42	42	1 x 4	1 x 3	1 x 3	1 x 3[1]	1 x 4
32	500	48	54	1 x 6	1 X 4	1 X 4	1 x 4[1]	1 X 4
28	1000	42	54	1 x 6	1 x 4	1 x 4	1 x 4[1]	1 x 4
24	2000	36	48	1 x 6	1 x 6	1 x 6	1 x 6	1 x 6
20	3000	36	48	1 x 8	1 x 6	1 x 6	1 x 6[2]	1 x 6
16	4000	36	42	1 x 8	1 x 8	1 x 8	1 x 8	1 x 8

[1] For edge struts use 1 x 4 except that 1 x 6 members shall be used when edge struts of ends are 2 x 4 inches in size.
[2] For edge struts use 1 X 8 members.

Table 6-10. Number and size of Lag Bolts Required to Assemble the Base (Demountable Base) of Type V, Style B Crates

	Total Minimum Number of Lag Bolts		
	Size of Both for Each Skid Size		
Gross Weight (Crate and Contents	5/16 X 3 inch bolt for 2X3 or 2 X 4-nch skid (flat)	3/8 X 3 inch bolt for 3 X 3 inch skid	1/2 X 3-1/2- inch lag bolt for 4 X 4-inch or two 2 X 4-inch skids (on edge and laminated)
pounds			
1000	8	8	6
2000	14	10	10
3000	18	16	12
4000	24	20	14
5000	30	26	18

Table 6-11. Classification of MIL-C-3774 Crates

Assembly	Maximum net load (lb)	Maximum dimensions		
		Length	Width	Height
Type I, Nailed[1]	12,000	16	8	8
Type II, Bolted[2]	16,000	40	8	16

[1] Nailed assembly - nondemountable.
[2] Bolted assembly - demountable.

OPEN WOOD CRATES, MIL-C-3774 (GENERAL)

CRATE DESIGN

The open crates covered by MIL-C-3774 consist of framing members partially sheathed in specified areas. This sheathing is applied to protect the enclosed item and acts as a reinforcement to the sides, ends, and top of the crate. These crates are designed to carry large or heavy items. A minimum of 1-inch clearance is required between the item and the nearest framing member of the sides, ends, and top.

Classification

Crates designed under this specification may be either bolted or nailed (table 6-11).

Open Bolted Crates (Demountable)

These crates are designed to withstand a superimposed load of 200 pounds per square foot on the top, including dunnage. These crates may be used as reusable containers.

Open Nailed Crates (Nondemountable)

Crates designed under this classification are considered to be "one trip" containers. This type may be constructed with a skid-or sill-type base.

Lumber Requirements

Lumber

Lumber used in crate construction must meet the same rigid requirements as for other wooden containers. Lumber used in crate construction shall be free of defects that would materially weaken the container.

Plywood

Requirements for plywood are stated in A-A-55057.

Fasteners

Nails, strapping, bolts, etc., are commonly used.

OPEN BOLTED CRATES (MIL-C-3774)

DESIGN REQUIREMENTS

Demountable crates are designed and constructed so that the major components may be readily assembled or disassembled without damage to the component parts. This is accomplished through the use of lag bolts or bolts (fig 6-5).

Fabrication of Open Bolted Crates

Skid base

Skids

The size of the skids is based upon the net load and the outside length of the crate, as stated in table 6-12. The number of skids are dictated by the item being packed. However, the clear distance between any adjacent skid is limited to 48 inches center to center (fig 6-39).