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MILITARY SPECIFICATION

CRATES, WOOD; OPEN
 12,000- AND 16,000-POUND CAPACITY

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

1 Scope

1 1 Scope. This specification covers open crates

1 2 Classification The crates shall be of the following types and styles, as specified (see 6.2).

Type I - Nailed (for loads not exceeding 12,000 pounds or sizes not greater than 16 feet in length, 8 feet in width, and 8 feet in height.

Style A - Skid base, nailed assembly.

Style B - Sill base, nailed assembly.

Type II - Bolted, fully demountable, skid base (for loads not exceeding 16,000 pounds or sizes not greater than 40 feet in length, 8 feet in width, and 16 feet in height) For further limitations based on load and length combinations see Table VIII and X.

2 APPLICABLE DOCUMENTS

2 1 Government documents

2 1 1 Specifications and standards The following specifications, standards, and handbooks form a part of this document to the extent specified herein Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDJSS) and supplement thereto, cited in the solicitation (see 6 2)

Beneficial comments (recommendations, additions, deletions) any pertinent data which may improve this document should be addressed to Commanding Officer (code 156), Naval Construction Battalion Center, Port Hueneme, CA 93043-5000, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or letter.
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FSC 8115

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MIL-C-3774B

SPECIFICATIONS

FEDERAL

- FF-B-561 - Bolts, (Screw) Lag
- FF-B-575 - Bolts, Hexagon and Square
- FF-B-584 - Bolts, Square Neck and Tee Head
- FF-N-105 - Nails, Brads, Staples and Spikes, Wire, Cut and Wrought
- FF-N-836 - Nut: Square, Hexagon, Cap, Slotted, Castle, Knurled, Welding and Single Ball Seat
- NN-P-530 - Plywood, Flat Panel

STANDARDS

MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes
- MIL-STD-129 - Marking for Shipment and Storage
- MIL-STD-731 - Quality of Wood Members for Containers and Pallets
- MIL-STD-1186 - Cushioning, Anchoring, Bracing, Blocking and Waterproofing, with Appropriate Test Methods

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Document Order Desk, Bldg 40, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2 2 Other Government documents, drawings and publications The following other Government documents, drawings, and publications form a part of this specification to the extent specified herein Unless otherwise specified, the issues are those cited in the solicitation (see 6 2)

ASTM

- ASTM D 3953 - Standard Specification for Strapping Flat Steel and Seals
- ASTM D 4442 - Standard Test Methods for Direct Moisture Content of Wood and Wood-Base Materials
- ASTM D 4444 - Standard Test Methods for Using and Calibration of Hand-Held Moisture Meters

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

NATIONAL MOTOR FREIGHT TRAFFIC ASSOCIATION, INC , AGENT

National Motor Freight Classification

(Application for copies should be addressed to the American Trucking Association, Inc , Traffic Department, 1616 P Street, N W , Washington, DC 20036)

MIL-C-3774B

UNIFORM CLASSIFICATION COMMITTEE, AGENT

Uniform Freight Classification

(Application for copies should be addressed to the Uniform Classification Committee, Tariff Publishing Officer, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for related associated detailed specifications, sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained

3. REQUIREMENTS

3.1 Preproduction pack. When specified (see 4.3 and 6.2) the contractor shall furnish a preproduction pack for examination and test within the time frame specified (see 6.2) to prove prior to starting production packaging, that the applied preservation, packaging, packing, and marking comply with the requirements of this specification. Examination and test shall be as specified in section 4 and shall be subject to surveillance and approval by the government (see 6.3)

3.2 Materials. Material shall be as specified herein and in applicable specifications and standards, and other referenced documents. Materials not specified shall be selected by the contractor and shall be subject to all the provisions of this specification. Materials shall be free of defects which adversely affect performance or serviceability of the finished product (see 6.4)

3.2.1 New materials. The use of newly developed packaging materials or procedures are encouraged and recommended and shall be permitted under conditions specified herein, provided they are equal or better than the specified materials or procedures

3.2.2 Safety. Materials used for the crates shall present no environment or toxicological hazards as defined by current industry standards or applicable federal or state laws or regulations.

3.2.1 Lumber. Wood members shall be selected from the wood groups listed in and shall conform to the requirements of MIL-STD-731 as follows

- Class 1 - All load-bearing floorboards, Skids and all framing members
- Class 3 - All rubbing strips and non-load-bearing floorboards

Unless otherwise specified herein, the nominal sizes as specified in MIL-STD-731, Table I shall be the minimum acceptable sizes for lumber components

MIL-C-3774B

3 2 2 Plywood Unless otherwise specified (see 6.2), plywood shall conform to NN-P-530, type II, class 1 or 2

3 2 3 Nails and staples Nails and staples shall be steel and shall conform FF-N-105.

3 2 4 Bolts and nuts Bolts shall conform to FF-B-575, FF-B-584, and FF-N-836, type and style as applicable.

3.2.5 Lag bolts. Lag bolts shall conform to FF-B-561, Type and grade as applicable.

3 2.6 Metal strapping Strapping used to reinforce crates shall conform to ASTM D 3953 Type 1, 2, or 3 as applicable. Strapping finish shall be as specified herein

3 3 Construction (for definitions see 6.8)

3 3 1 Nail application The following rules shall be followed to determine the size, placement, and quantity of nails for fabrication and assembly of the crates when not specifically covered in detailed requirements.

3.3.1.1 Nail types All nails, that are not clinched shall be cement coated or etched (see 6 9). Nails used for assembly (nailing of side, end, top and base panels to form the crate) shall be cement-coated countersunk head (sinkers), cement-coated standard (coolers), cement-coated countersunk railroad (corkers), or common

3 3.1.2 Fastening methods Nails shall be driven through the thinner into the thicker member whenever possible. When the flat faces of two pieces of lumber, whose combined thickness is 3 inches or less, are nailed together, nails used shall be long enough to pass through both pieces and shall be clinched not less than 1/4 inch. Unless otherwise specified (see 6.2), nails shall not be clinched when the combined thickness of two pieces is more than 3 inches or when the flat face of one or more pieces is nailed to the edge of another. Unclinched nails shall be as long as practicable without splitting the material. However, that portion of the nail in the thicker piece shall be not less than two times the length of the nail in the thinner piece for tenpenny nails and smaller, and not less than 1 1/2 inches for twelvepenny nails and larger

3.3.1.3 Nailing patterns The pattern to be used for the fabrication nailing (fastening together of wood parts to form panels) of two flat pieces of lumber shall follow the patterns shown in figure 1. Nailing of members to the edges of other members shall conform to details shown in figure 1 when not otherwise specified herein. Nail sizes designated in table VII for assembly of crates are based on group I and II woods. When group III and IV woods are used, nail sizes shall be not more than onepenny size smaller than those specified

3 3 2 Lag bolt application The portion of the lead hole for the shank of the lag bolt shall be the same diameter as the shank. The portion of the lead hole for threads of lag bolts shall be as shown in table I

3 3 3 Bolt application Countersinking of bolts shall not be permitted. Holes shall be prebored to receive bolts and shall be the exact diameter of the

MIL-C-7748

bolt shank. A flat washer shall be used under the head and nut of each machine bolt and under the nut of each carriage bolt and step bolt.

3.3.4 Splicing Splices and butt joints in frame members and skids of long crates shall be as shown in figure 2.

TABLE I. Lead holes for lag bolts

Diameter of threaded portion of lag bolt	Diameter of lead hole	
	Group I, II, and III woods	Group IV woods
	Inch	Inch
1/4	3/16	3/16
5/16	1/4	1/4
3/8	1/4	5/16
1/2	3/8	3/8
5/8	3/8	1/2
3/4	1/2	5/8

3.3.5 Clearance. A minimum clearance of 1 inch shall be provided between the contents and the inner surfaces of the sides, ends, and top of all crates

3.4 Type I, nailed crates. The dimensions of the crates shall be as specified (see 6.2) but shall not exceed the maximum dimensions specified in 1.2 for type I crates.

3.4.1 Skid base (style A) The skid base shall be constructed of longitudinal skids framed with crossmembers. Construction shall be as shown in figures 3 or 4, as applicable, and as specified herein. Variations in skid bases for high, narrow crates (when height is three or more times greater than width) shall be as shown in figure 4 and as specified in 3.4.1.5

3.4.1.1 Skids. Any species of wood except group I shall be used for skids. Skids shall be spaced no further apart than 48 inches, center to center, across the width of the skid base. Where a heavy concentrated load is involved, intermediate skids may be placed closer together under the points of load concentration. The minimum sizes in table II shall be followed, and when either the crate length or net load exceeds the maximum shown, the next larger skid shall be used. The 2- by 4- and 3- by 3-inch skids shall be used in one piece without splices.

TABLE II Skid sizes

Maximum net load	Maximum length of crate	Size of skids
Pounds	Feet	Inches
500	12	2 x 4
2,000	12	3 x 3
10,000	16	4 x 4
12,000	16	4 x 6 (on edge)

MIL-C-3774B

3 4 1 2 Rubbing strips Rubbing strips shall be used on each skid, and shall be made of 2-inch-thick lumber, and be approximately the same width as the skid. Rubbing strips shall be attached to the skid with two rows of twelpenny nails staggered and spaced 12 inches apart in each row. The strips shall be beveled full depth at an angle of 45 degrees, and provisions shall be made at each end for sling handling and at the center of balance for forklift handling (see figure 3)

3 4 1 3 End headers The end headers shall be located as shown in figures 3 and 4 and shall be bolted to each skid with one carriage bolt. The sizes of end headers and bolts are outlined as follows:

Skid size (inches)	Header size (inches)	Bolt diameter (inch)
2 x 4	2 x 4	3/8
3 x 3	3 x 3	3/8
4 x 4	4 x 4	1/2
4 x 6 (on edge)	4 x 4	1/2

3.4 1.4 Load-bearing floorboards Load-bearing floorboards shall be placed where the concentrated loads occur. The cross section for various spans shall be specified in table X. The end floorboards of 2-inch flooring may be considered as load-bearing within limits of their assigned values. The load-bearing members shall be placed with the ends flush with the outside faces of the skids, as shown in figures 3 and 4, and bolted to each skid with carriage bolts. One bolt shall be used at each skid crossing for widths not exceeding 4 inches and two bolts, for greater widths. The size of carriage bolts shall be the same as those used in the end headers.

3 4 1 5 Forklift area flooring. The reinforcement of the base for forklift handling at the ends shall consist of one of the following, as specified (see 6 2)

- (a) Forklift headers spaced 20 and 40 inches from each header
- (b) 2-inch-thick boards extending 42 inches from each end
- (c) Plywood for narrow crates

Forklift headers shall be the same size as the end headers. The forklift headers shall be placed and bolted to the skids, including intermediate skids, as shown in figure 3. The flooring covering 42 inches of each end (see figures 3 and 4) shall consist of 2-inch boards and shall be bolted to the outer skids with 3/8-inch carriage bolts. When intermediate skids are used, the boards shall be fastened to the center skids with nails as specified in 3.3 1 and as shown in figure 1. For high, narrow crates (when height is three or more times the width) the base as shown in figure 4 shall be used. Plywood-sheathed bases shall be used when high, narrow crates are 30 inches or less in width. The 1/2-inch plywood shall cover the entire base and shall be nailed to the skids as shown in figure 4.

3 4 1.6 Diagonals Diagonals 1 by 6 inches in size shall be used between forklift areas and load-bearing floorboards, or between floorboards, and shall be nailed to the skids and to each other at the point of intersection. When intermediate skids are used, the diagonals shall be nailed to the intermediate skid. Nailing shall be as specified in 3 3 1 and as shown in figure 1.

MIL-C-3774B

Diagonals shall be placed in an X pattern as close to a 45 degrees as possible, except when the crate width is one and one-half to three times more than the distance between cross members, a single diagonal shall be used, and when the width of the crate is more than three times the distance between cross members, diagonals shall be omitted.

3.4.2 Sill base (style B) The sill base shall be constructed as shown in figure 5.

3.4.2.1 Sills. The load contained on sill bases shall be transmitted to the side sills by means of intermediate sills or by the end sills. The center-to-center spacing of any two adjacent sills shall not exceed 48 inches.

3.4.2.1.1 Side and end sills. The size of the side and end sills shall be as specified in table III. Exterior sills shall be placed on edge. The bottom sheathing shall be applied crosswise to the base, and the side sills shall be fitted to the end sills as shown in figure 5. Side and end sills shall be spliced or laminated as shown in figure 2 when necessary to meet the sizes in table III. Side, end, and intermediate sills shall be assembled by nailing through the side grain of one into the end grain of another with twentypenny nails in addition to metal hangers as specified in 3.4.2.1.3. Two nails shall be used for 2 by 4 members, three nails for 2 by 6 members, and four nails for wider members.

3.4.2.1.2 Intermediate sills. Intermediate sills shall not be required if the crate is less than 48 inches wide and all of the load is supported by the side and end sills. The size of the intermediate sills shall be as specified in table IV. The weight of the actual load supported by the sill shall be used to determine the size of an intermediate sill. Intermediate sills shall be attached at their ends to side or end sills by a combination of nailing and the use of metal strap hangers.

3.4.2.1.3 Strap hangers. Strap hangers shall be steel strapping conforming to ASTM D 3953, Type 3, size 1 1/4 by 0.035 inch, and 12 inches long, applied as shown in figures 7 and 13. Strap hangers shall not be required for nonload-bearing intermediate sills.

3.4.2.1.4 Bridging. Intermediate sills shall be bridged at their ends with 1-inch lumber and along their length, at intervals not exceeding 5 feet, with 2-inch lumber of the same depth as the sills and positioned at right angles to the sill (see figures 5 and 6). The bridge shall be fastened to side, end, and intermediate sills by toenailing with tenpenny nails. Two nails shall be used on each exposed side for 4-inch-deep members and three nails shall be used for wider members.

3.4.2.1.5 Bottom sheathing. Bottom sheathing shall be nailed to the bottom surface of sills at right angles to the direction of side sills. Sheathing boards shall be 4 to 10 inches in width, shall be of not less than 2-inch material, and shall be used in only the forklift area. Bottom sheathing shall extend 1/2 to 5/8 inch beyond the outside vertical face of all side sills (see figure 5). Bottom sheathing shall be one piece in length, and at least one diagonal shall be placed in the unsheathed portion of the base as shown in figure 5. Sheathing shall be nailed to sills with twelvepenny nails in patterns shown in figure 1.

MIL-C-3774B

3 4 2 1 6 Rubbing strips Crates shall have rubbing strips 2 inches thick in widths approximately the same as the sill but not less than 4 inches. The rubbing strips shall always be applied lengthwise of the crate and positioned under each longitudinal sill (see figure 7). When intermediate sills are crosswise, the rubbing strips shall be located directly under side sills and at intervals of not more than 30 inches. Where no sheathing is used between fork-lift areas, a filler shall be placed between the rubbing strip and the bottom of the side sill. Rubbing strips shall be nailed to the flooring with two rows of twelvepenny nails placed 12 inches apart in each row and staggered.

TABLE III Sizes of side and end sills

Net weight of contents Pounds	Height in feet	Length of crate (feet)			
		4	8	12	16
2,500 to 4,000	Over 3	2 x 4	2 x 4	2 x 6	2 x 6
	3 or under	2 x 8	2 x 8	2 x 6	2 x 6
4,001 to 6,000	over 3	2 x 4	2 x 6	2 x 6	2 x 6
	3 or under	2 x 8	2 x 6	2 x 6	2 x 6
6,001 to 8,000.	over 3	2 x 6	2 x 6	2 x 6	2 x 8
	3 or under	2 x 6	2 x 6	2 x 6	2 x 10
8,001 to 10,000	over 3	2 x 6	2 x 8	2 x 8	2 x 8
	3 or under	2 x 6	2 x 10	2 x 10	2 x 10
10,001 to 12,000.	over 3	2 x 8	2 x 8	2 x 10	2 x 10
	3 or under	2 x 10	2 x 10	2 x 12	2 x 12

TABLE IV. Allowable load for intermediate sills
(in pounds per inch of sill width)

Length of sill of sill Feet	Sill depth (inches, actual)				
	Group I and II woods				
	3 5/8	5 1/2	7 1/2	9 1/2	11 1/2
	Pounds	Pounds	Pounds	Pounds	Pounds
4	274	659	1,172	1,880	2,755
5	219	527	937	1,504	2,204
6	183	440	781	1,254	1,837
7.	157	377	670	1,074	1,574
8.	137	330	586	940	1,378
9.	122	293	521	836	1,224
10 .	110	264	469	752	1,102
11. ..	100	240	426	684	1,004
12.	91	220	391	627	920
13	84	203	361	579	850
14	78	188	335	537	786
15	73	176	313	501	735
16	68	165	293	470	690

Note: If group III or IV are used, the above allowable loads may be increase by 20 percent

MIL-C-37743

3 4 2 1 7 Drainage Sheathing boards shall be spaced 1/4 to 3/8 inch apart for drainage.

TABLE V. Panel member selection 1/

Length	Members	Net load	4-foot width				6-foot width				8-foot width			
			Height (feet)				Height (feet)				Height (feet)			
Feet		Pounds	2	4	6	8	2	4	6	8	2	4	6	8
6	Upper frame	6,000	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame	6,000	..	...	..	2x4	..	..	..	2x4	..	..	...	2x4
	Struts	6,000	...	..	...	2x4	..	..	...	2x4	...	..	...	2x4
	Diagonals	6,000	..	..	..	2x4	...	...	...	2x4	..	...	...	2x4
8	Upper frame	6,000	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame	6,000	...	...	...	2x4	..	...	..	2x4	...	..	...	2x4
	Struts	6,000	..	...	...	2x4	..	...	...	2x4	...	..	...	2x4
	Diagonals	6,000	...	...	...	2x4	...	...	...	2x4	..	...	...	2x4
10	Upper frame	6,000	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame	6,000	...	...	...	2x4	...	...	...	2x4	...	...	...	2x4
	Struts	6,000	...	..	..	2x4	..	..	..	2x4	...	..	..	2x4
	Diagonals	6,000	...	..	...	2x4	...	..	...	2x4	..	...	...	2x4
12	Upper frame	6,000	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame	6,000	...	...	..	2x4	...	...	...	2x4	...	...	...	2x4
	Struts	6,000	...	..	...	2x4	..	..	..	2x4	..	..	..	2x4
	Diagonals	6,000	...	...	...	2x4	..	..	..	2x4	..	...	..	2x4
16	Upper frame	6,000	2x6	2x4	2x4	2x4	2x6	2x4	2x4	2x4	2x6	2x4	2x4	2x4
	Lower frame	6,000	..	..	..	2x4	..	..	..	2x4	...	..	...	2x4
	Struts	6,000	..	..	..	2x4	..	..	..	2x4	..	..	..	2x4
	Diagonals	6,000	..	..	..	2x4	..	..	..	2x4	...	..	..	2x4
6	Upper frame	8,000	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame	8,000	...	..	..	2x4	..	..	..	2x4	...	...	..	2x4
	Struts	8,000	..	..	..	2x4	..	..	..	2x4	...	..	..	2x4
	Diagonals	8,000	...	...	1x6	2x4	...	...	1x6	2x4	...	...	1x6	2x4
8	Upper frame	8,000	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame	8,000	...	..	..	2x4	..	..	...	2x4	...	..	...	2x4
	Struts	8,000	..	..	..	2x4	..	..	..	2x4	..	..	...	2x4
	Diagonals	8,000	..	...	1x6	2x4	..	..	1x6	2x4	...	..	1x6	2x4
10	Upper frame	8,000	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame	8,000	..	...	..	2x4	..	...	..	2x4	..	..	..	2x4
	Struts	8,000	..	..	..	2x4	..	..	..	2x4	..	...	...	2x4
	Diagonals	8,000	..	...	1x6	2x4	...	..	1x6	2x4	..	..	1x6	2x4
12	Upper frame	8,000	2x6	2x4	2x4	2x4	2x6	2x4	2x4	2x4	2x6	2x4	2x4	2x4
	Lower frame	8,000	...	...	...	2x4	..	..	...	2x4	...	...	...	2x4
	Struts	8,000	..	..	...	2x4	...	..	..	2x4	...	...	...	2x4
	Diagonals	8,000	..	..	1x6	2x4	..	..	1x6	2x4	..	..	1x6	2x4
16	Upper frame	8,000	2x6	2x4	2x4	2x4	2x6	2x4	2x4	2x4	2x6	2x4	2x4	2x4
	Lower frame	8,000	..	..	..	2x4	..	..	..	2x4	..	..	..	2x4
	Struts	8,000	..	..	..	2x4	..	..	..	2x4	..	..	..	2x4
	Diagonals	8,000	..	..	1x6	2x4	..	..	1x6	2x4	..	..	1x6	2x4

1/All blank spaces 1x4's

Note See text for size of end struts of sides

MIL-C-3774B

TABLE V Panel member selection Cont' 1/

Length	Members	Net load	4-foot width				6-foot width				8-foot width			
			Height (feet)				Height (feet)				Height (feet)			
			2	4	6	8	2	4	6	8	2	4	6	8
Feet		Pounds												
6	Upper frame	10,000	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame	10,000	..	.	.	2x4	...	...	...	2x4	.	...	2x4	2x4
	Struts	10,000				2x4	..		1x6	2x4		1x6	2x4	2x4
	Diagonals	10,000			1x6	2x4	.	..	1x6	2x4	1x6	..	2x4	2x4
8	Upper frame	10,000	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame	10,000	..		2x4	2x4	.	...	2x4	2x4	.	..	2x4	
	Struts	10,000		.	2x4	2x4	.	...	2x4	2x4		1x6	2x4	2x4
	Diagonals	10,000		1x6	2x4	2x4	1x6	1x6	2x4	2x4	1x6	1x6	2x4	2x4
10	Upper frame	10,000	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4	2x4
	Lower frame	10,000	.	.	.	2x4			..	2x4	.	..		2x4
	Struts	10,000			1x6	2x4	.	..	1x6	1x4	...	...	1x6	1x4
	Diagonals	10,000	.	1x6	1x6	2x4	1x6	1x6	1x6	2x4	1x6	1x6	1x6	2x6
12	Upper frame	10,000	2x6	2x4	2x4	2x4	2x6	2x4	2x4	2x4	2x6	2x4	2x4	2x4
	Lower frame	10,000		.	..	2x4	.	.	2x4	2x4	.	.	2x4	2x4
	Struts	10,000	.	...	1x6	2x4	..		2x4	2x4	.	..	2x4	2x4
	Diagonals	10,000	.	1x6	1x6	2x4	1x6	1x6	2x4	2x4	1x6	1x6	2x4	2x4
16	Upper frame	10,000	2x8	2x6	2x4	2x4	2x8	2x6	2x4	2x4	2x8	2x6	2x4	2x4
	Lower frame	10,000		.		2x4			2x4	2x4		.	2x4	2x4
	Struts	10,000	.	.		2x4	.		2x4	2x4		1x6	2x4	2x4
	Diagonals	10,000	1x6	1x6	1x6	2x4	1x6	1x6	2x4	2x4	1x6	1x6	2x4	2x6

1/All blank spaces 1x4's

Note: See text for size of end struts of sides.

3 4 3 Sides

3 4 3 1 Number and type of panels. Sides shall be constructed as shown in figures 8 and 9. In crates with style B (sill) bases, the sheathing of sides and ends shall extend below the lower frame member a distance equal to the sill depth. For crates up to 48 inches inside height, sides shall be constructed as shown in figure 8, and for crates over 48 inches to 96 inches inside height, sides shall be constructed as shown in figure 9. The number of panels for each full length side shall be determined by dividing the inside crate length by the inside height.

3 4 3.2 Frame members. The size of frame members of the sides for net loads up to 12,000 pounds shall be as specified in tables V, and VI, as applicable. If the exact net load or size is not given in the table, member sizes for the crate of the next greater net load or length, width, and height shall be used. The loads given in the tables are net loads, and the dimensions are inside measurements of the crate.

3 4 3.2 1 Upper and lower frame members. Upper and lower frame members shall be continuous. When splicing of the upper or lower frame members is required, the splicing shall be done as shown in figure 2, but 1-inch-thick members shall not be spliced. Splicing shall be made at a strut.

MIL-C-3774B

TABLE VI. Panel member selection 1/

Length	Members	Net load	4-foot width			6-foot width			8-foot width		
			Height (feet)	Height (feet)	Height (feet)	Height (feet)	Height (feet)	Height (feet)	Height (feet)	Height (feet)	Height (feet)
Feet		Pounds	4	6	8	4	6	8	4	6	8
6	Upper frame	12,000	..	..	..	..	..	..	..	..	..
	Lower frame	12,000	..	..	..	..	..	..	..	..	..
	Struts	12,000	..	..	..	..	..	..	..	..	..
	Diagonals	12,000	..	..	(*)	..	..	(*)	..	(*)	(*)
8	Upper frame	12,000	..	..	..	..	..	..	..	..	..
	Lower frame	12,000	..	..	..	..	..	..	..	..	..
	Struts	12,000	..	..	..	..	..	..	..	..	(*)
	Diagonals	12,000	..	(*)	2x6	..	(*)	2x6	..	(*)	2x6
10	Upper frame	12,000	..	..	..	..	..	..	..	..	..
	Lower frame	12,000	..	..	..	..	..	..	..	..	..
	Struts	12,000	..	..	..	..	..	(*)	..	..	2x6
	Diagonals	12,000	..	2x6	2x6	..	2x6	2x6	..	2x6	2x6
12	Upper frame	12,000	..	..	..	..	..	..	..	..	..
	Lower frame	12,000	..	..	..	..	..	..	..	..	..
	Struts	12,000	..	..	..	..	..	2x6	..	2x6	2x6
	Diagonals	12,000	..	..	2x6	..	2x6	2x6	..	2x6	2x6
16	Upper frame	12,000	..	..	..	..	..	..	..	..	..
	Struts	12,000	..	..	..	..	..	2x6	..	..	2x6
	Diagonals	12,000	..	..	2x6	..	..	2x6	2x6	2x6	2x6

1/ All blank spaces are 2x4's

Note. The above sizes are for uniform loads but apply also to concentrated loads where an asterisks is shown When an asterisk (*) is shown, increase the member size to a 2x6 for concentrated load

3.4.3.2.2 Vertical struts and diagonals. The vertical struts shall be continuous from the lower frame member to the upper frame member, and the diagonals and horizontal braces shall be cut in between the vertical struts All end vertical struts (corner posts) of the sides shall be a least 2 by 4 inches in size to provide sufficient nailing space in fastening ends to sides during assembly.

3.4 3.2.3 Partial sheathing. Sheathing boards shall be one piece, nominal 1 inch in thickness, applied vertically No board shall be less than 4 inches nor more than 10 inches in width. End boards for all sides shall be not less than 6 inches wide and preferably wider No more than 10 percent of the boards shall be of minimum width, nor shall narrow boards be used adjacent to each other. While figures 8 and 9 show a number of sheathing boards, this number will vary depending upon the quantity required to receive sufficient nailing to carry the internal load as specified in 3 4.6.3 and table VIII However, there shall be a minimum number of boards as shown in figures 8 and 9 to hold the diagonals and horizontal braces in place. If more than the minimum number are required for assembly nailing, the additional boards shall be placed near the center of the side or at the load-bearing points When specified (see 6.2), plywood strips shall be substituted for lumber in sides, ends, or tops These strips shall have a width equal to the sum of the widths of lumber sheathing

MIL-C-3774B

boards required at any one place. The strips shall be either three- or five-ply and shall have a thickness of at least $7/16$ inch for group-I woods, $3/8$ inch for group-II woods, and $5/16$ inch for group-III or -IV woods for gross loads up to 5,000 pounds. For loads 5,000 to 10,000 pounds, the strips shall have a thickness of at least $1/2$ inch for group-I woods, $7/16$ inch for group-II woods, and $3/8$ inch for group-III or -IV woods. For loads over 10,000 pounds, plywood sheathing strips shall have a thickness of $3/4$ inch for group-I woods, $5/8$ inch for group-II woods, and $1/2$ inch for group-III or -IV woods.

3 4 3.3 Nailing.

3 4.3 3 1 Lumber sheathing Nails fastening sheathing boards to frame members up to and including 2-inch thickness shall be clinched a minimum of $1/4$ inch. In nailing lumber sheathing to horizontal members and diagonals 4 to 6 inches wide, three rows of nails shall be used (see figure 10). There shall be a minimum of three nails in sheathing boards from 4 to 6 inches wide where they cross frame members and not less than four nails in wider boards. For nailing lumber sheathing to vertical frame members, two rows of nails shall be used. The nails shall be placed on 6-inch centers in each row and staggered between rows (see figure 10).

3 4 3.3.2 Plywood sheathing The length of nails for fastening plywood to the frame members shall be not less than the sum of the thickness of the plywood and the frame members plus $1/4$ inch. The nailheads shall be against the plywood. The nails shall be staggered in two parallel rows in each frame member up to 4 inches wide and in three rows in wider frame members. Nails shall be placed not less than $1/2$ inch from the edge of the frame members. The distance between adjacent nails in any row shall not exceed 6 inches. The distance between rows of nails shall be not less than 1 inch. All nails shall be clinched.

3 4.3 4 Gusset plates When the crates are constructed with 1-inch frame members and partial lumber sheathing, $1/4$ -inch plywood gusset plates shall be used. The minimum dimensions of gussets shall be 12 inches for 1-by 4-inch struts or diagonals and 18 inches for 1-by 6-inch frame members. The corners of the gussets shall be placed at the centerline of the diagonals (see figure 11). Gussets shall be placed where the diagonals contact the vertical struts and horizontal braces and where diagonals cross each other. Gusset plates shall be nailed to the back face of frame member as shown in figure 11. The nails shall be clinched on the lumber sheathing. When plywood is substituted for lumber sheathing, plywood gussets shall not be required.

3 4 4 Ends

3 4.4 1 Number and types of panels. The number and type of panels and the size of members shall be similar to the sides, (see 3 4 3), except that all strut sizes shall be as specified in tables V, or VI, as applicable. Arrangements of members shall be as shown in figures 8 and 9. Gusset plates as specified in 3 4 3 4 shall be used. Nailing of the ends shall be as specified in 3 4.3 3.

3 4 5 Top

MIL-C-37748

3.4.5.1 Number and types of panels. The number of panels shall be determined by dividing the inside crate length by the inside crate width and using the nearest whole number. The arrangement of members and type of panels for narrow, medium, and wide tops shall follow the details shown in figure 12. Partial sheathing shall be as specified in 3.4.3.2.3. Gusset plates shall be as specified in 3.4.3.4 and shall be placed crosswise to the length of the crate.

3.4.5.2 Frame members. Tops shall have 1-by 6-inch frame members for widths of 25 inches or greater and 1-by 4-inch members for widths of 24 inches or less. Longitudinal members shall be continuous.

3.4.5.3 Top bracing joists. Joists shall be used as outlined for tops of bolted crates (see 3.5.4.4). The sizes shall comply with table XII. Joists shall extend between the upper frame members of the sides when the crate is assembled. Thus the ends of the joists shall be positioned back from the outer edges of the longitudinal members a distance equal to the thickness of the upper frame members of the sides (see figure 12).

3.4.5.4 Nailing

3.4.5.4.1 Lumber sheathing to frame members. Nails used to fasten sheathing 1-inch frames members shall be clinched at least 1/4 inch. Lumber sheathing shall be nailed to the side frame members, intermediate members, and diagonals in patterns shown in figure 1. In fastening sheathing to the end frame members, nails shall be placed not less than 3/4 inch from the inside edge of the frame member. Sheathing shall be nailed to struts with nails not less than 3/4 inch in from each edge of the frame members. Joists shall be nailed to longitudinal members with nails at each crossing as specified in 3.3.1.3.

3.4.5.4.2 Plywood sheathing to frame members. When plywood strips are substituted for lumber sheathing (see 3.4.3.2.3), the nails through the plywood and intermediate members shall be staggered in two parallel rows and spaced 6 inches apart in each row. Nails shall be placed 3/4 inch from the edges of the frame members. Nailing of plywood to struts and diagonals shall be as specified in 3.4.5.4.1.

3.4.5.5 Gussets. Plywood gussets as specified in 3.4.3.4 shall be used for tops over 40 inches in width and placed as shown in figure 12.

3.4.6 Assembly

3.4.6.1 Sides, ends, and top. The sides, ends, and top shall be fastened together by nailing as shown in figure 13, 14, and 15, and as specified in table VII. When holes are drilled for large nails, a drill bit not greater than 75 percent of the diameter of the nail shank shall be used.

3.4.6.2 Ends to sill or skid base. The end sheathing shall be fastened to the end sills of a sill base or the end headers of a skid base with eightpenny nails (minimum) for 1-inch lumber sheathing and plywood 1/2 inch or more in thickness. Plywood less than 1/2 inch shall be nailed with sevenpenny nails (minimum). Nails shall be spaced no more than 3 inches apart, but the total number shall be not less than specified in table VIII for various gross weights.

MIL-C-3774B

TABLE VII Nailed crate assembly

Fasten		Size and type of nail	Maximum spacing	Notes
Part	To part			
Corner strut of end (1-inch member)	Corner strut of the side	12d	Inches 12	
Corner strut of end (2-inch member)	Corner strut of the side	20d	12	Predrill through sheathing of end and corner strut of end.
Sheathing of side	Corner strut of the end	8d	6 to 8	Stagger
Edge frame member of top-(through sheathing).	Upper frame member of sides	12d	6 center to center	
Edge frame member of top	Upper frame member of sides	8d	6 to 8	Space nails between top sheathing
End strut of top	Upper frame member of end	12d	6	

One-half the total number of nails shall be placed on each side. When the total number of nails required provides spacing less than a minimum of 1 1/2 inches, additional sheathing shall be used. One row of nails (staggered) shall be used for 2-inch-deep skids, two rows for 3- or 4- inch-deep sills or skids, and three rows for deeper members (see figures 13 and 14).

3.4 6 3 Sides to sill or skid base Lumber sheathing and plywood sheathing 1/2 inch and greater in thickness shall be nailed to the skids or the side sill with eightpenny nails (minimum). Plywood sheathing less than 1/2 inch thick shall be nailed with sevenpenny nails (minimum). Nails shall be placed no more than 3 inches apart but the total number shall be not less than specified in table VIII for various gross weights. One-half the total number of nails shall be placed on each side. When the total number of nails required provides spacing less than a minimum of 1 1/2 inches, additional sheathing shall be used. One row of nails (staggered) shall be used for 2-inch-deep skids, two rows for 3- or 4- inch-deep sill or skids, and three rows for deeper members (see figures 13 and 15).

3.5 Type II, bolted crates The dimensions of the crate shall be as specified (see 6 2), but shall not exceed the maximum dimensions specified in 1 2 for type II crates.

3 5 1 Skid base The skid base shall be constructed of longitudinal skids framed with cross members. Construction shall be as shown in figures 16 or 17, as applicable, and as specified herein. Variations in skid bases for high, narrow crates (when height is three or more times greater than width) shall be as shown in figure 4 and as specified in 3 5 1.5.

MIL-C-3774B

Table VIII. Nails per each 1,000-pound gross load,
nailing side sheathing to skids or sills and
end sheathing to headers and sills

Nail		Wood group of skids		
Type	penny size	II	III	IV
Common	7	20	21	16
Sinker or cooler.. . . .	7	23	26	19
Sinker or cooler.....	8 or 9	19	21	16
Sinker or cooler...	10	18	19	14
Corker.	8 or 9	17	19	14

3.5 1.1 Skids Any species of wood except group I shall be used for skids. Skids shall be spaced no further apart than 48 inches, center to center, across the width of the skid base. Where a heavy concentrated load is involved, intermediate skids may be placed closer together under the points of load concentration. The minimum sizes in table IX shall be followed, and when either the crate length or net load exceeds the maximum shown, the next larger skid shall be used. When 4- by 4- and 4- by 6-inch skids require splicing for lengths greater than 16 feet, the splicing details shall be as shown in figure 2. The 2- by 4- and 3- by 3-inch skids shall be used in one piece without splices.

TABLE IX Skid Sizes

Maximum net load	Maximum length of crate	Size of skids
Pounds	Feet	Inches
2,000	12	3x3
4,000	1/ 40	4x4
5,000	20	4x4
10,000	16	4x4
5,000	32	4x6 (on edge)
16,000	20	4x6 (on edge)

1/ For lengths over 32 feet, crate heights shall be not less than 8 feet

3.5.1.2 Rubbing strips Rubbing strips shall be used on each skid, shall be made of 2-inch-thick lumber, and shall be approximately the same width as the skid. Rubbing strips shall be attached to the skids with two rows of twelve penny nails staggered and spaced 12 inches apart in each row. The strips shall be beveled full depth at an angle of 45 degrees and provisions shall be made at each end for sling handling and at the center of balance for forklift handling (see figure 16)

MIL-C-3774B

3 5 1 3 End headers The end headers shall be located as shown in figures 16 and 17 and shall be bolted to each skid with one carriage bolt. The sizes of end headers and bolts are outlined as follows:

Skid sizes (inches)	Header size (inches)	Bolt diameter Inches)
3 x 3	3 x 3	3/8
4 x 4	4 x 4	1/2
4 x 6 (on edge)	4 x 4	1/2

3.5 1 4 Load-bearing floorboards. Loading-bearing floorboards shall be placed where the concentrated loads occur. The cross section for various spans shall be as specified in table X. The end floorboards of 2-inch flooring may be considered as load-bearing within limits of their assigned values. The load-bearing members shall be placed with the ends flush with the outside faces of the skids, as shown in figures 16 and 17, and bolted to each skid with carriage bolts. One bolt shall be used at each skid crossing for widths not exceeding 4 inches and two carriage bolts for greater widths. The size of carriage bolts shall be the same as those used in the end headers.

Table X Allowable load per inch of floorboard width of groups I and II woods 1/

Distance between outside skids Inches	Thickness of load-bearing floorboards (inches) 2/					
	3/4	1 5/8	2 5/8	3 5/8	5 1/2	7 1/2
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
12	47	220	574	1,095	2,520	4,682
18	32	147	382	731	1,678	3,118
24	24	110	287	548	1,260	2,341
30	19	88	229	438	1,008	1,870
36	16	73	192	365	841	1,562
42	14	63	164	313	720	1,339
48	12	55	144	274	630	1,170
54	11	49	127	243	560	1,040
60	9	44	115	219	504	936
66	9	40	104	199	458	852
72	8	37	96	182	420	781
78	7	34	88	168	388	721
84	7	31	82	156	360	669
90	6	29	77	146	336	625
96	6	27	72	137	315	585

1/ If group III or IV woods are used, the above allowable loads may be increased by 20 percent

2/ Wood thickness shown is actual thickness.

3 5 1 5 Forklift area flooring. The reinforcement of the base for forklift handling at the ends shall consist of one of the following, as specified (see 6 2)

- (a) Forklift headers spaced 20 and 40 inches from each end header
- (b) 2-inch-thick boards extending 42 inches from each end
- (c) Plywood for narrow crates

MIL-C-3774B

Forklift headers shall be the same size as the end headers except that the ends of the forklift headers shall be flush with the outside faces of the outside skids. The forklift headers shall be placed and bolted to the skids, including intermediate skids, as shown in figure 15. The flooring covering 42 inches of each of each end (see figures 16 and 17) shall consist of 2-inch boards and shall be bolted to the outer skids with 3/8-inch carriage bolts. When intermediate skids are used, the boards shall be fastened to the center skids with nails as specified in 3.2.1 and as shown in figure 1. For high, narrow crates (when height is three or more times the width) the base as shown in figure 17 shall be used. Plywood sheathed bases shall be used when high, narrow crates are 30 inches or less in width. The 1/2-inch plywood shall cover the entire base and shall be nailed to the skids as shown in figure 17.

3.5.1.6 Diagonals. Diagonals 1 by 6 inches in size shall be used between forklift areas and load-bearing floorboards, or between floorboard and shall be nailed to the skids and to each other at the point of intersection. When intermediate skids are used, the diagonals shall be nailed to the intermediate skid. Nailing shall be as specified in 3.3.1 and as shown in figure 1. Diagonals shall be positioned as shown in figures 16 and 17. Diagonals shall be placed in an X pattern as close to a 45 degree angle as possible, except when the crate width is one and one-half to three times more than the distance between cross members, a single diagonal shall be used, and when the width of the crate is more than three times the distance between cross members, diagonals shall be omitted.

3.5.2 Sides. The construction of the sides shall conform to the details as shown in figures 18 and 19 and to the following paragraph.

TABLE XI Frame-member sizes
(sides of bolted crates)

Limit		Size of members		
Length	Net load	Upper frame members	Lower frame members	Horizontal braces 1/
Feet	Pounds	Inches	Inches	Inches
2/ 12	500	3/ 5/8x4	3/ 5/8x4	3/ 5/8x4
10	2,000	1x4	1x4	1x4
16	4,000	1x6	1x6	1x6
12	8,000	1x6	1x6	1x6
4/ 40	4,000	2x4	2x6	2x4
16	10,000	2x4	2x6	2x4
20	10,000	2x6	2x8	2x6
20	16,000	2x8	2x10	2x8

1/ For crate heights of 48 inches and over

2/ Size limits of crates. In addition to the 12-foot length and 500-pound gross weight limitations, this crate having 5/8-inch members shall be limited to 4-foot widths and 6-foot heights maximum.

3/ Actual thickness of members equals 5/8 inch.

4/ Crates over 32 feet in length shall be not less than 8 feet in height. Open bolted crates cannot be fabricated in lengths over 32 feet if the height is less than 8 feet. Long crates less than 8 feet high shall be fabricated in accordance with the requirements of MIL-C-104.

MIL-C-3774B

3 5 2 1 Member sizes

3 5 2 1.1 Longitudinal members. The upper and lower frame members and the horizontal brace shall be continuous except where sides are built in sections. To make members continuous, 2-inch material shall be spliced as shown in figure 2. The sizes of the members shall be as specified in table XI.

3.5 2 1 2 Corner struts. The corner struts which receive bolts or lag bolts from the ends of the crate shall be continuous from the upper to the lower frame member of the side and end header of the frame. When the top of the end header and top of the lower frame member are not even, the corner strut shall be notched. Corner struts shall be not less than 3 by 3 inches in size.

3 5.2 1.3 Corner sheathing. The corner sheathing boards of the sides shall be not less than 1 by 8 inches except that when diagonals are 5/8 inch thick the corner sheathing boards shall be 5/8 inch by 8 inches.

3.5.2.1 4 Diagonals. The sizes of diagonals shall conform to the following: (a) 5/8 inch by 6 inches for crates not exceeding 12 feet in length, 4 feet in width, and 6 feet in height with maximum net load of 500 pounds, (b) 1 by 8 inches for crates exceeding 32 feet in length and 12 feet in height; and (c) 1 by 6 inches for all other conditions. The spacing of the diagonals shall conform to the following:

Maximum spacing	Thickness of longitudinal members	Crate size	
		Height	Width
Inches	Inches	Feet	Feet
24	2	to 6	to 6
18	2	6-12	6-8
1/ 18	2	12-16	to 5
24	1	to 6	to 4
18	1	6-12	4-8

1/ For crates over 32 feet in length

One-half of the diagonals shall be nailed to the outside of the longitudinal frame members and the other half shall be nailed to the inside of the same members, sloped in the opposite direction (see figures 18 and 19). The points of fastening of the diagonals, except at the end ones, to the longitudinal members shall be the same for inside and outside diagonals to permit the same lag bolts or bolts to pass through both diagonals. At the ends of the upper and lower frame members where no diagonals are present on the inside surface of the member, a filler block 12 inches long, the same thickness as one diagonal and same width as the frame member, shall be used to provide continuous bearing. The number of diagonals is determined by the spacing of diagonals.

3 5 2 2 Nailing. The corner sheathing boards shall be nailed to the corner posts with two rows of tenpenny nails staggered and spaced 8 inches apart in each row. Corner sheathing shall be nailed to horizontal members in patterns as shown in figure 1. Nails shall be long enough to be clinched when 1-inch horizontal members are used and shall be sevenpenny nails for 2-inch members. Both inner and outer diagonals shall be nailed to each 2-inch horizontal member.

M L-C-3774B

with sevenpenny nails in patterns as shown in figure 1. The outer diagonals shall be nailed to each 1-inch horizontal member with six nails, three driven from each side, and clinched. The inner diagonals shall be nailed to each horizontal member with sevenpenny nails as shown in figure 1. When 5/8-inch frame members are used, the nail sizes shall be reduced as required.

3.5.2.3 Sides built in sections. If required for ease of handling of side panels of long, high crates, sides over 20 feet in length shall be built in sections as shown in figure 19.

3.5.3 Ends. The construction of the ends shall be as shown in figure 20 and to the following paragraphs.

3.5.3.1 Member sizes

3.5.3.1.1 Upper and lower frame members and horizontal brace. The upper and lower frame members and the horizontal brace shall have the same cross sectional area as the upper frame member of the sides. The horizontal brace shall be used for crate heights of 48 inches and greater and shall coincide with the horizontal brace of the sides.

3.5.3.1.2 Corner struts. The vertical struts of the ends shall have the same sectional area as the horizontal members of the end.

3.5.3.1.3 Corner sheathing. The corner sheathing boards shall be not less than 1 by 6 inches for net loads not exceeding 3,000 pounds and 1 by 8 inches for net loads over 3,000 pounds, except when members in the sides are 5/8-inch thick, the corner sheathing shall be 5/8 inch by 6 inches in size.

3.5.3.1.4 Diagonals. All diagonals of the same ends shall be 6 inches wide and the same thickness as the corner sheathing. There shall be one pair of cross diagonals when the wide of the crate is not more than 1 1/2 times the height, and two pairs of cross diagonals when the width is greater than 1 1/2 times the height. One-half of the diagonals shall be placed on the outside and one-half on the inside and sloped in the opposite direction. When more than one pair is used, the points of fastening near the center of the ends of the diagonals shall coincide so that the same lag bolt or bolt will pass through both. In high, narrow crates the diagonals shall be placed only on the outside of the ends over the corner sheathing boards as shown in figure 20. The number of diagonals shall be such that there are the same number in each direction, and the diagonals shall be placed at a 45 degree angle as nearly as possible.

3.5.3.1.5 Nailing. The corner sheathing boards shall be nailed to the struts with two rows of nails. Nails shall be staggered, spaced 8 inches apart in each row, and clinched. The horizontal members and diagonals shall be nailed together as outlined for the sides (see 3.4.3).

3.5.4 Top

3.5.4.1 Panels. The top shall be constructed as shown in figure 21 except that for high, narrow crates (where height is three times greater than the width), the top shall be constructed as shown in figure 22. The number of panels for standard tops shall be determined by dividing the length of the crate by the width and selecting the nearest whole number so that diagonals are at an

MIL-C-3774B

angle of approximately 45 degrees (see figure 21) The edge sheathing boards shall be 1 by 8 inches for all loads, and all diagonals shall be 1 by 6 inches except for those crates using 5/8-inch diagonals in the side and end panels. For these crates, edge sheathing boards and diagonals shall be 5/8-inch thick. The tops for narrow crates 30 inches or less in width shall be covered with 1/2-inch plywood sheathing (see figure 22) Tops for narrow crates over 30 inches in width shall be constructed with double diagonals, placing one-half on each side at an angle of approximately 45 degrees (see figure 22).

3.5 4.2 Framing members. The tops shall have framing members of 2 by 4 inches (on edge) or 3 by 3 inches for net loads not exceeding 4,000 pounds, and 4 by 4 inches for net loads over 4,000 pounds. Frame members shall be one piece or spliced and bolted as shown in figure 2.

3 5 4 3 Filler strips. Except those tops for high, narrow crates, 1 by 4 inch filler strips shall be nailed to the frame members between the diagonals for dunnage upon which superimposed loads may be placed.

3 5 4 4 Top bracing joists. All tops shall be provided with top bracing joists for grabhook lifting. A single joist shall be placed between the longitudinal frame members and at the center of balance. For long crates or for crates over 10,000 pounds in weight, two sets of joists shall be used and placed not more than 43 inches on each side of the center of balance. The sizes shall be as specified in table XII.

TABLE XII Joist sizes

Size of joist	Limits	
	Gross load	Length
	Pounds	(Crate width) Inches
Inches		
2x4	1,000	72
2x4	2,000	60
2x4	3,000	48
2x4	5,000	36
4x4	10,000	1/ 96
2/ 4x4	16,000	96

1/ Use two joists for greater widths of tops

2/ Use two joists (see 3 5 4 4)

3 5 4.5 Nailing. The frame members shall be fastened together by nailing. The 2 by 4 side frame members (on edge) shall be nailed to the end frame members and 2 by 4 joists with three twelpenny nails at each connection. The 3 by 3 and 4 by 4 end frame members and joists shall be fastened to the side frame members by toenailing with three tenpenny nails at each connection. The edge sheathing boards shall be nailed to the end frame members with eightpenny nails spaced 4 inches apart in a staggered row for 2 by 4 frame members and in two rows for larger members. The edge sheathing boards and the diagonals shall be nailed to the side frame members with eightpenny nails in patterns shown in figure 1. In wide tops, the crossed diagonals shall be nailed to each other in nailing patterns shown in figure 1. All nails shall be clinched. When plywood

MIL-C-37748

is used, it shall be nailed to the frame members with sevenpenny nails spaced 4 inches apart and staggered for 2- by 4-inch frame members and placed in two rows for larger members

3.5.5 Assembly.

3.5.5.1 Fasteners (see figures 23 through 26) Lag bolts or bolts shall be used in assembling sides, ends, tops, and base panels. When bolts are used, they shall be machine bolts and have a washer under both head and nut. Maximum spacing of lag bolts and bolts shall be as follows: 5/8-inch, 36-inch spacing, 1/2-inch, 30 inch spacing; and 3/8-inch, 24 inch spacing. When a single diagonal is on the outside, a filler the same thickness as the diagonals shall be placed between the frame member and the part to which the member is being fastened. When the single diagonal is on the inside, the length of lag bolt or bolt shall be reduced accordingly.

3.5.5.2 Sides to base The size and number of lag bolts or bolts used to fasten the sides to the base shall be as specified in tables XIII and XIV. When 2-by 4-inch skids are used in light crates, 5/16- by 4-inch lag bolts shall be used and spaced no more than 24 inches on center. One-half the number listed shall be used on each side of the crate. However, at least one lag bolt or bolt shall be used at each panel point (where ends of diagonals contact the upper and lower frame members). Assembly details shall comply with those shown in figures 23 to 26, inclusive. When connector plates are used (see figure 25 and 26) for heavier crates, the number of lag bolts or bolts required to fasten sides to base shall be reduced by one-half. For example, if the gross load is 10,000 pounds and connector plates are used, the number of lag bolts or bolts required shall be the same as shown in tables for 5,000-pound gross loads. One connector plate shall be used with each lag bolt or bolt, and it shall be placed between the inside diagonal or filler and the skid (see figure 25). The connector plates shall be placed so that the prongs that enter the diagonal member are located between the lag bolt or bolt and the end of the diagonal. A minimum of one lag bolt or bolt shall be placed at each intersection of a diagonal with the lower frame member of the side. If the number of lag bolts or bolts listed in the tables is greater than the number of intersections, the additional lag bolts or bolts shall be placed between the intersections near the center of the crate, a 1-inch filler piece being between the skid and the lower frame member of the side.

3.5.5.3 Sides to top For fastening the sides to the top, the size and length of lag bolts or bolts shall be selected on the basis of the combined thicknesses of the diagonal or diagonals, the upper frame member of the side, and the thickness of the side frame member of the top. When the sum of actual thickness is 4 3/4-inches or more, 1/2-inch diameter lag bolts or bolts shall be used. When the sum is less than 4 3/4 inches, 3/8-inch diameter lag bolts or bolts shall be used. When the 5/8-inch diagonals are used in the sides, 5/16-inch lag bolts or bolts shall be used to fasten sides to top. The length of the lag bolts shall be approximately equal to the sum of the thicknesses, and the length of the bolts shall be sufficient to receive a nut and a washer under head and nut. There shall be one lag bolt or bolt at each intersection of the diagonals with the upper frame member of the side.

MIL-C-2774B

3.5.5.4 Ends to sides, top, and base. The diameter and length of the lag bolts or bolts shall be as specified for fastening the sides to the top (see 3.5.5.3). For both standard ends (see figure 23) and the narrow ends (see figure 24), filler blocks shall be used in those fastening areas where a diagonal or a horizontal member is not present. When 5/8-inch frame members are used in the ends for loads not exceeding 500 pounds, 5/16-inch-diameter lag bolts or bolts shall be used. Location and placement of lag bolts or bolts shall follow the assembly details as shown in figures 23 to 26, inclusive.

3.6 Loading and closure When crates are furnished as filled containers, the waterproofing, anchoring, blocking, bracing, and cushioning of the contents shall be in accordance with MIL-STD-1186

3.7 Workmanship. Workmanship shall be of such quality so as to provide adequate protection, when packaged in accordance with the requirements contained herein, to prevent corrosion, deterioration, and physical damage during handling, shipment, and storage

4. QUALITY ASSURANCE PROVISIONS.

4.1 Responsibility for inspection Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility of compliance. All items shall meet requirements of section 3. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturer's operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Material inspection. The contractor is responsible for insuring that supplies and materials are inspected for compliance with all the requirements specified herein and in applicable referenced documents.

4.2 Classification of inspections The inspection requirements specified herein are classified as follows:

- a. Preproduction pack inspection (see 4.3)
- b. Quality conformance inspection (see 4.4)
- c. Packaging inspection (see 4.7)

MIL-C-3774B

4.3 Preproduction pack inspection When specified (see 3.1 and 6.2), a preproduction pack inspection shall be performed on one complete pack, packed as for shipment and meeting the requirements of this specification. This inspection shall include the examination of 4.6. The preproduction pack may be a preproduction model, first production model or a production unit. If a preproduction model is used, any preservation, packaging, and packing shall be removed by the contractor at no expense to the Government, when requested by the Government to facilitate comparison of the preproduction model and the production units.

4.4 Quality conformance inspection The quality conformance inspection shall include the examination of 4.6.

4.5 Sampling Sampling and inspection procedures shall be in accordance with MIL-STD-105. A unit of product shall consist of one exterior container or one unitized load, as applicable. All units of the same classification, offered for delivery at one time, shall be considered a lot for the purpose of inspection (see 6.5).

4.5.1 Examination. Samples selected in accordance with 4.5 shall be examined for the defects specified in 4.6.1.

4.5.2 Test Sampling selected in accordance with 4.5 tested as specified in 4.6.2. Inability to assemble the crate as specified shall be cause for rejection of the lot. The lot may be accepted after complete screening and correction of defects.

4.6 Inspection procedure

4.6.1 Examination The crate, or the unassembled components to make a complete crate, as applicable, shall be examined as specified herein for the following defects:

101. Dimensions of crates not as specified
102. Components of crates not as specified
103. Nail sizes, patterns, and application not as required
104. Assembly with lag bolts and bolts not as specified
105. Gussets not as specified

4.6.2 Tests.

4.6.2.1 Moisture content Moisture content shall as specified in MIL-STD-731 and determined by using Method A, oven-dry, of ASTM D 4442. If hand-held moisture meters are used they shall be in accordance with ASTM D 4444. A minimum of six readings, at least one reading on a frame member of each panel, shall be taken. The average of the six reading shall meet the requirements of 3.3.1.

4.6.2.2 Assembly test A crate shall be completely assembled to insure achievement of a container which can properly and easily assembled, which is square, and is of the proper size.

4.7 Packaging inspection The preservation, packing, and marking of the item shall be inspected to verify conformance to the requirements of section 5.

MIL-C 3774B

5 Packaging

5.1 Packing. Packing shall be level A or commercial as specified (see 6.2)

5.1.1 Level A Crates shall be unassembled with the base, sides, ends, and top secured together to form a single bundle. The bundle shall be secured with at least two straps conforming to ASTM D 3953, Type 1 or 2, and having a minimum size of 5/8 x 0.020 inch. Unless otherwise specified, strapping shall be finish B. When specified (see 6.2), strapping shall be Finish A. Strapping shall be located one-sixth the length of the bundle from each end, intermediate straps shall be used when the distance between straps exceeds 60 inches. Prior to bundling, the preserved assembly instructions shall be secured to the crate base in a protected location.

5.1.2 Commercial Crates shall be shipped either assembled or unassembled and bundled, as specified (see 6.2). When bundled, components panels for one complete crate shall be secured together or a number of like panels (sides, ends, base, etc.) shall be secured together in a manner which will assure carrier acceptance and safe delivery to destination at the lowest rating in compliance with Uniform Freight Classification rules or National Motor Freight Classification rules. Preserved assembly instructions, if required, shall be secured in a protected location on the bundle of complete crates or bundles of component panels.

5.2 Marking. Marking for shipment and storage shall be in accordance with MIL-STD-129.

5.2.1 Special marking When specified the following markings shall apply (see 6.2).

5.2.1.1 Grabhook area The grabhook area shall be marked GRABHOOK AREA

5.2.1.2 Center of balance The center of balance shall be marked in accordance with MIL-STD-129.

5.2.1.3 Sling points Sling points shall be legibly marked SLING HERE

5.2.1.4 Dunnage Top diagonal and sheathing shall be legibly marked USE DUNNAGE FOR STACKING

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory)

6.1 Intended use Crates covered by this specification are to be used for the shipment of items not requiring the protection of a fully sheathed crate. Care should be taken to insure that items fall within the dimensional and weight limits of the crate types.

6.2 Ordering data. Acquisition documents should specify the following

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

MIL-C-3774B

- b Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2 1.1 and 2 2).
- c Type and style of crate required (see 1 2)
- d When a preproduction pack is required and the time frame required for submissions of the preproduction pack (see 3 1 and 4 3)
- e Type of plywood required if other than as specified (see 3.2.2).
- f. Whether nails shall be clinched (see 3.3 1 2)
- g Dimensions of the crates required (see 3 4 and 3.5).
- h. The type of reinforcement required (see 3 4 1 5 and 3.5.1.5)
- i Whether plywood strips shall be substituted for lumber (see 3.4.3 2.3).
- j Whether packing is to be level A or Commercial (see 5 2)
- k Finish A strapping is required (see 5 2 1)
- l Whether Commercial packed crates shall be assembled or bundled (see 5.2.2).
- m. When special marking is required (see 5.3.1)

6 3 Preproduction pack Any changes or deviations of production packs from the approved preproduction pack shall be subject to the approval of the contracting officer Approval of the preproduction pack shall not relieve the supplier of his obligation to preserve, package, pack and mark the cable in accordance with this specification

6 4 Recycled materials. Recycled materials are encouraged for use as long as they meet the requirements specified herein and in applicable specifications, standards, and other reference documents (see 3 2)

6 5 Sampling procedures

6 5.1 Sampling for examination. Recommended Inspection level is S-2 and acceptable quality level is 2 0 (see 4 5)

6 5 2 Sampling for tests Recommended Inspection level is S-2 and acceptable quality level is 2 0 (see 4 5)

6 6 Design methods. This specification outlines a method for designing open crates fully capable of resisting stresses to which a crate may normally be subjected (including superimposed top loads of 200 pounds per square foot with dunnage) and which will support its gross weight when lifted by grabhooks or slings or handled by forklift trucks Top joists, to carry superimposed loads, have been eliminated so as to save material and cubage, therefore, these crates are not capable of carrying top loads without dunnage Bolted crates have double sets of diagonals in the sides and ends and normally require less lumber than nailed crates Since each nail can carry only a given load, more nails are required to assemble crates with greater loads. This requires more sheathing to nail into, with a net reduction in the lumber saving as compared to completely sheathed crates

6 6 1 Selection In selecting the applicable design of a crate for one or more articles, the objective is an adequate shipping container which will assure the arrival of the articles without mechanical damage The total weight of the articles, the required inside dimensions of the shipping container, and the future use of the container after reaching its destination are the principle

MIL-C-3774B

factors in determining the applicable style of container. Figures 3 and 4 illustrate the skid base and figure 5 illustrates the sill base. Where an article has parts reaching below the bearing points (such as a motorcar axle), the sill base is preferable because the gear case can extend downward between the sills, thus saving depth in the crate construction. Where an article is flat on the bottom (such as a planer), the skid base is preferable because the depth is saved, since the distance from the top of the load-bearing floorboards to the underside of the crate is less than in a sill base. The bolted crate allows for easy removal of the crate panels and removal of the item.

6.6.2 Minimum cubage. Crates should be of the smallest dimensions consistent with adequate rigidity, strength, and protection to the contents against external loads which may be applied incidentally to handling, shipment, and storage. If space can be saved by disassembling the items and crating in two or more shipping containers, this method should be considered subject to the approval of the bureau or agency concerned. However, the advantages of minimum cubage should be carefully weighted against the increase in time and labor of disassembly of articles at the shipping point and reassembly of the articles at the receiving destination.

6.7 Estimate of tare weight of crate.

6.7.1 Weight. The approximate tare weight of the crate is estimated in the following paragraphs for the two types of crates. The gross weight (item weight plus crate weight) is required to determine the total number of nails, lag bolts, or bolts needed to fasten the sides to the base. Outside dimensions are figured to the nearest foot or half foot. The total outside area of sides, ends, top, and base is computed in square feet.

6.7.2 Bolted crates. Multiply the entire crate area, in square feet, by 2.5 for the tare weight of all crates 4 feet or less in width and having a net load of 5,000 pounds or less. For each 1 foot or fraction thereof of increase over 4 feet in outside width, add 0.1 to the multiple 2.5. For each increase of 1,000 pounds over 5,000 pounds in net load, add 0.1 to the multiple 2.5. For example, for a crate 6 feet wide and carrying a net load of 9,000 pounds the multiple would be $2.5 + 0.4$, or 3.1.

6.7.3 Nailed crates. Following the same procedure as given for bolted crates, except the multiple shall be 3.0 instead of 2.5, and it shall be increased in the same manner as given for crates of over 4 feet in width or carrying a net load over 5,000 pounds.

6.8 Definitions.

Center of balance - That location along the length of a completely packed crate at which it would balance on a fulcrum placed across the crate at right angles to the sides. The center of balance may be determined by placing the crate on a single roller and moving the crate on the roller until it balances.

Cubic displacement - For a crate it is calculated from the outside dimensions in feet and inches, stated in decimals of a foot. Multiply length by width by height.

MIL-C-3774B

Frame members - Those parts which form the fundamental structure of the crate and upon which the strength and rigidity of the crate depends

Diagonals - For nailed crates diagonals are those frame members positioned between parallel frame members and placed as nearly as possible at angles of 45 degrees to the edge members. Diagonals for bolted crates are nominal 1-inch members running diagonally from the upper to the lower frame members of the sides and ends

End frame - The end struts of the top panels

Filler strips - The boards placed between or across the ends of diagonals of nailed crate bases. Filler strips may also be short pieces of nominal 1-inch boards to fill the gaps between the upper or lower frame members of the sides or ends and the skids or top frame members of bolted crates to give a uniform bearing for lag bolts or bolts. Filler strips may be pieces of nominal 1-inch board placed between the ends of the diagonals in the tops of bolted crates to give a uniform bearing for superimposed loads

Hanger metal - A metal nailed strap used to aid in support of intermediate sills in a sill base

Headers - Cross members in a skid base located at the ends and attached to the skids

Horizontal braces - The members positioned between and parallel to the lower and upper frame members

Inside dimensions - As considered in this specification are the shortest distance between the inside surfaces of opposite members

Intermediate members - The frame members in the top panel of nailed crates running the long way of the crate and located between the side frame members

Load-bearing floorboards - Crosswise members used to transfer the loads to the outside skids.

Outside dimensions - The extreme overall length, width, and height of the crate or its contents, whichever is greater. The outside height of a crate includes the rubbing strips

Rubbing strips - The boards nailed to the underside of sill-based crates to protect the floor sheathing and nailed on the bottoms of skids to skid-based crates for sling and forklift handling

Sheathing - The plywood or boards nailed to the frame members and partly enclosing the nailed crates. Usually, that nailed to the top of the crate is called top sheathing, that used on the sides and ends is called side or end sheathing, and that nailed to skids are called floorboards

Side frame members - Edge members of the top which run in the long dimension and tie the top together

MIL-C 3774B

Sills - The enclosed structural frame members of the sill base. There are side, end, and intermediate sills

Sill bridging - Consists of spacers used between sills to prevent lateral turning or buckling of sills.

Skids - The primary lengthwise frame members of the base.

Struts - Frame members placed between and perpendicular to the upper and lower frame members in the side and end panels of nailed crates; also between side frame or intermediate members in top panels of nailed crates.

Top bracing joist - Member extending across the crate underneath the top used to prevent crushing when slings or grabhooks are used

Upper and lower frame members - Members are those horizontal members at the top and bottom of the side and end panels which serve to tie the construction together

6 9 Nail etching A simple etching procedure provides for immersing nails in monoammonium phosphate solution. The following steps are suggested

- a Prepare a 10 percent solution (by weight) of commercial monoammonium phosphate in water Do not use metal container for preparing or storing solution Keep solution near room temperature (about 70 degrees F).
- b Immerse nails in solution for about seven hours, stirring occasionally Five gallons of solution is sufficient to etch about 100 pounds of nails.
- c At end of etching period remove nails and rinse with water
- d Air-dry nails to prevent rusting.

6 10 Subject term (key word) listing

Bolted Members
Struts
Shipping

6 11 Changes from previous issue Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes

Custodians:

Army - ME
Navy - YD
Air Force -

Preparing Activity

Navy - YD

(Project 8115-0512)

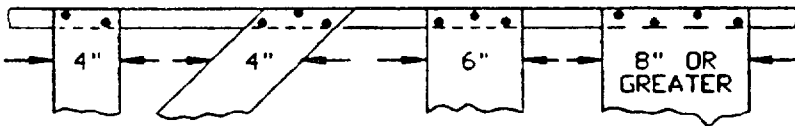
Review Activities

Army - EL, SM, GL,
Navy - SA

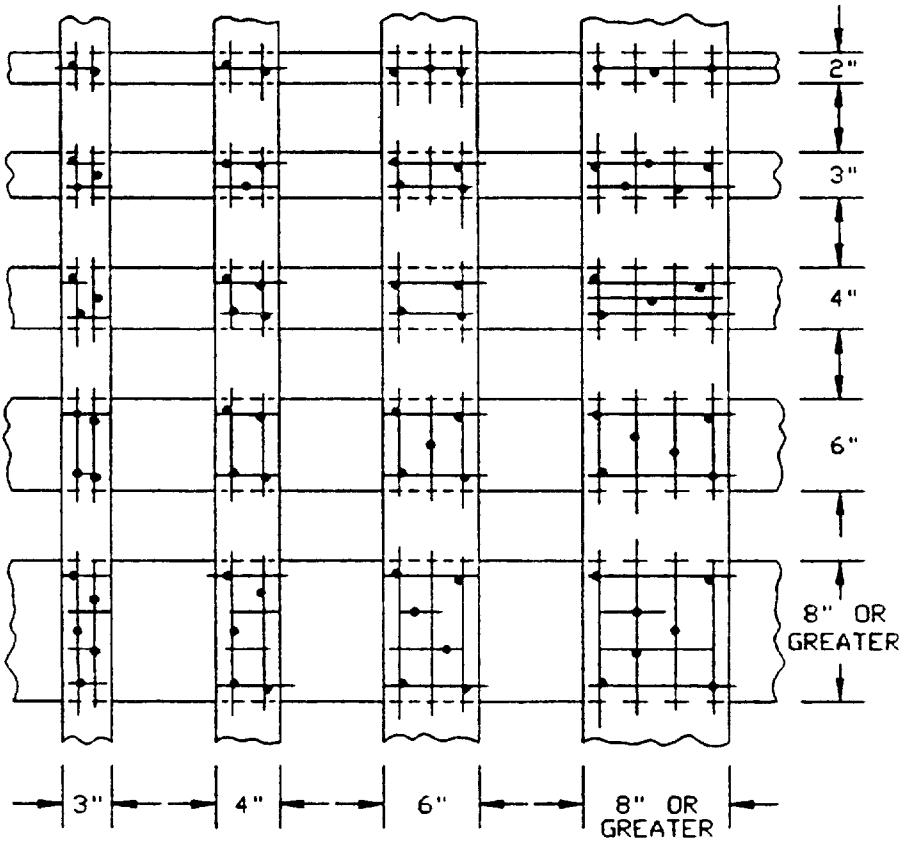
User Activity

Army - AT, MU
Navy - MC

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EDGE NAILING
OPEN CRATES



FABRICATION AND ASSEMBLY NAILING

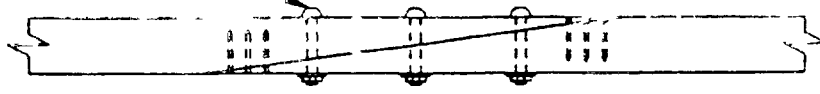
Notes:

1. All widths nominal
2. Use similar nailing patterns when boards cross at angles other than 90 degrees

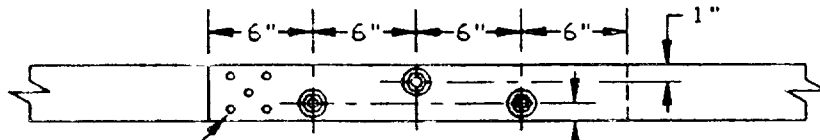
FIGURE 1 Nailing patterns

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3/8" CARRIAGE BOLTS

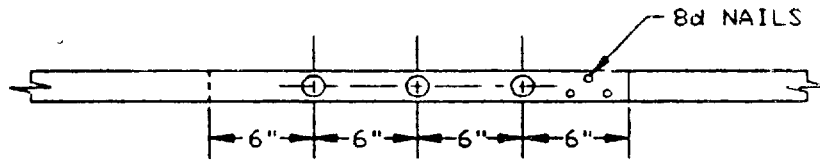


TOP VIEW



8d NAILS

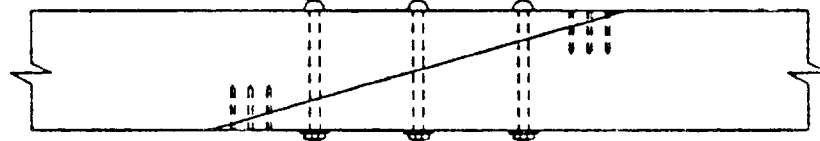
SIDE VIEW
SPLICE FOR SKIDS



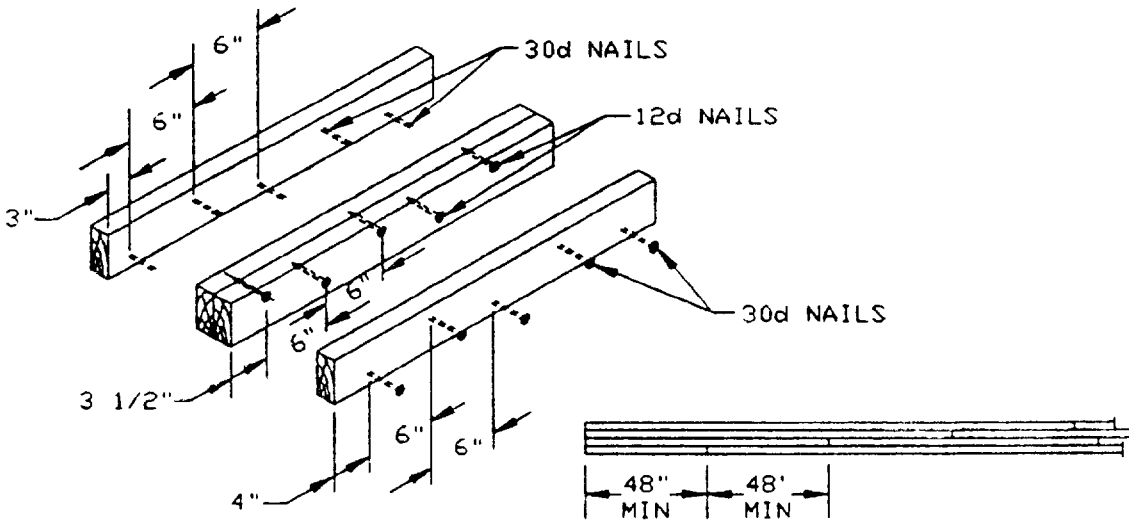
8d NAILS

TOP VIEW

3/8" CARRIAGE BOLTS



SIDE VIEW
SPLICE FOR 2 INCH MEMBER



LAMINATING OF SKIDS AND SILLS

FIGURE 2 Splicing and laminating details

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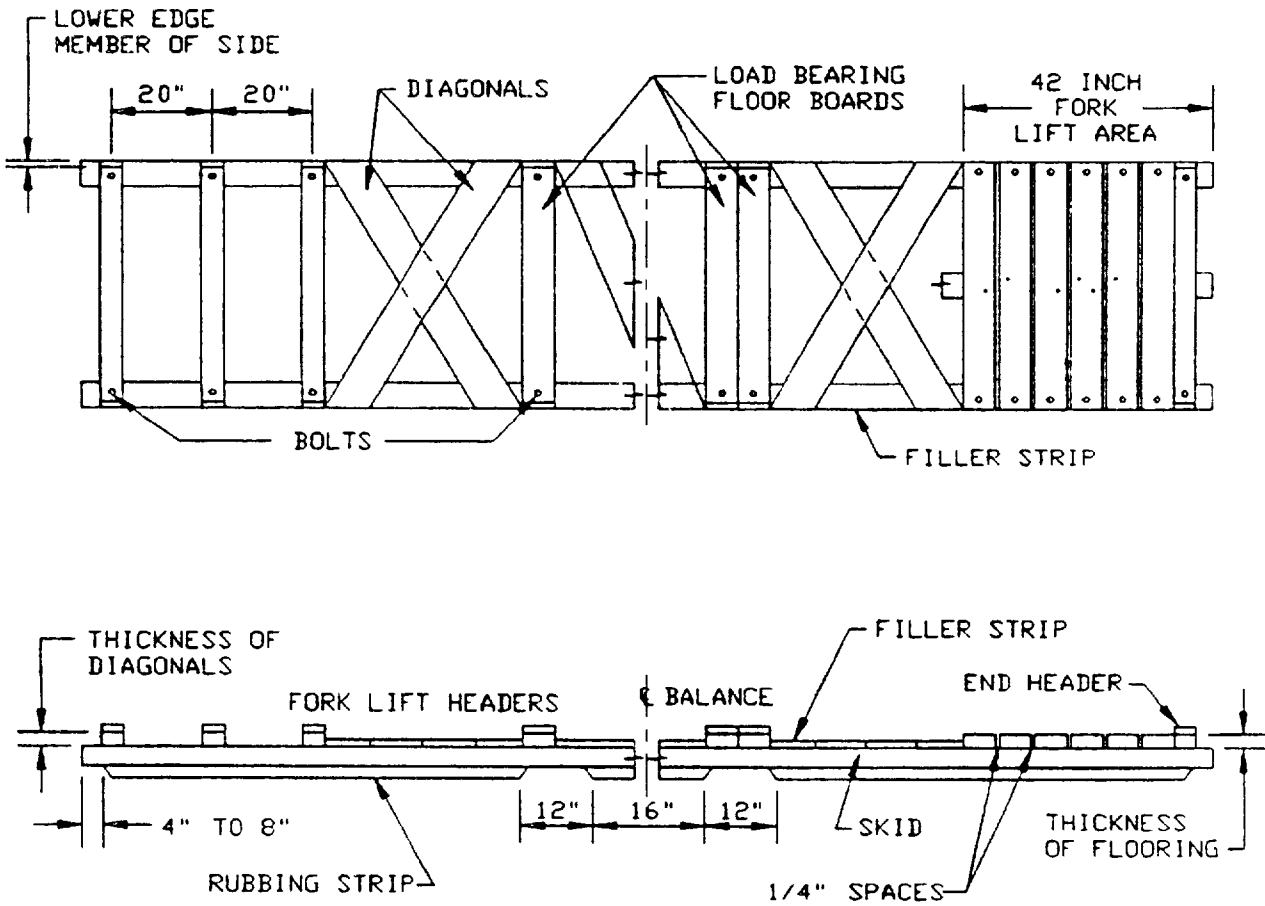


FIGURE 3 Skid base - (style A - type I crate)
(except for high narrow crates)

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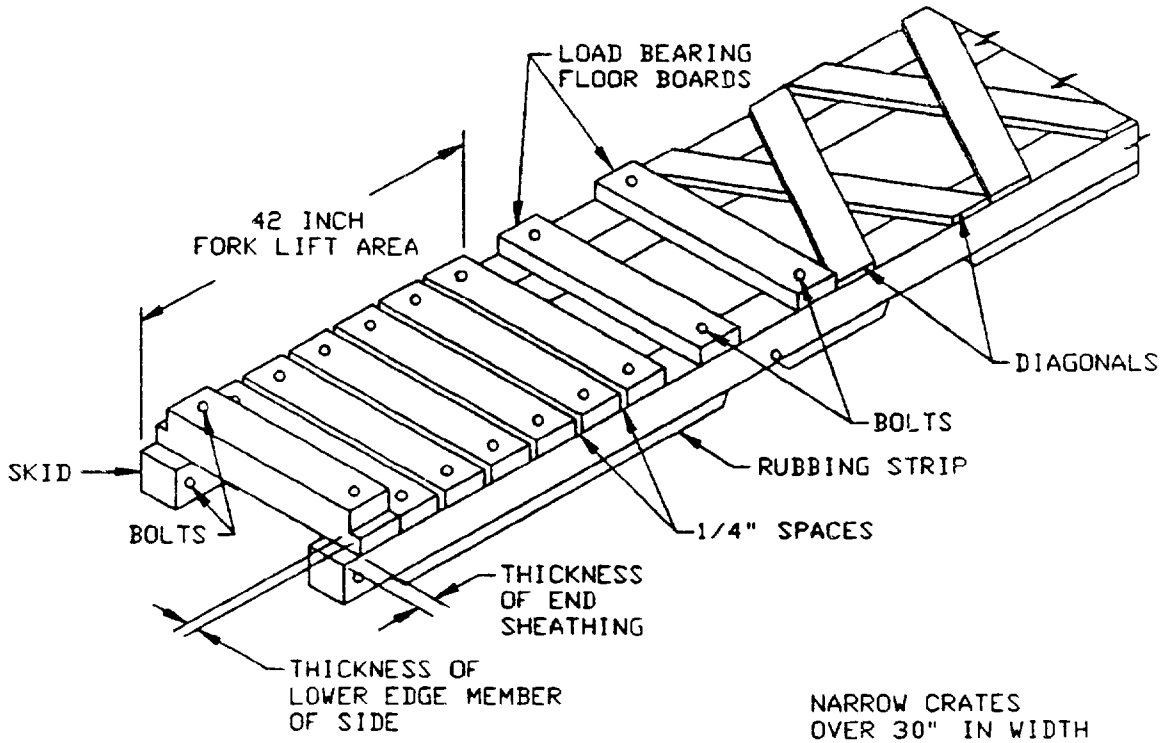
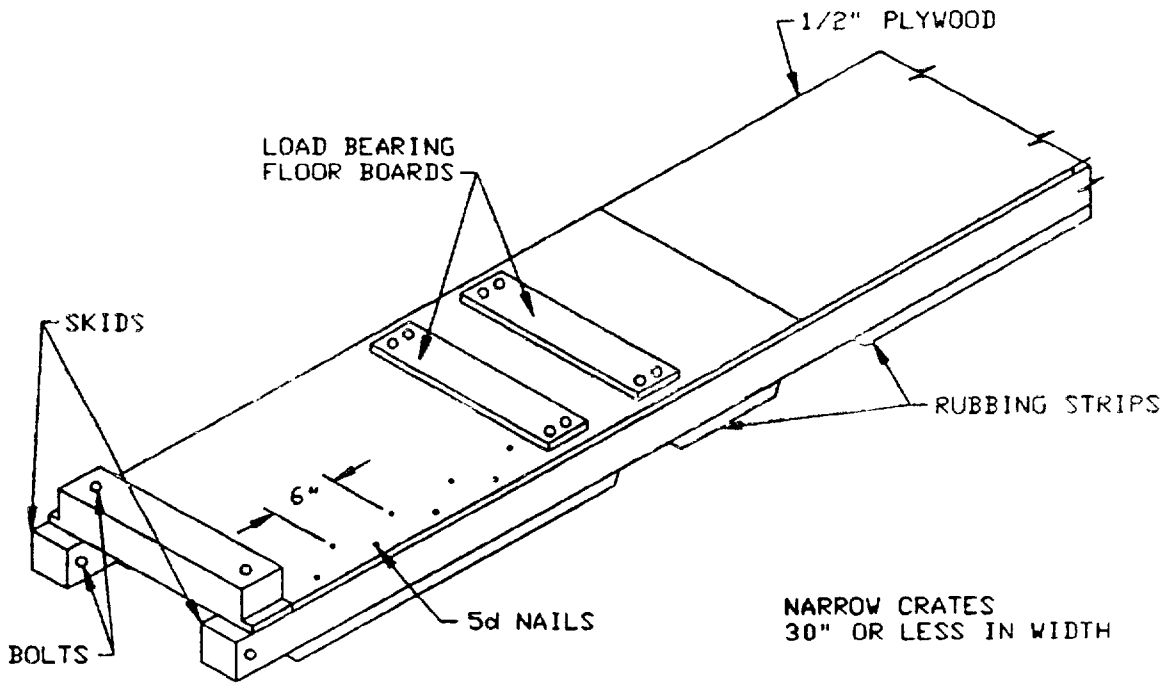


FIGURE 4 Skid base - (style A - type I, high narrow crate)
(height 3 or more times base)

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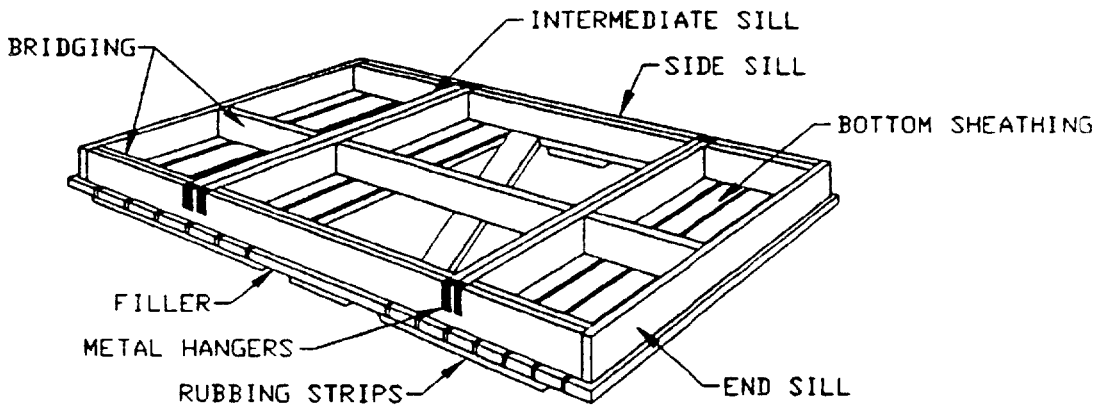
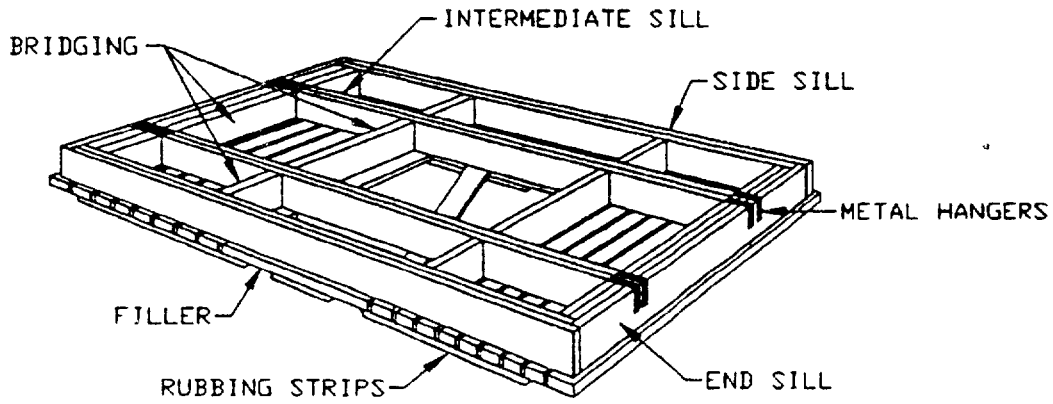


FIGURE 5 Sill base - (style B - type I crate)

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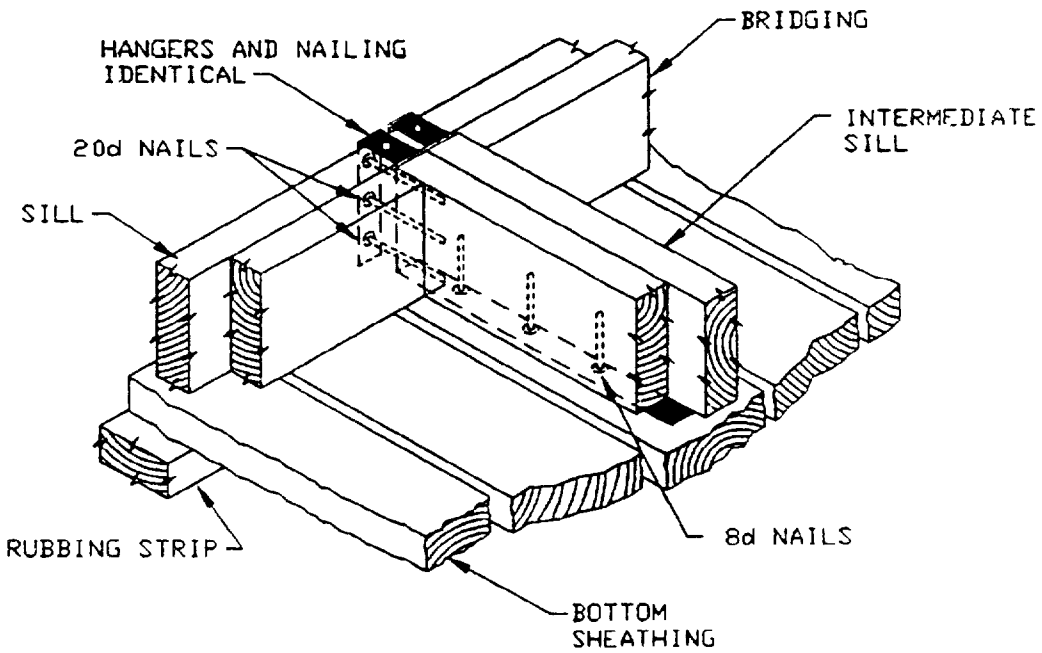
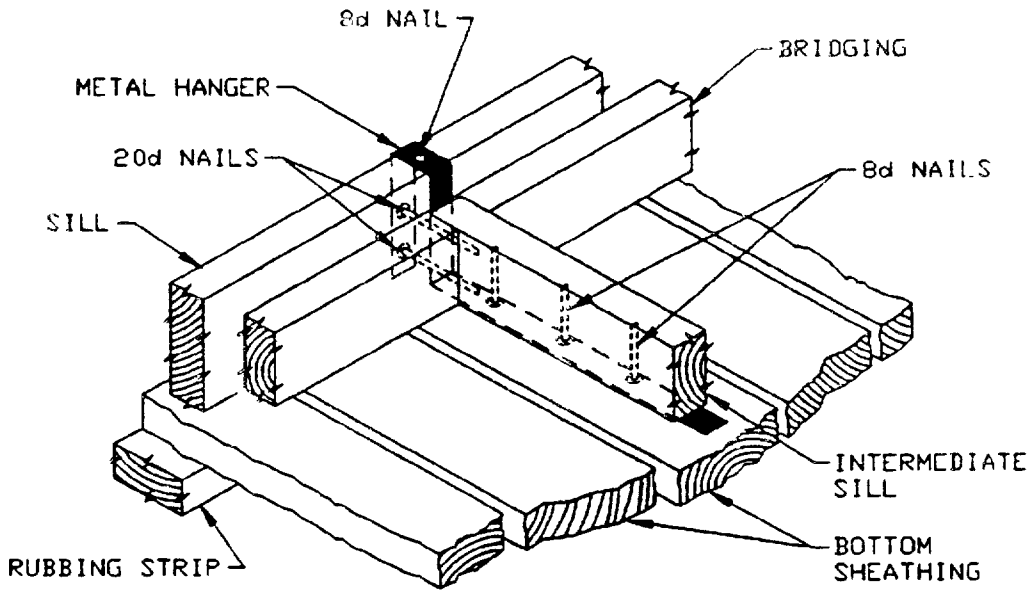


FIGURE 6 Method of attaching intermediate sills to end or side (style B, type I crate)

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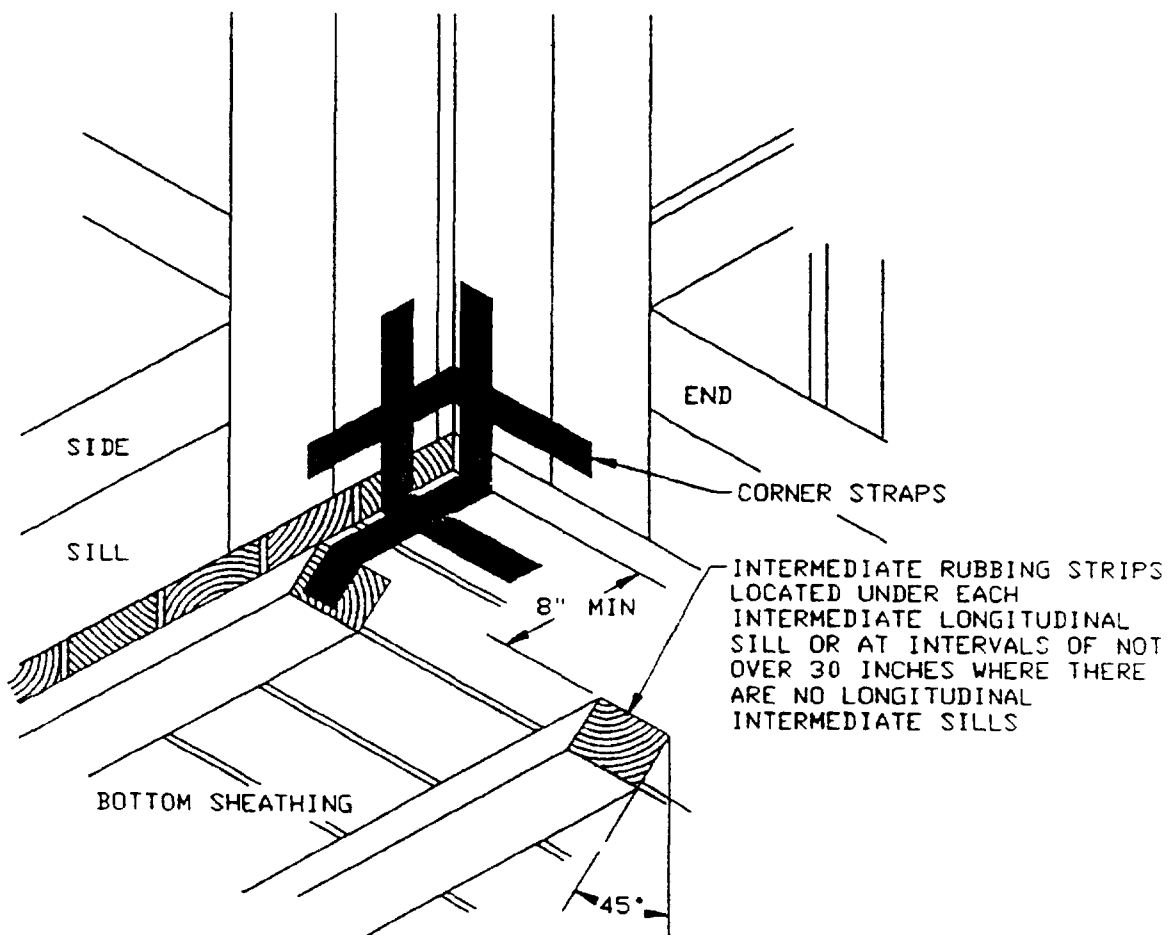


FIGURE 7. Corner straps and rubbing strips -
(style B base, type I crate)

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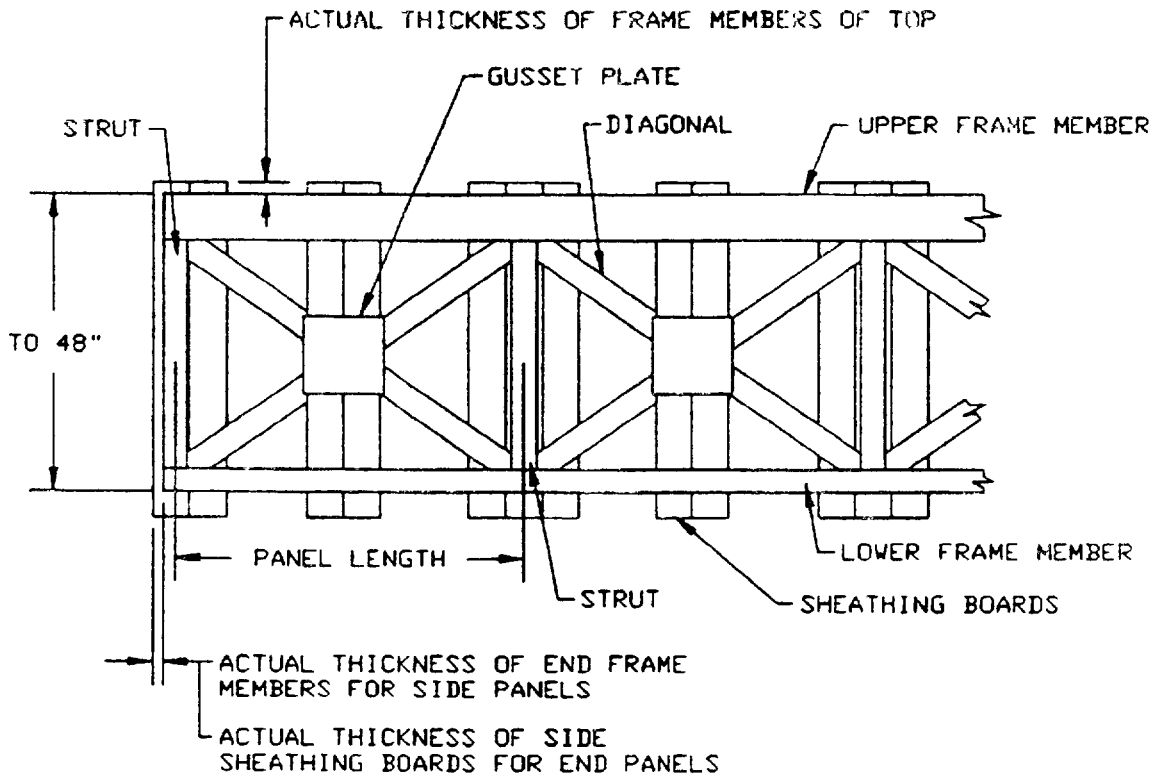


FIGURE B Side or end panel - (type I crate)
(for heights to 48 inches)

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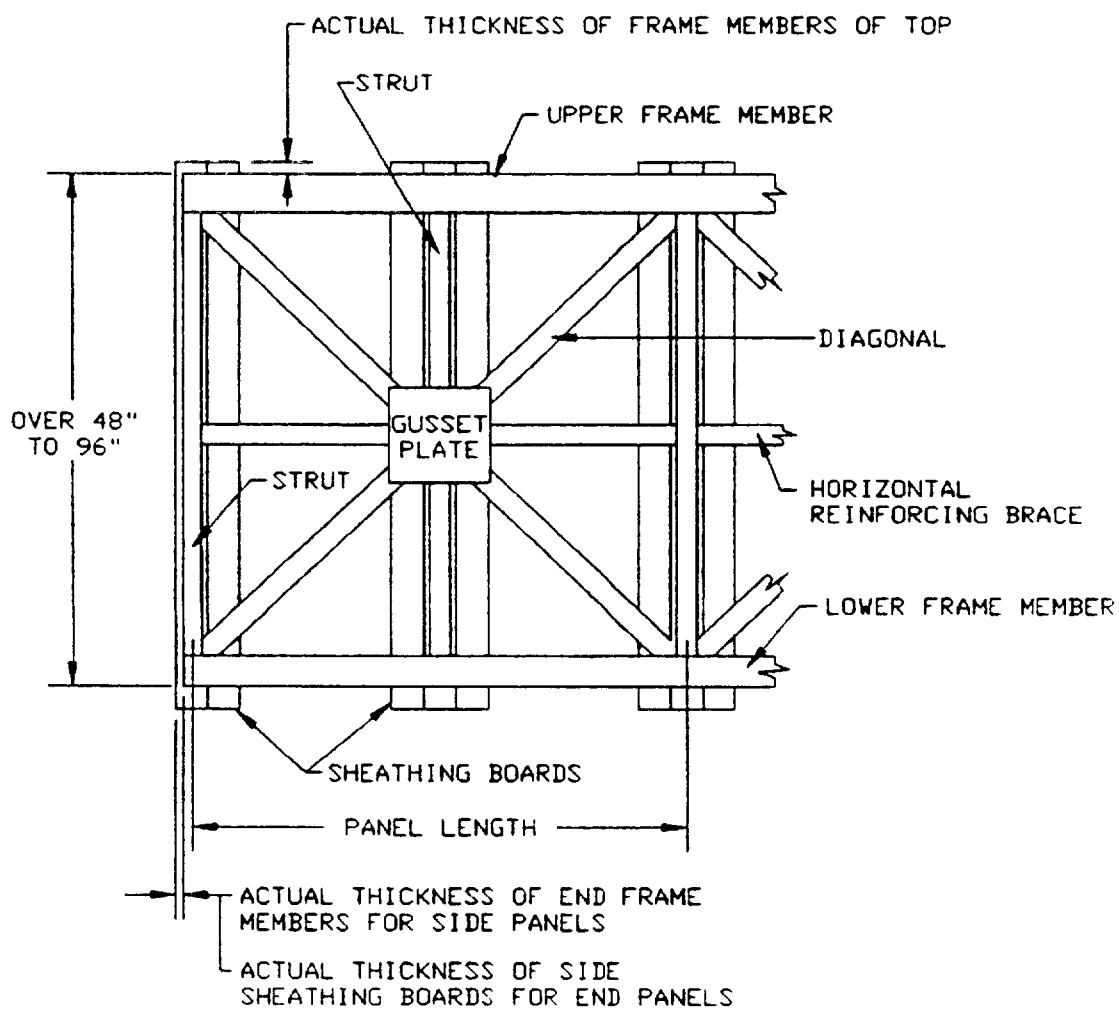


FIGURE 9. Side or end panel - (type I crate)
(for heights over 4 feet to 8 feet)

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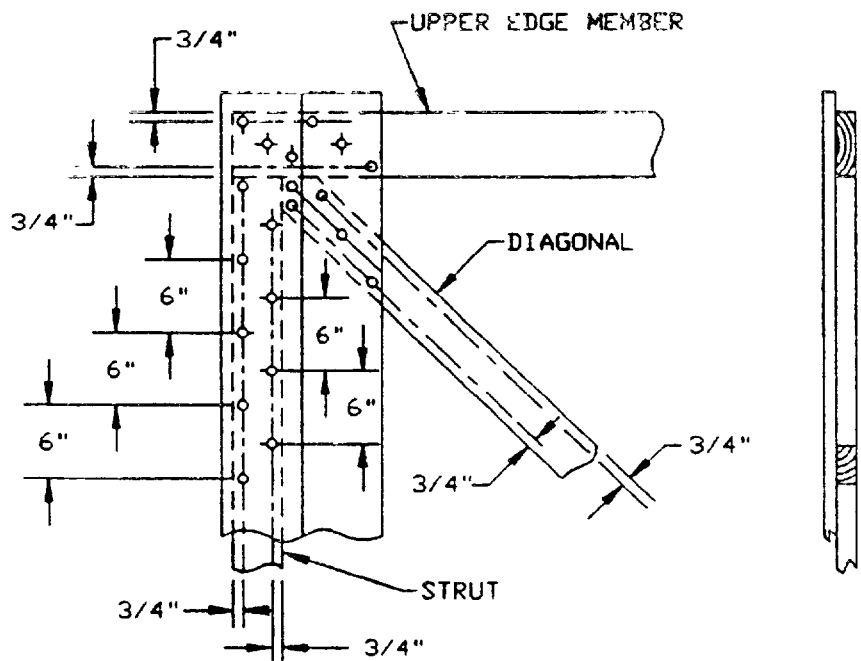


FIGURE 10 Nail spacing, sides and ends - (type I crate)

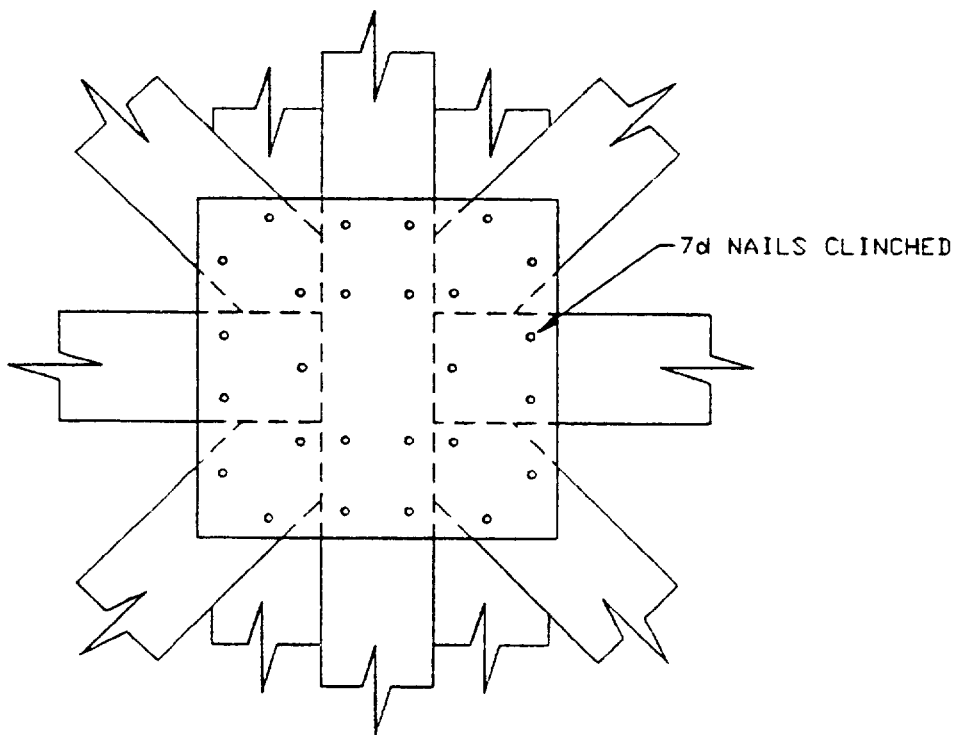
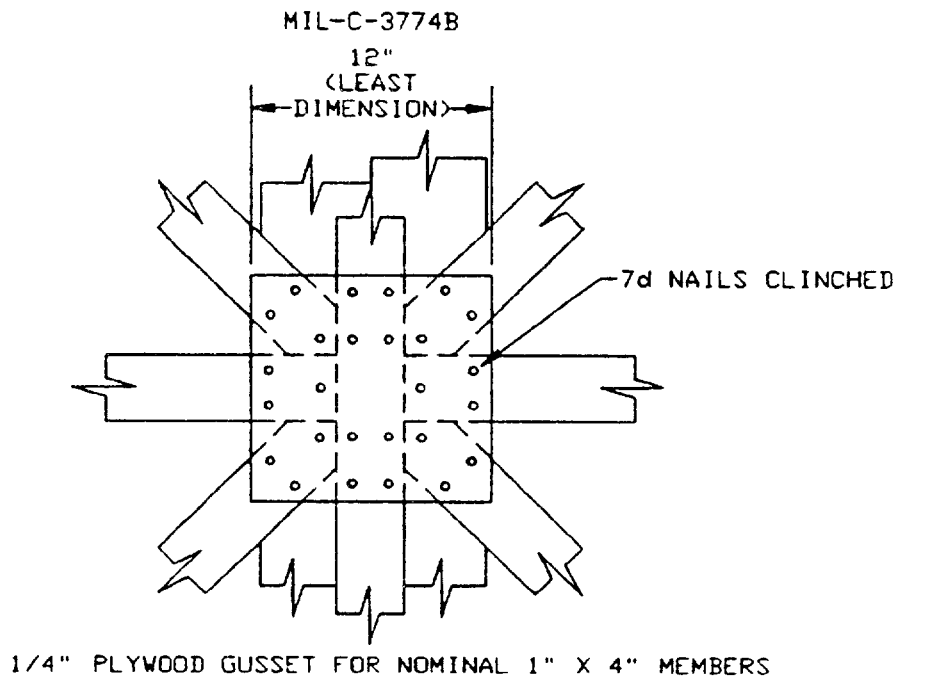


FIGURE 11 Detail of plywood gusset - (type I crate)

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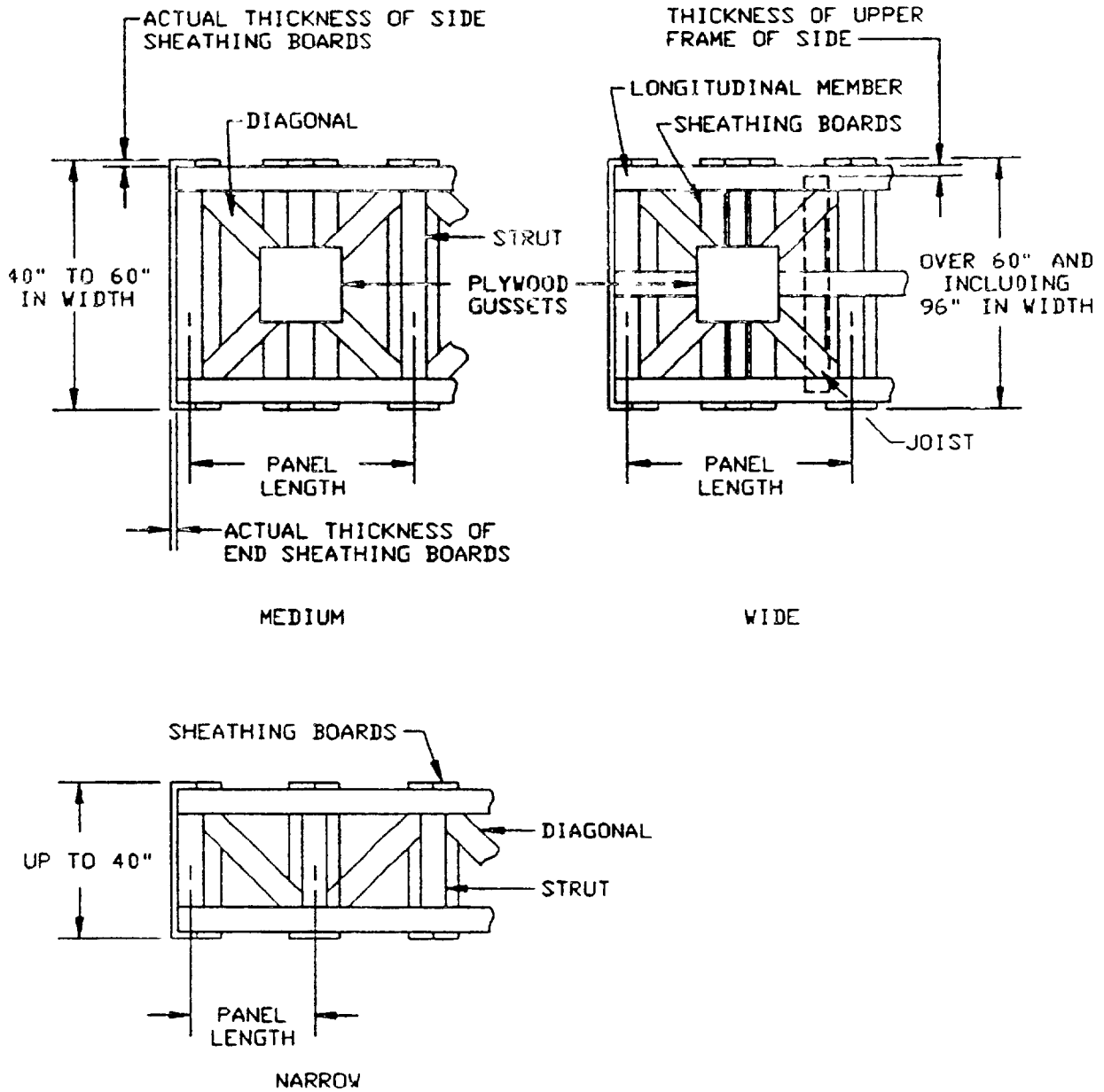


FIGURE 12 Top panels - (type 1 crate)

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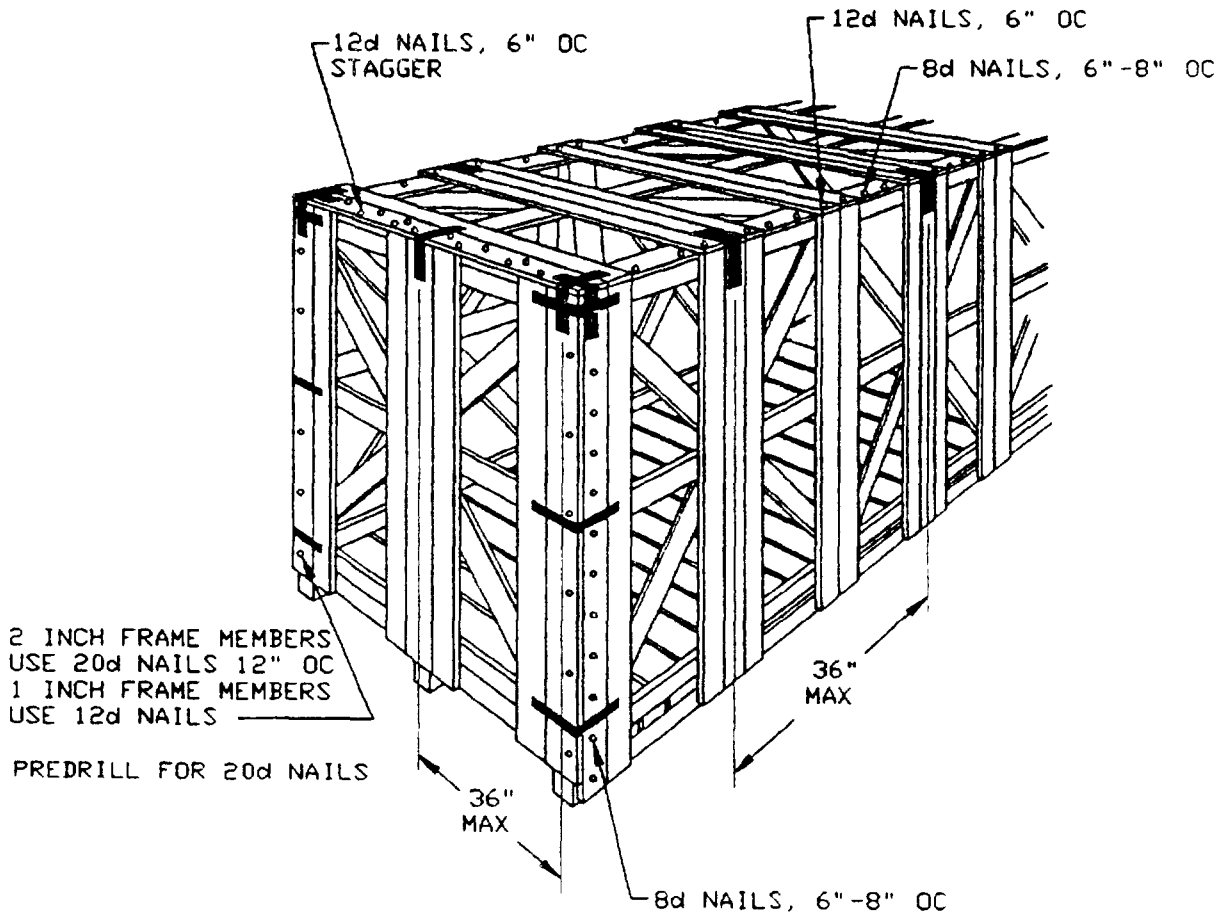


FIGURE 13 Assembly - (type I crate)

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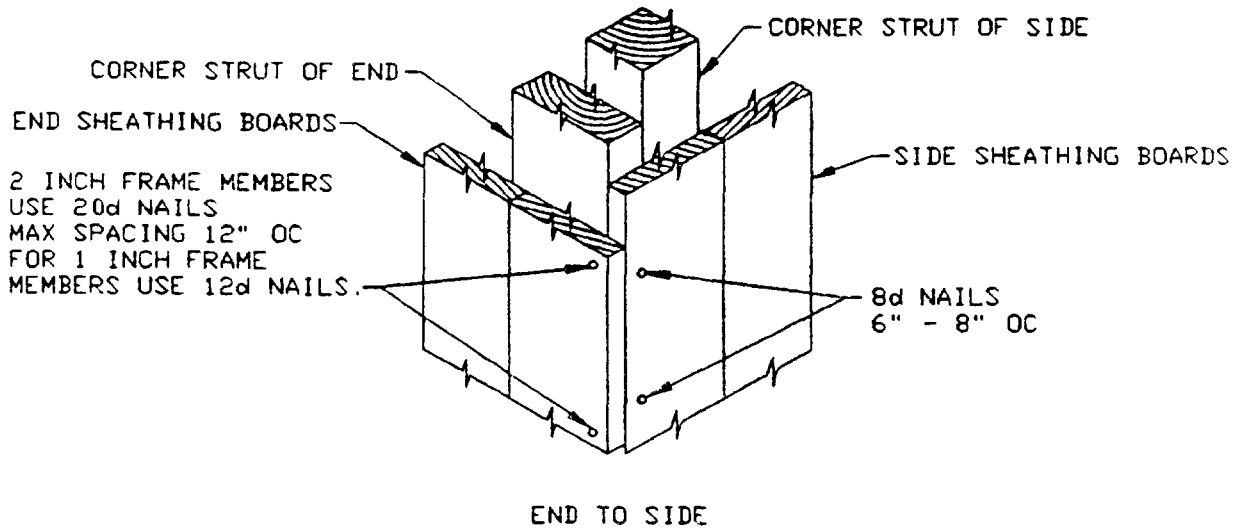
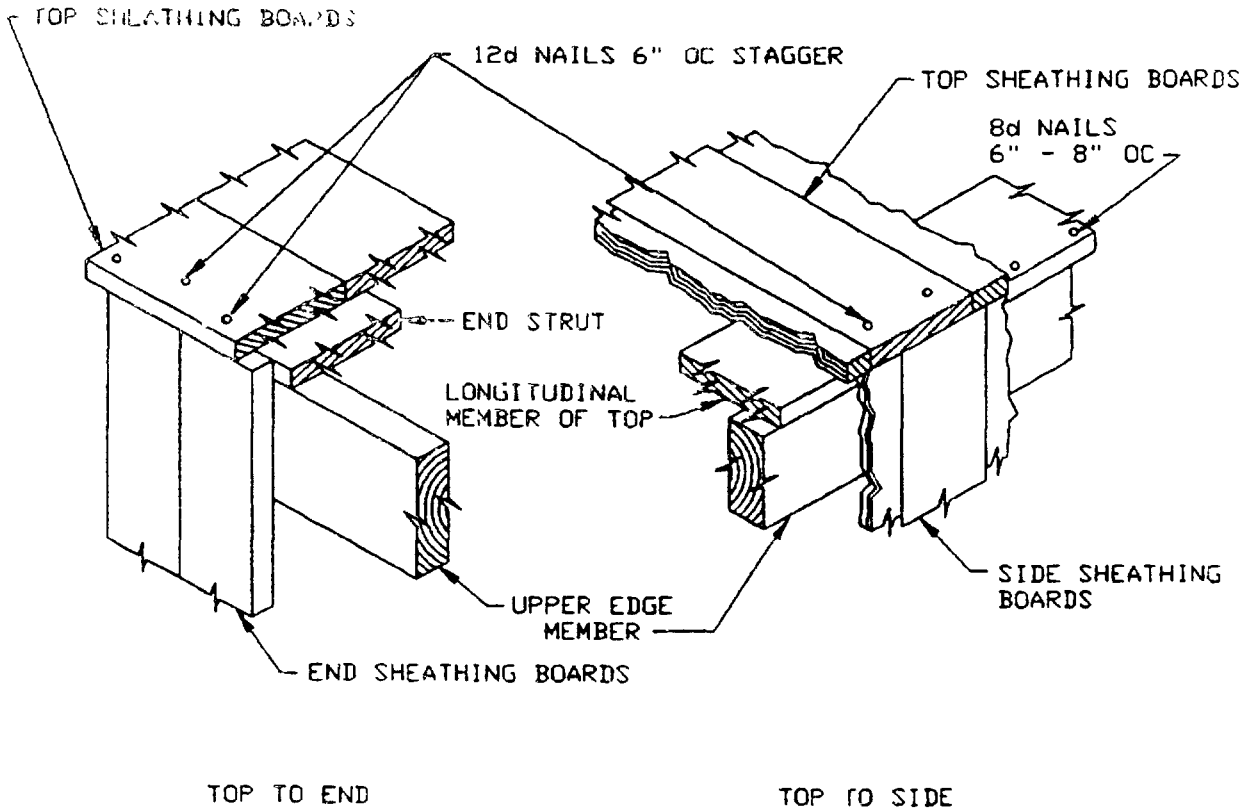


FIGURE 14 Assembly details - (type I crate)

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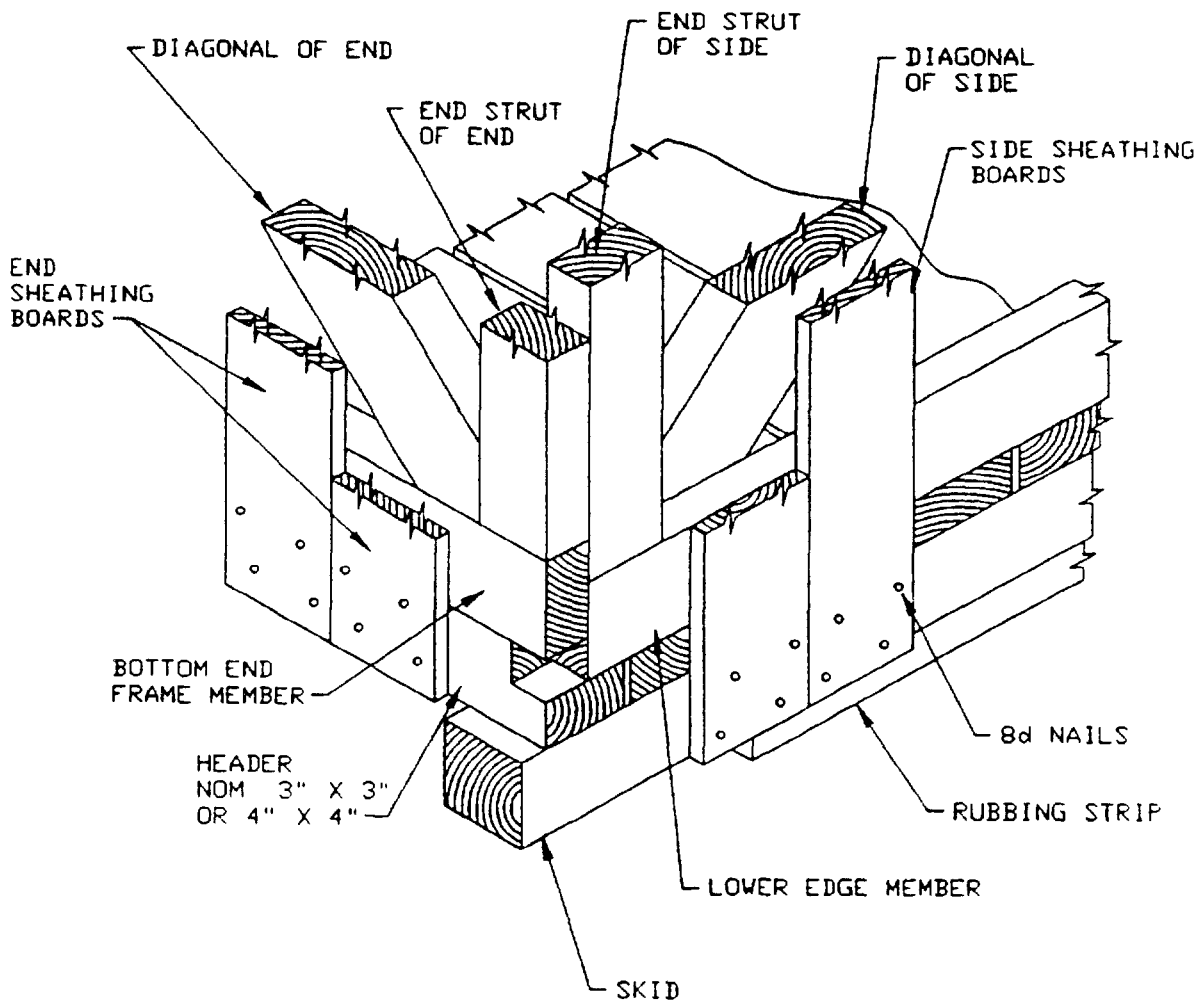


FIGURE 15 Assembly sides and ends to base - (type I crate)

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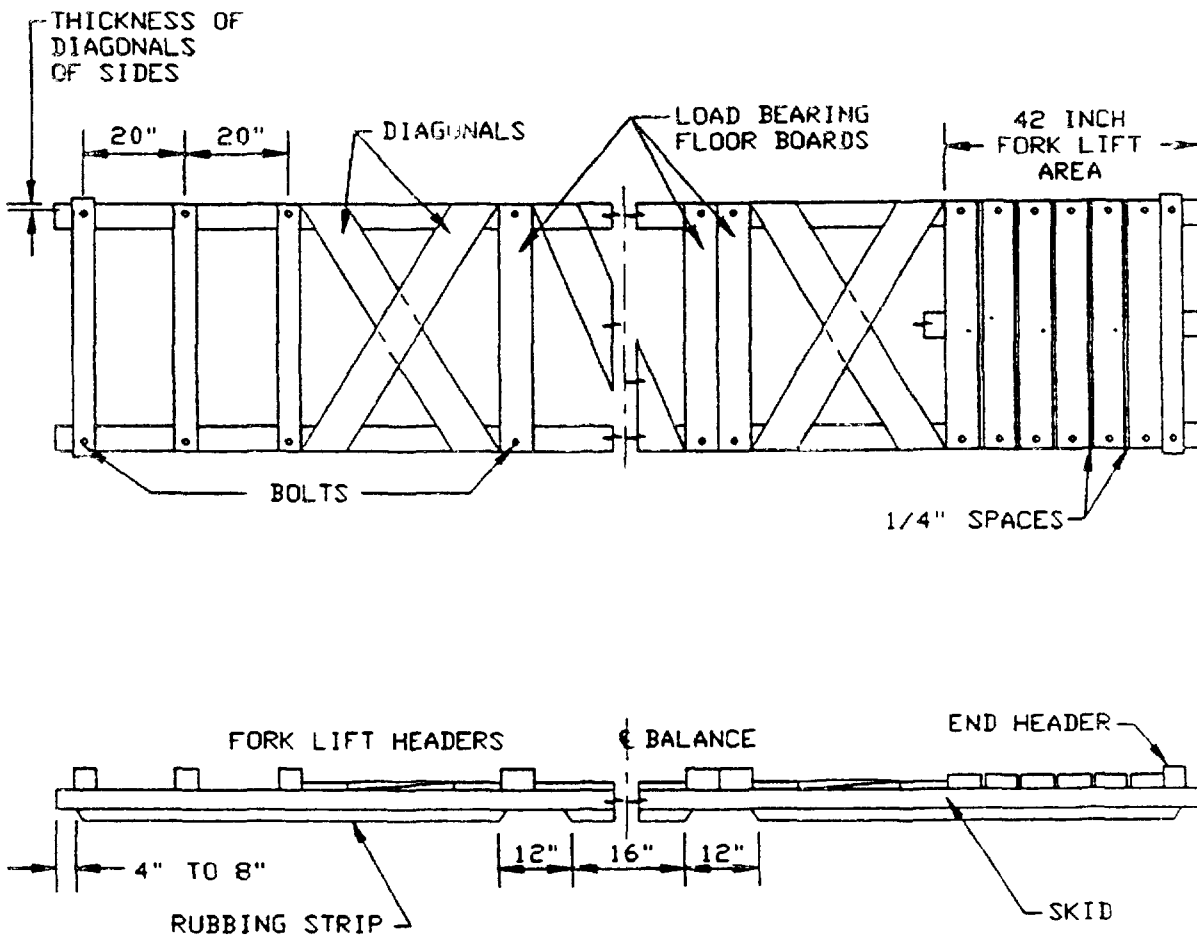


FIGURE 16. Skid base - (type II crate)
(except for high narrow crates)

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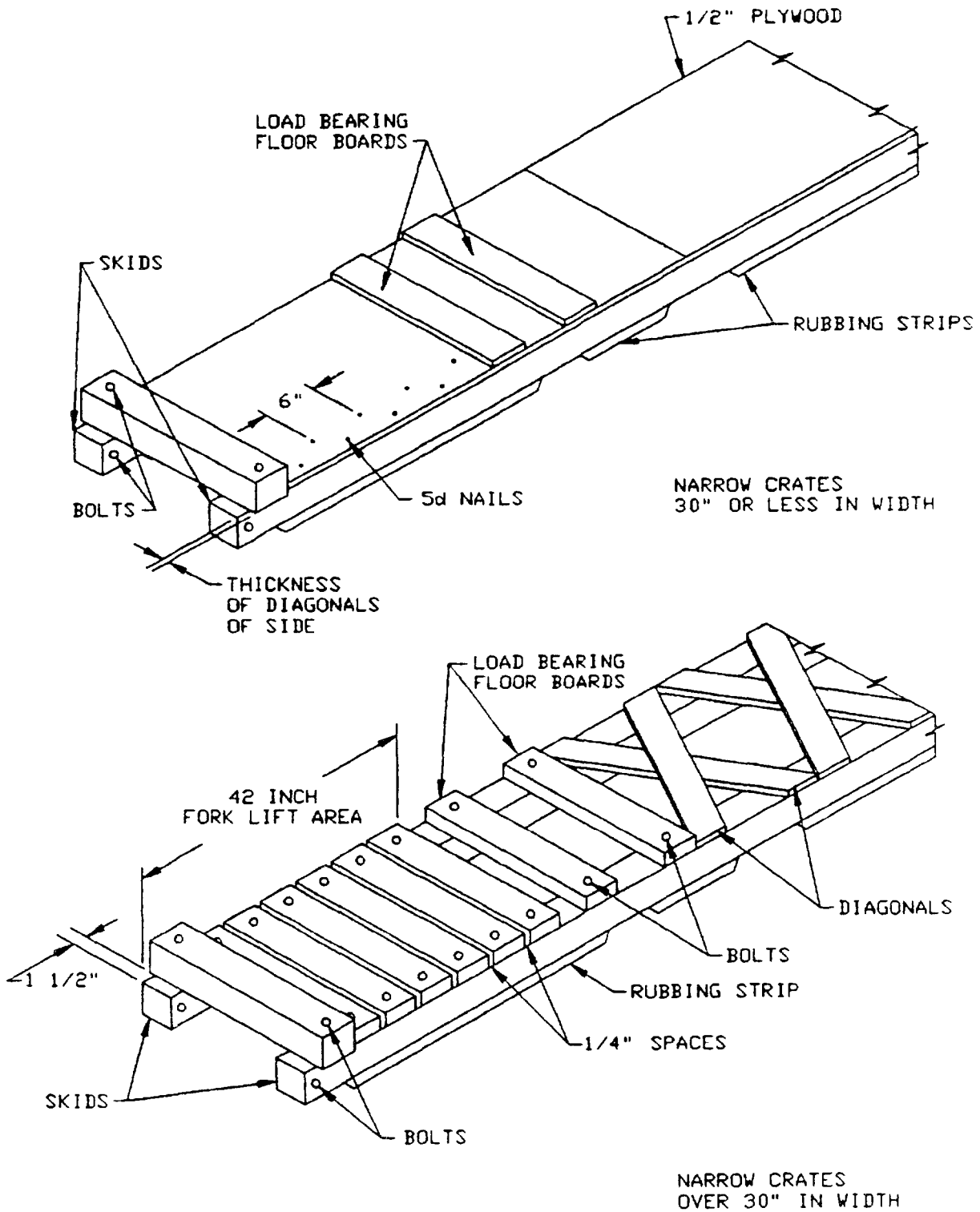


FIGURE 17 Skid base - (type II, high narrow crate)
(height 3 or more times width)

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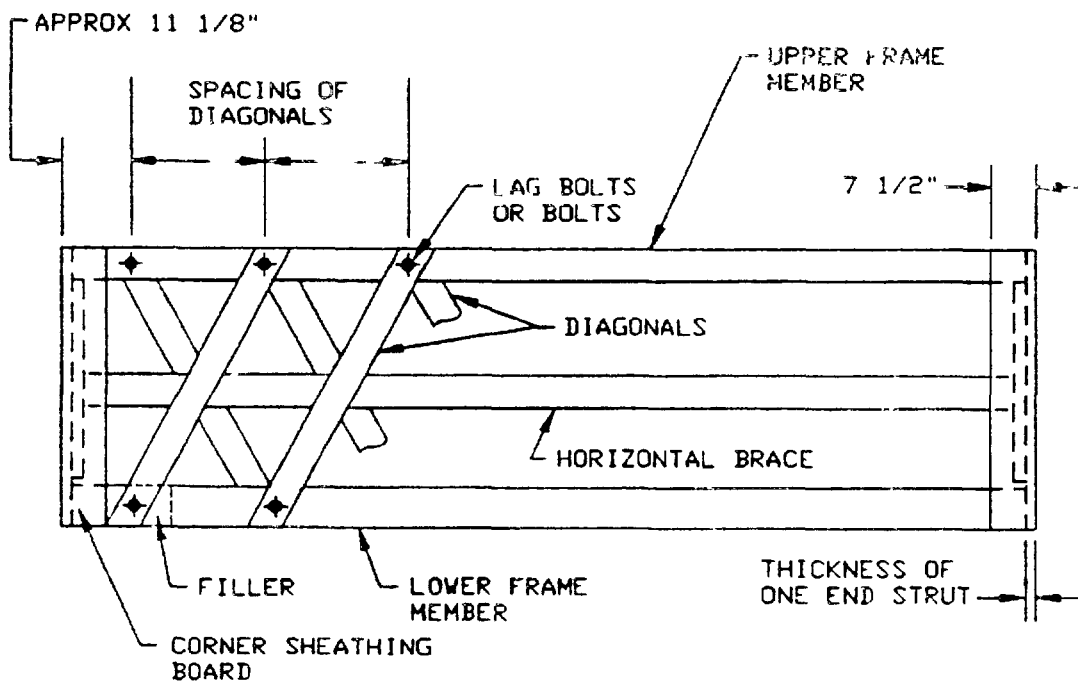


FIGURE 18 Side - (type II crate).

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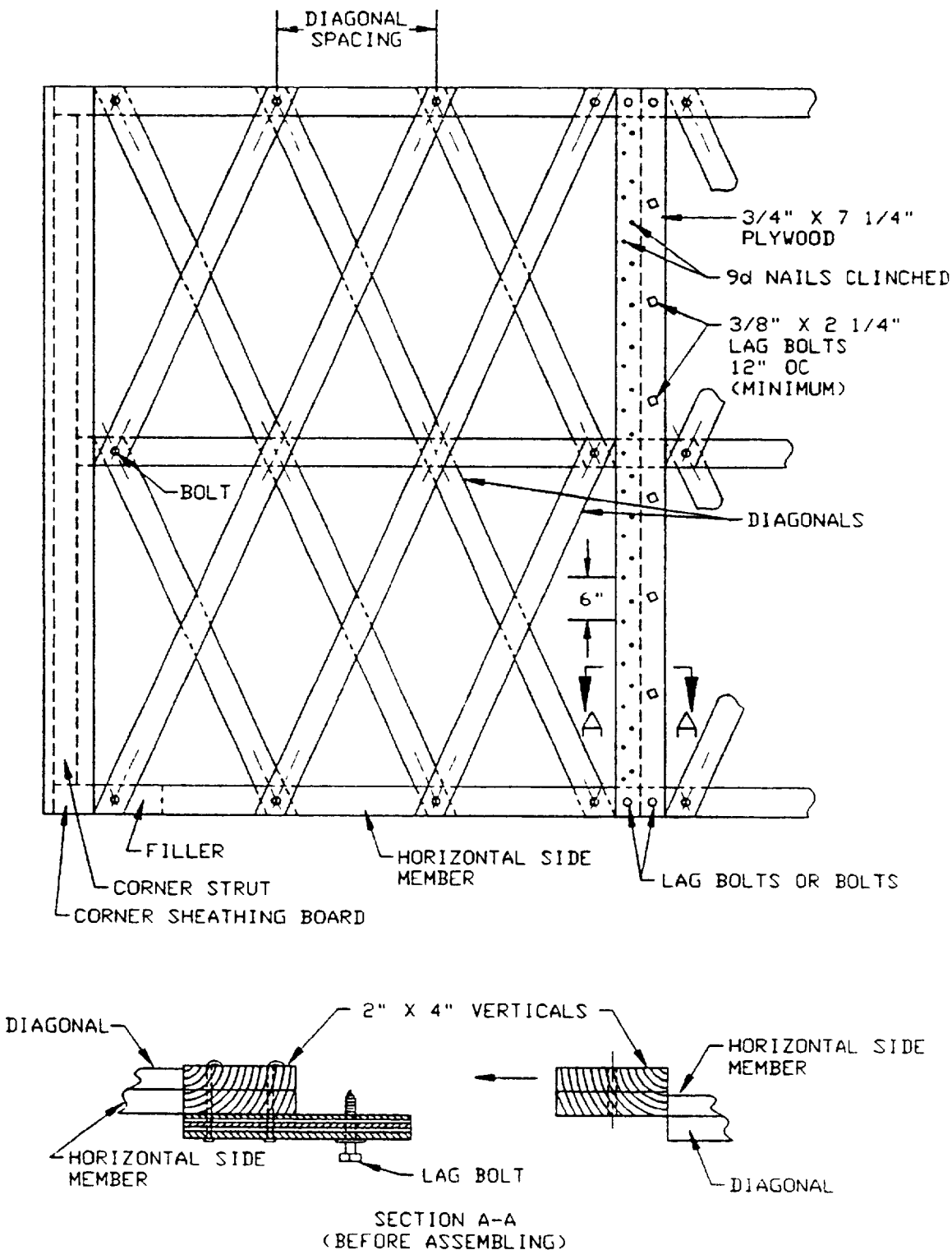


FIGURE 19 Side, (type II, high narrow crate)
(when heights are over 12 feet)

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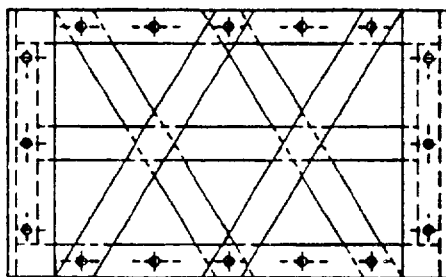
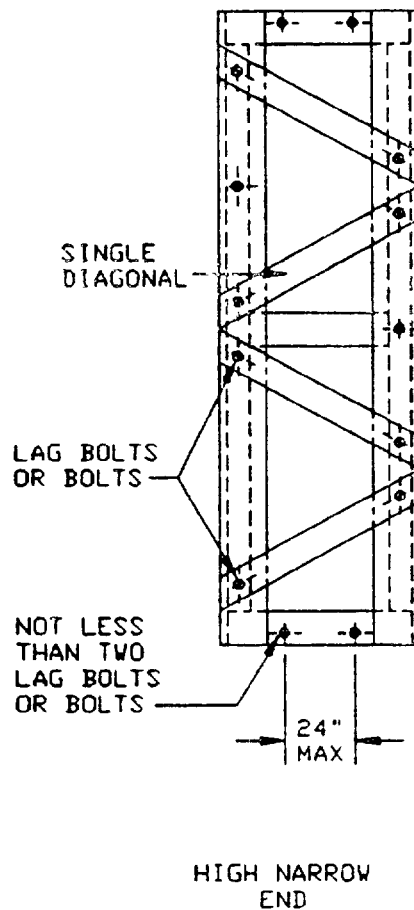
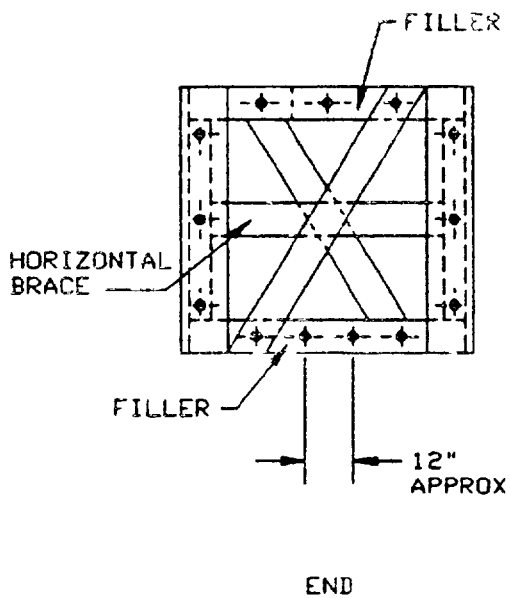


FIGURE 20. Ends - (type II crate)

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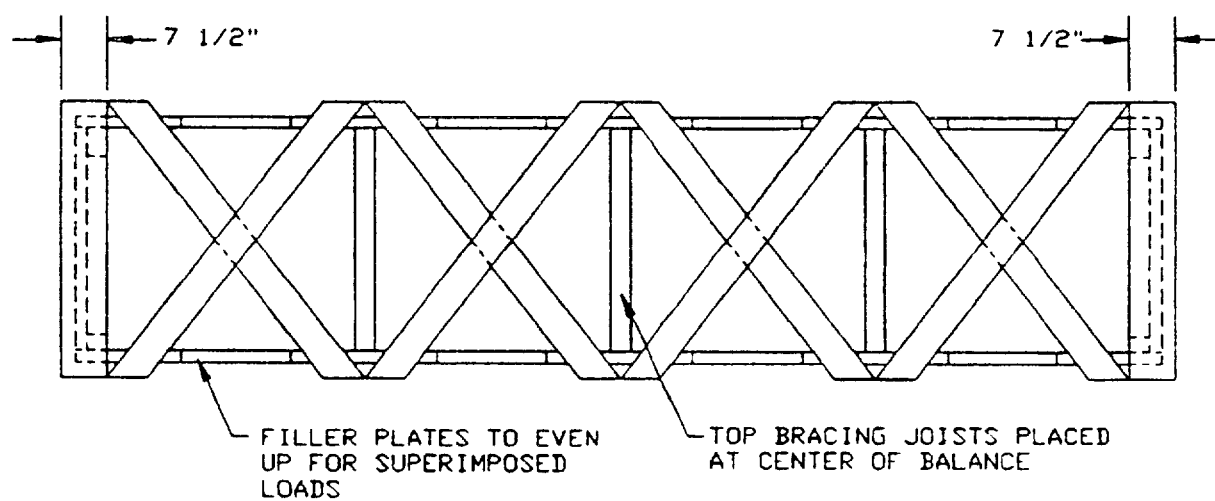
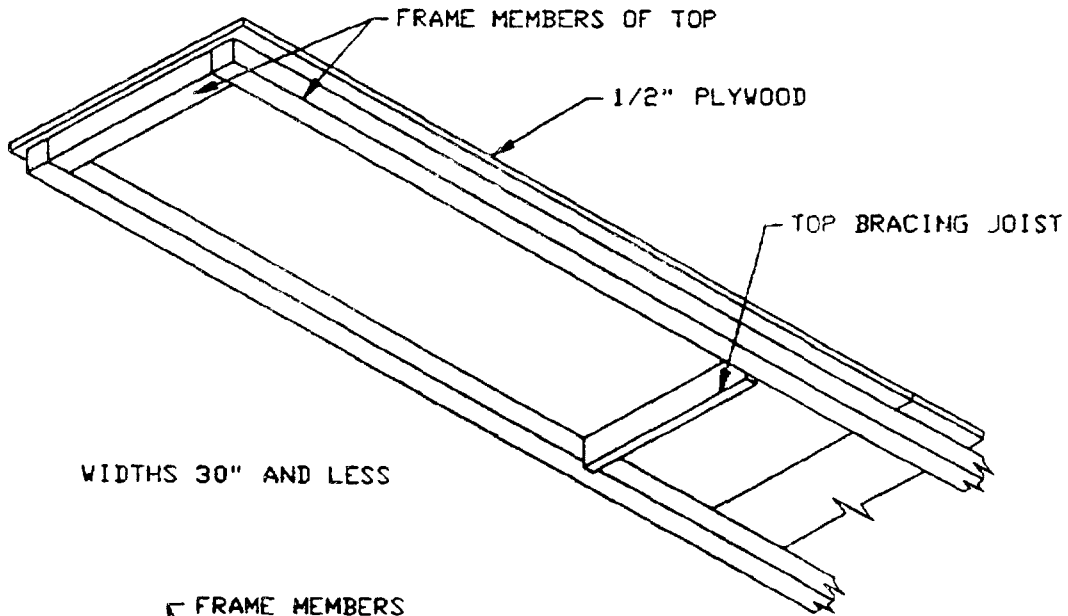
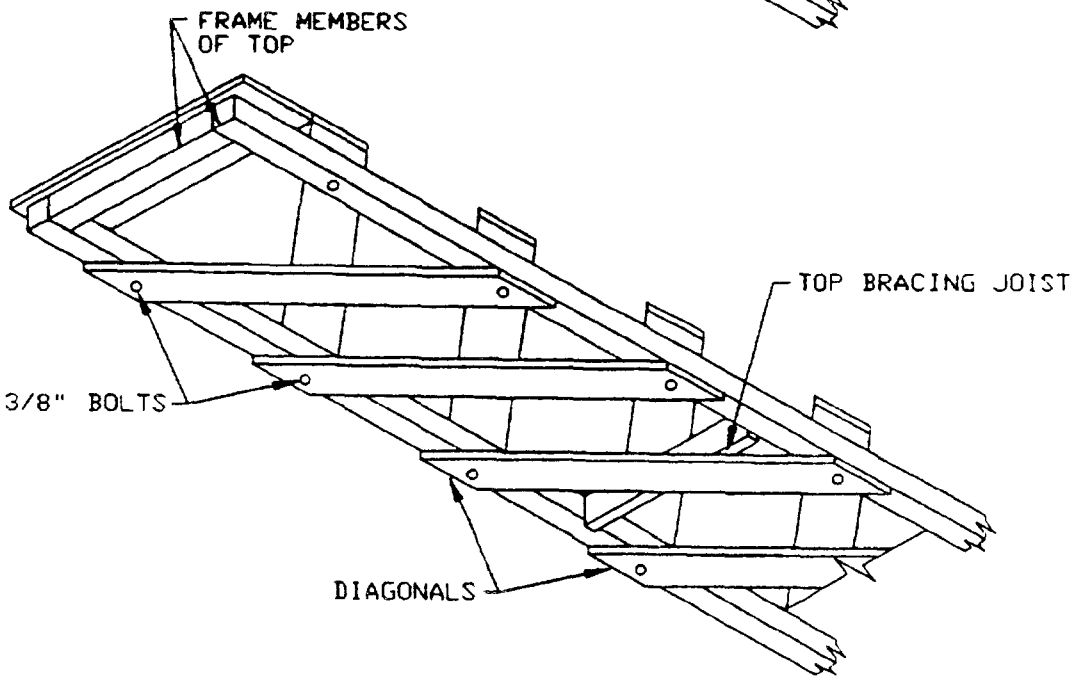


FIGURE 21. Top - (type II crate)

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WIDTHS 30" AND LESS



WIDTHS GREATER THAN 30"

FIGURE 22 Top - (type II, high narrow crate)

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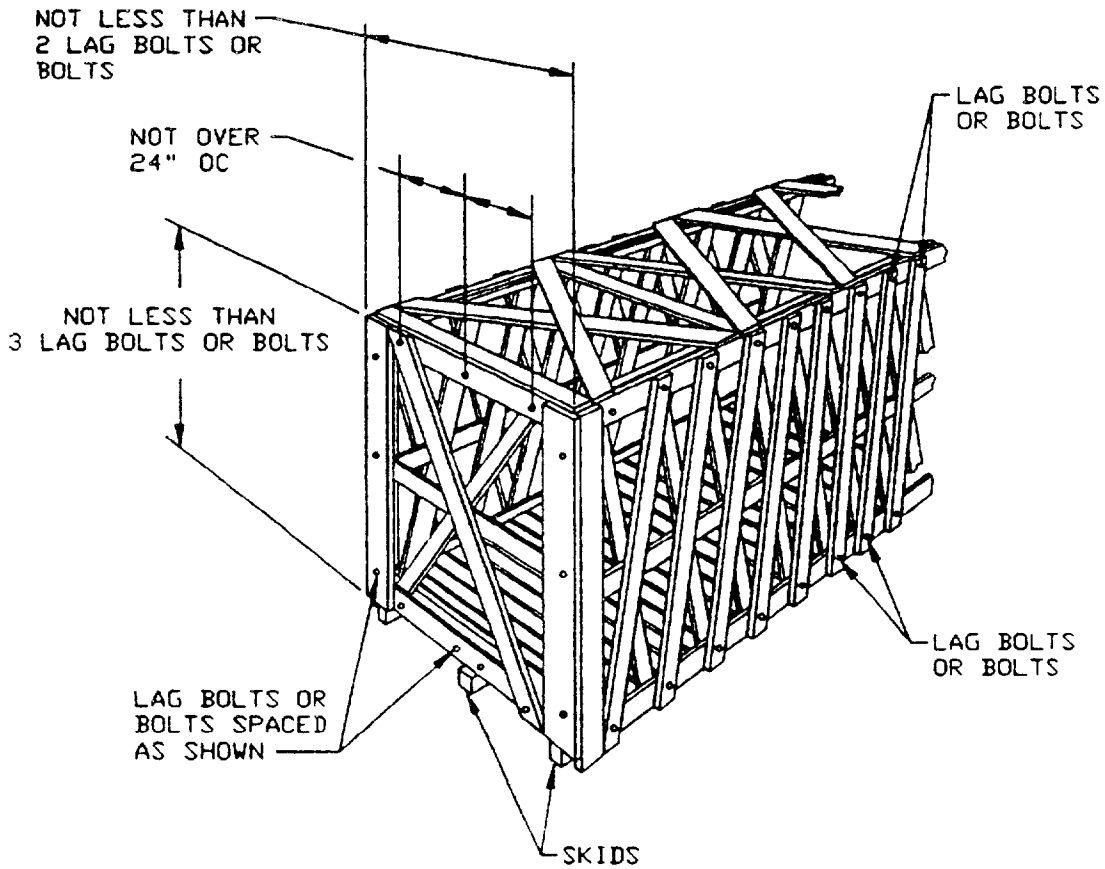


FIGURE 23. Assembly - (type II crate)

MIL -C-3771B

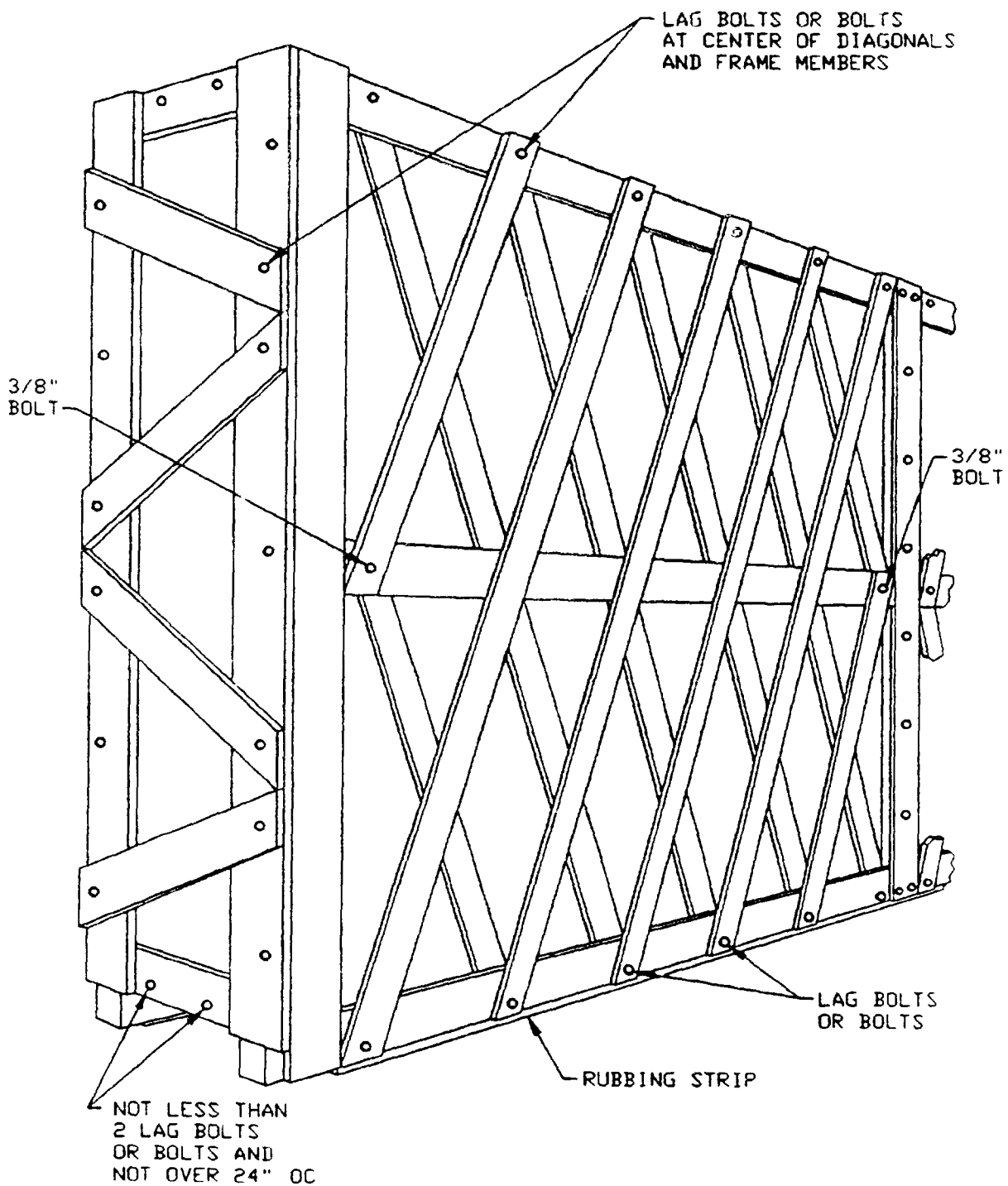
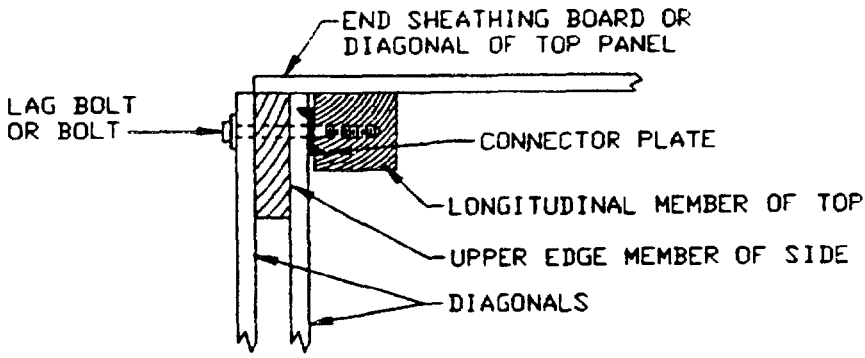
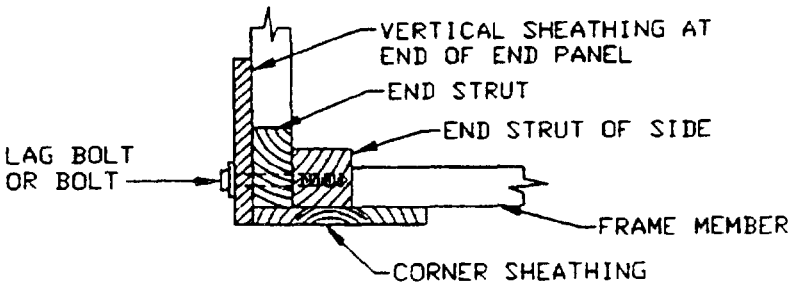


FIGURE 24 Assembly - (type II high narrow crate).

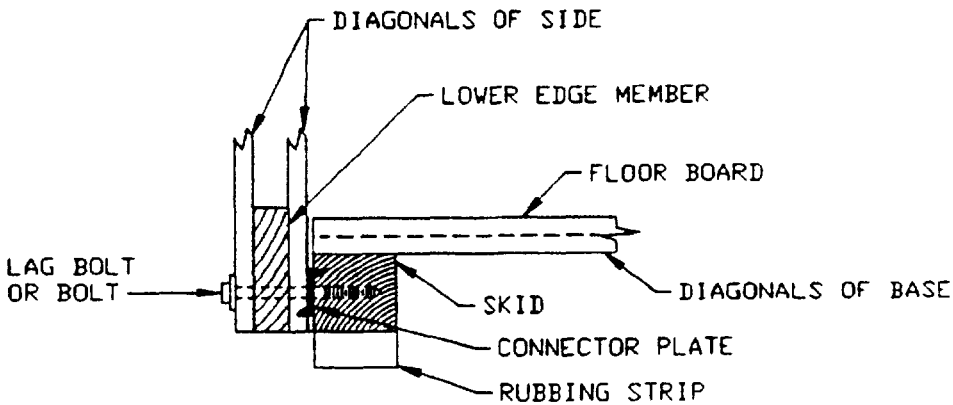
MIL-C-3774B



ASSEMBLING SIDE PANEL TO TOP



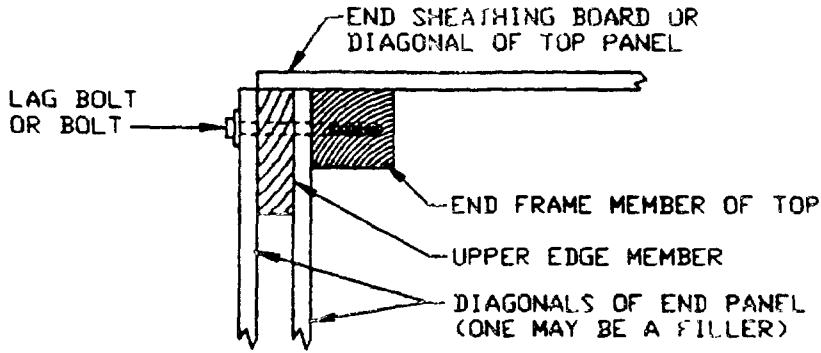
ASSEMBLING END PANEL TO SIDE



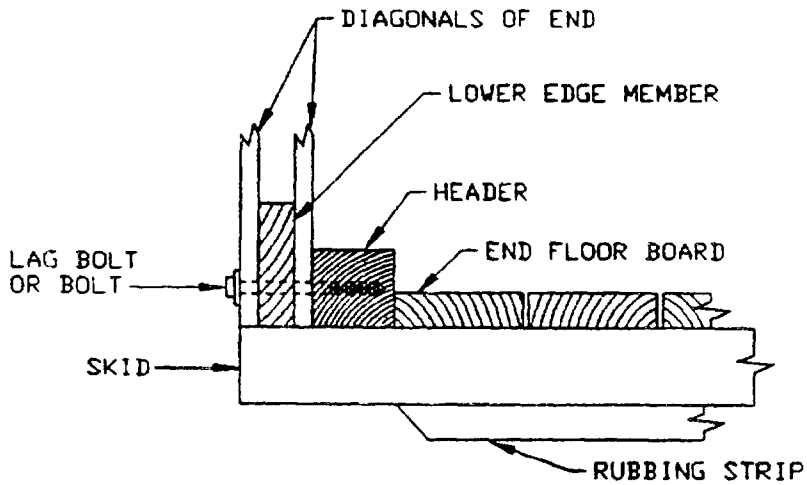
ASSEMBLING SIDE PANEL TO BASE

FIGURE 25 Assembly details - (type II crate)

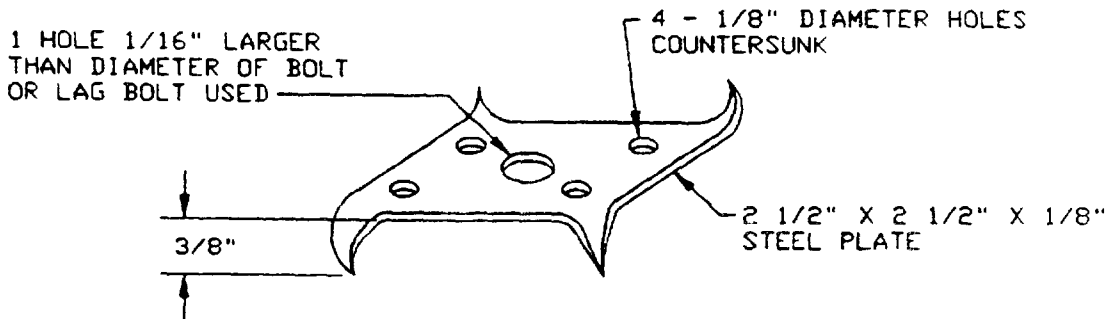
MIL-C-3774B



ASSEMBLING END PANEL TO TOP



ASSEMBLING END PANEL TO BASE



CONNECTOR PLATE
BETWEEN SIDES AND TOP OR BASE

FIGURE 26. Assembly details - (type II crate)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

- 1 The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
- 2 The submitter of this form must complete blocks 4, 5, 6, and 7.
- 3 The preparing activity must provide a reply within 30 days from receipt of the form.

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RECOMMEND A CHANGE:		1. DOCUMENT NUMBER MIL-C-3774B	2. DOCUMENT DATE (YYMMDD) 14 June 1991
3. DOCUMENT TITLE Crates, Wood; Open 12,000 - and 16,000 - Pound Capacity			
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)			
5. REASON FOR RECOMMENDATION			
SUBMITTER			
a. NAME (Last, First, Middle Initial)		d. ORGANIZATION	
c. ADDRESS (Include Zip Code)		e. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (if applicable)	f. DATE SUBMITTED (YYMMDD)
PREPARING ACTIVITY			
NAME Kenneth A. Pollock		b. TELEPHONE (Include Area Code) (1) Commercial (805) 982-5612	(2) AUTOVON 551-5612
ADDRESS (Include Zip Code) Commanding Officer (156) Naval Construction Battalion Center Port Hueneme, CA 93043-5000		IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403 Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	