



Designation: D6573/D6573M – 13 (Reapproved 2020)

Standard Specification for General Purpose Wirebound Shipping Boxes¹

This standard is issued under the fixed designation D6573/D6573M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers the fabrication of new wirebound general purpose (GP) panelboard (hereafter referred to as wirebound boxes) shipping boxes intended for use as containers for domestic and overseas shipment of general materials and supplies, not exceeding 500 lb [226.8 kg] for Class 1 domestic, 400 lb [181.4 kg] for Class 2 overseas shipments or 300 lb [136.0 kg] for Class 3 extreme distribution hazard conditions or military contingency purposes.

1.2 Wirebound box performance is dependent on its fabricated components; therefore, a variety of types of load, classes, styles, and treatments reflecting varied performance are specified. This specification does not cover wirebound box performance under all atmosphere, handling, shipping, and storage conditions. Wirebound boxes in compliance with Hazardous Material Modal Regulations or United States Code of Federal Regulations (CFRs) are found in the Supplementary Requirements.

1.3 The use of other construction methods or techniques are acceptable and shall be permitted, provided the resulting packaging systems are of equal or better performance than would result from the use of these specified materials and procedures. The appropriate Practice **D4169** distribution cycle(s) can be used to develop comparative procedures and criteria.

1.4 *Units*—The values stated in inch-pound units are to be regarded as standard. The SI values given in brackets are mathematical. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in non-conformance with the standard. See **IEEE/ASTM SI 10** for conversion of units.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appro-*

priate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

A641/A641M Specification for Zinc-Coated (Galvanized) Carbon Steel Wire

D996 Terminology of Packaging and Distribution Environments

D3951 Practice for Commercial Packaging

D3953 Specification for Strapping, Flat Steel and Seals

D4169 Practice for Performance Testing of Shipping Containers and Systems

D4442 Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials

D4444 Test Method for Laboratory Standardization and Calibration of Hand-Held Moisture Meters

D6199 Practice for Quality of Wood Members of Containers and Pallets

D6253 Practice for Treatment and/or Marking of Wood Packaging Materials

D6254/D6254M Specification for Wirebound Pallet-Type Wood Boxes

F1667 Specification for Driven Fasteners: Nails, Spikes, and Staples

IEEE/ASTM SI 10 Standard for Use of the International System of Units (SI) (the Modern Metric System)

2.2 Code of Federal Regulations:³

CFR Parts 107–180, Title 49 Hazardous Materials Regulations

¹ This specification is under the jurisdiction of ASTM Committee **D10** on Packaging and is the direct responsibility of Subcommittee **D10.12** on Shipping Containers, Crates, Pallets, Skids and Related Structures.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from U.S. Government Printing Office, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, www.access.gpo.gov.

2.3 Federal Standard:

Fed-Std-123 Federal Standard Marking for Shipment (Civil Agencies)⁴

2.4 Military Handbook:

MIL-HDBK-129 Department of Defense Handbook Military Marking⁵

2.5 National Motor Freight Traffic Association Standard:

National Motor Freight Classification⁶

2.6 ANSI Standard:

ANSI/ASQC Q91-1987 Quality Systems-Model for Quality Assurance and Design/Development, Production, Installation, and Servicing⁷

2.7 Hardwood Plywood and Veneer Association Standard:

ANSI/HPVA HP-1-2004 American National Standard for Hardwood and Decorative Plywood

2.8 National Institute of Standards and Technology (NIST)

Standard:⁹

PS 1-07 Structural Plywood

PS 20-05 American Softwood Lumber Standard

2.9 International Standard:¹⁰

International Standards for Phytosanitary Measures Publication No. 15 (ISPM 15) Regulation of Wood Packaging Material in International Trade

3. Terminology

3.1 *Definitions*—General definitions for packaging and distribution environments are found in Terminology **D996**.

3.2 *Definitions of Terms Specific to This Standard*: The wood box components discussed herein were selected on the basis of part function. Alternate names are sometimes used by the wood packaging industry and end-users.

3.2.1 *batten*—lumber reinforcement nailed or stapled to the end faceboards together to create rigidity.

3.2.2 *binding wire*—round steel wire stapled to the faceboards which ends in a loop, the prong of which is firmly anchored in a board or twisted to form a loop.

3.2.3 *cleat*—lumber pieces which form the wirebound box framework and to which the faceboards are stapled.

3.2.4 *end*—composed of faceboard to which liners, battens, or both are attached forming a subassembly.

3.2.5 *faceboard*—sheating materials used for the container faces (top, bottom, sides, and ends).

3.2.6 *liner*—thin wood board staples to the end to reinforce the end faceboard.

3.2.7 *lumber*—manufactured wood product derived from a log through sawing or planing.

3.2.8 *plywood*—panel built up of sheers of veneer called plies, united under pressure by a bonding agent to create a panel with an adhesive bond between plies.

3.2.9 *staple*—U-shaped piece of wire with pointed ends, driven astride the binding wires in fabricating the blank or attaching boards to battens.

3.2.10 *veneer*—thin layer or sheet of wood.

4. Classification

4.1 Type of Load:

4.1.1 *Type 1*—Easy load, one interior container that supports the top, bottom, and sides of the outer wirebound shipping box. Articles of moderate density packed in and completely filling one and only one interior box, which, in turn, completely fills and supports all the faces of the outer shipping box into which it is packed. As examples, canned and boxed articles, which are repacked in a fiberboard box which completely fills the outer shipping box. A single article of moderate density which contacts and completely supports all the faces of the shipping box and has sufficient strength, even though not boxed, to withstand the forces encountered in transportation and handling, but required the protection of the box to prevent scratching or marring. As examples, wood or metal chests, tool kits, and boxed sturdy instruments packed one in a shipping box.

4.1.2 *Type 2*—Average load, interior or intermediate containers that support and fill the voids of outer wirebound container. Contents are moderately concentrated articles, which may either be packed directly into the outer shipping box or subject to an intermediate stage of packing, such as wrapping or packing in interior boxes, or protected by other types of suitable interior intermediate stage of packing, such as wrapping or packing in interior boxes, or protected by other types of suitable interior packing. The contents or interior packing provide support for all the faces of the shipping box. As examples, goods in metal cans, which are packed in an inner container, bottles individually cushioned, hardware in cartons.

4.1.3 *Type 3*—Difficult load, interior contents that require a high degree of protection. Interior contents will not support outer wirebound shipping container top, bottom, or sides. Contents are articles, which are highly concentrated, required a high degree of protection, or do not support the faces of the shipping box. As examples, wrenches, long bolts, and rods, which can exert highly concentrated forces on faces of shipping box. Rivets, drop forgings, and bulk hardware which are packed loosely and according to no definite pattern and apply force on all faces of the shipping box, fragile articles and delicate instruments, which require special protection, valves, fittings, and machine parts which do not completely fill the shipping box.

4.2 Class:

4.2.1 *Class 1*—Domestic shipments capable of passing Practice **D4169**, distribution Cycle 1 testing as a minimum, with no maritime shipment testing required.

⁴ Available from ASSIST Quicksearch, assist.daps.dla.mil/quicksearch.

⁵ Available from ASSIST Quicksearch, assist.daps.dla.mil/quicksearch.

⁶ Available from the National Motor Freight Traffic Association (NMFTA), 1001 N Fairfax St., Ste 600, Alexandria, VA 22314, www.nmfta.org.

⁷ Available from the American National Standards Institute, 25 West 43rd St., New York, NY 10036.

⁸ Available from Hardwood Plywood and Veneer Association (HPVA), P.O. Box 2789, Reston, VA 22090-0789, www.hpva.org.

⁹ Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, www.nist.gov.

¹⁰ Available from the International Plant Protection Convention (IPPC), www.ippc.int.

4.2.2 *Class 2*—Overseas shipments capable of passing Practice D4169 distribution Cycles 1 with 15, 16, or 17 as applicable to the type of shipping container selected.

4.2.3 *Class 3*—Extreme Distribution hazards or military contingency operations the wirebound container will be capable of passing Practice D4169 distribution cycle 18 testing as a minimum requirement.

4.3 *Style (based on the method of closure, see Fig. 1):*

4.3.1 *Style 1*—Twisted wire closure.

4.3.2 *Style 2*—Looped wire closure.

4.3.3 *Style 3*—Looped wire closure with wired ends.

4.4 *Treatment:*

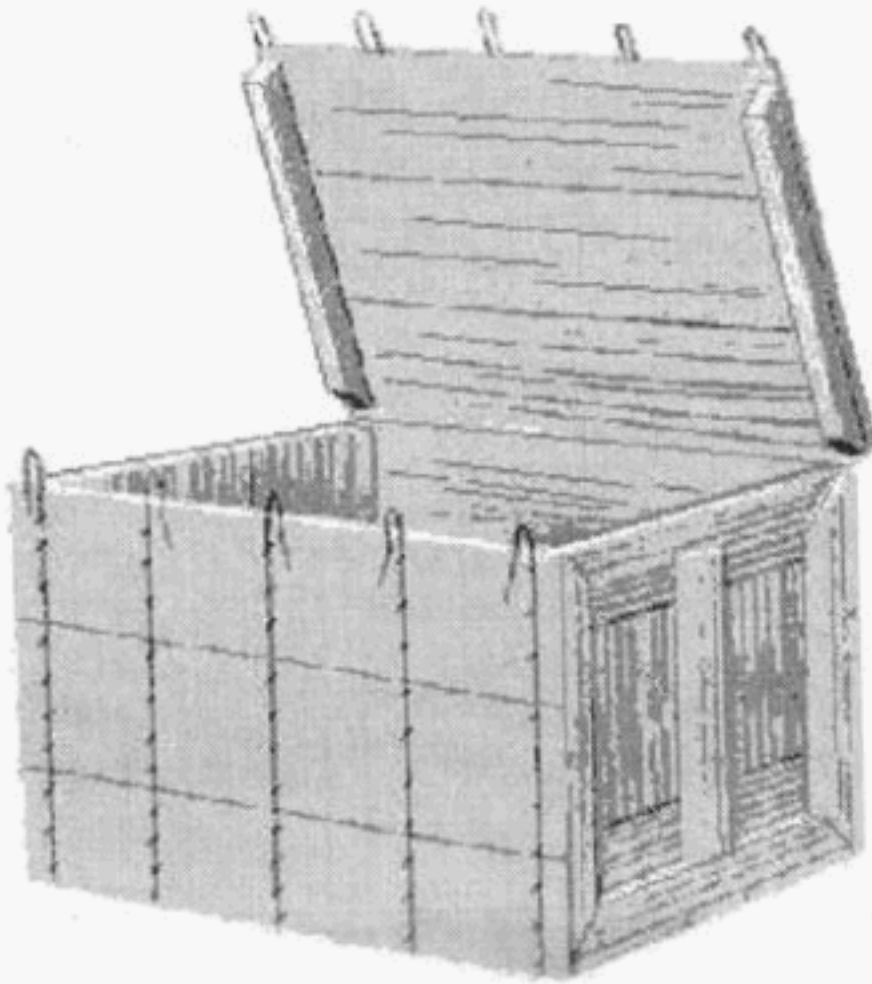
4.4.1 *Grade A*—With preservative treatment.

4.4.2 *Grade B*—Without water preservative.

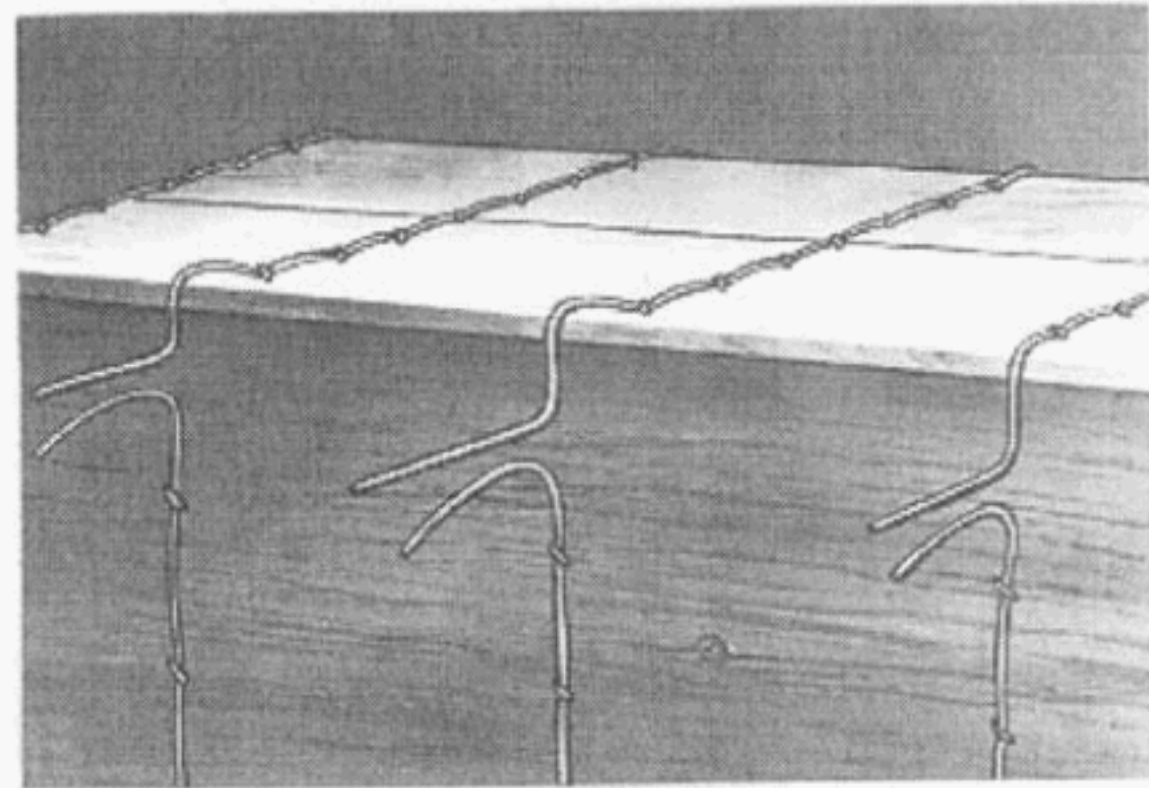
5. Ordering Information

5.1 Purchasers should cite the following information in procurement and purchase order documents:

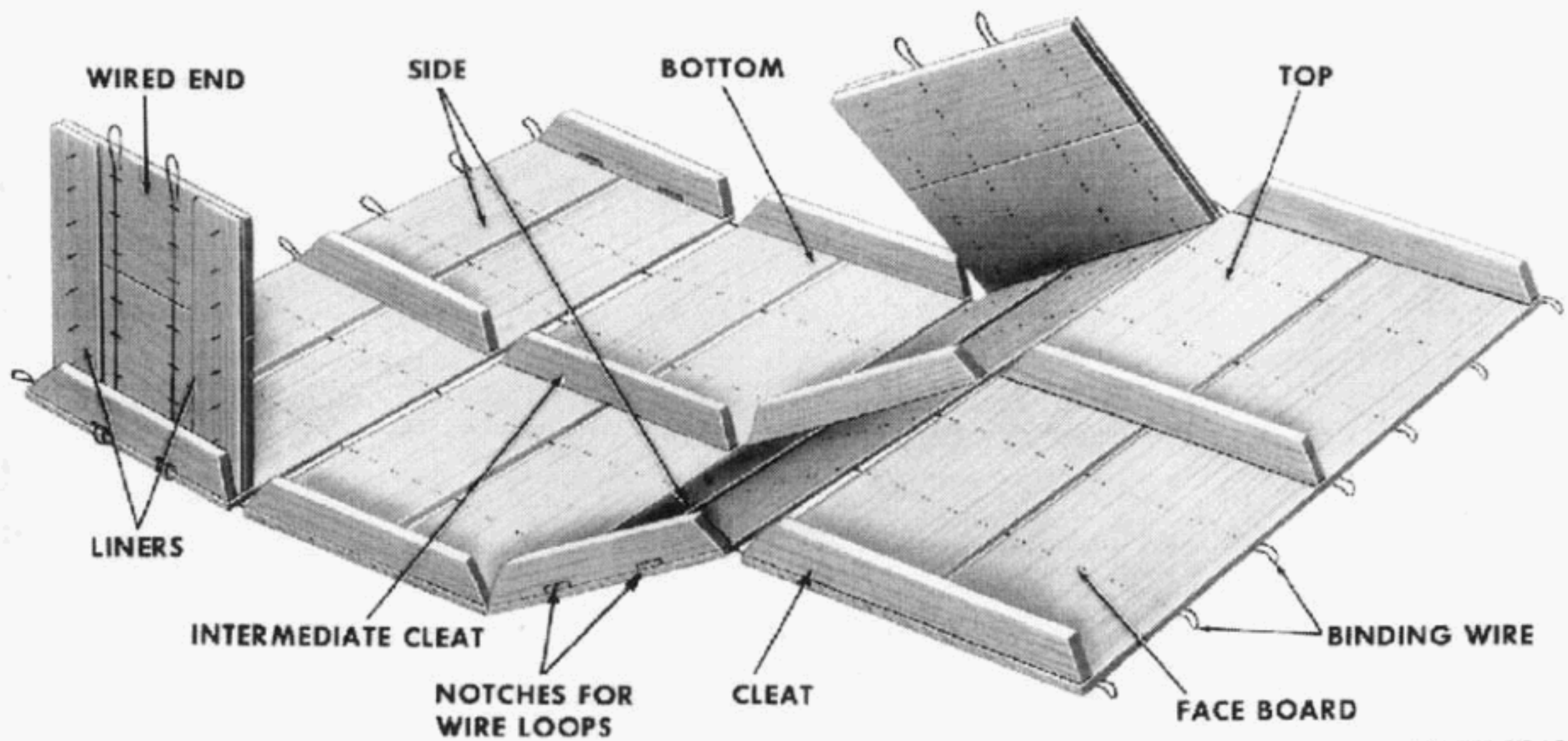
5.1.1 Specification title, number, and date.



STYLE 2



STYLE 1



SMPT 2643

STYLE 3

FIG. 1 Box Styles Based on Method of Closures

5.1.2 Type of load, box, class, and style, and treatment, if specified, (see 4.1 – 4.4 and S2).

5.1.3 Inside box dimensions (see 7.1).

5.1.4 Intermediate cleats for special designs, their size and location. (see 7.3.1).

5.1.5 Weight of contents or load specified in lb (kg).

5.1.6 Type of girth wire (see 7.7.2).

5.1.7 When palletization is required (see S3.4.3).

5.1.8 Marking required (see S4).

5.1.9 Exceptions to these specifications, if authorized.

5.1.10 When preservative treatment Grade A is required for Class 2 or 3 boxes for overseas shipments (see 6.1.5).

5.1.11 When four-way entry skids are required and when 3½ × 4-in. [76 × 89 mm] built-up skids are required (see 7.13).

5.1.12 Purchasers should reference by paragraph number any supplemental requirements applicable to their purchase request (see S1.1).

5.1.13 When ISPM 15 compliance is required (See 9.3).

6. Materials and Manufacture

6.1 *Materials*—Materials shall be as specified herein. Materials not specified shall be selected by the contractor or box builder and shall be subject to all provisions of this specification. Materials shall be free of defects, which adversely affect performance or serviceability of the finished product.

6.1.1 *Lumber*—Lumber shall conform to Practice D6199, PS 20 or the NHLA rules. All lumber sizes specified herein shall be nominal and shall be the minimum acceptable sizes for lumber components. Lumber components shall have a target thickness and width uniform in dimension and 50 % of components shall meet or exceed the target dimensions at the time of component manufacture.

6.1.2 *Plywood Panel*—Plywood shall conform to ANSI/HPVA HP-1-2004 or PS 1, Exposure 1 or Exterior panel. Plywood shall have no defects (knot holes, worm holes, and so forth) extending through the panel. Unless otherwise specified, plywood shall be finished unsanded.

6.1.3 *Wires*:

6.1.3.1 *Binding Wire and Staple Wire*—Binding wire shall be low carbon annealed steel wire and have the properties listed in Table 1. Staple wire shall be hard tempered, low carbon steel wire, and have the properties listed in Table 1.

6.1.3.2 *Wire Coatings*—The surfaces of binding wire and staple wire for Class 2 and 3 boxes shall be galvanized. The surface of binding and staple wires for Class 1 boxes need not be galvanized. Galvanized coating shall be smooth and shall not flake or peel when tested in accordance with Specification A641/A641M.

6.1.4 *Fasteners*:

6.1.4.1 *Nails*—Nails shall be made of steel wire and shall conform to the requirements of Specification F1667 or other industry standards. Nails are classified as plain-shank, helically threaded, annularly threaded, fluted, or twisted square wire. Nails will be clinched, cement-coated, or chemical etched to prevent premature withdrawal.

6.1.4.2 *Staples or Wire Stitches*—Staples have either round-wire or approximately square-wire legs, referring to the cross-sectional shape of the wire. Staples or wire stitches shall be made of steel wire not less than 0.0625 in. 16 gage [2 mm] and comply with Specification F1667 or other industry standards.

6.1.5 *Wood Preservative, Water Repellent*—Water repellent preservative shall be composed of either a 2 % copper naphthenate, a 3 % zinc naphthenate, or a 1.8 % oxine copper (formerly referred to as copper-8-quinolinolate) solution.

7. Construction

7.1 *Dimensions*—Boxes shall be furnished having the dimensions as specified (see 5.1.3). Dimensions of boxes are measured between the inside surfaces of the faceboards, and calculated to the nearest ⅛ in. [3 mm], the preferred sequence length, width, and depth is used to communicate size in the purchase order or contract.

7.2 *Faceboards*—The thickness of the faceboard can be determined by selecting the appropriate information from Tables 2 and 3. Weight of box contents, type of load and the groups of wood based on box class determine the appropriate faceboard.

7.2.1 *Grain of Faceboards*—End faceboards for Styles 1 and 2 boxes shall be placed with the grain horizontal, except that when horizontal battens are used in end panels, the grain of the faceboards shall be vertical. End faceboards for Style 3 boxes shall be placed with the grain vertical. A line of staples shall be located approximately 1 in. [25 mm] from the parallel to each horizontal edge of the end faceboard (see 7.8). The direction of grain of the plywood to which the end wire is stitched shall be vertical.

7.3 *Cleats*—The cleats shall be made of Group II (medium density softwoods), III (medium density hardwoods), or IV (high density hardwoods and softwoods) woods only as listed with Practice D6199. Each cleat shall be single piece of wood without joints. Cleats shall be made with mitered ends or with mortised and tenoned ends tongue- and groove. Dimensions shall be actual dimensions, 1⅜ in. [9 mm]. Edge cleats of all styles of boxes shall be 1⅜ in. [21 mm] wide and 7/8 in. [22 mm] in thickness for boxes having weight of contents up to 300 lb [136 kg]. Boxes having weight of contents from 300 to 500 lb [136 to 227 kg] edge cleats shall be 1⅜ in. [29 mm] wide and 1⅜ in. [29 mm] in thickness, except that horizontal and vertical battens (HVB) or HVBW end patterns are used (see Fig. 2), edge cleats shall be 1⅜ in. [21 mm] wide and 7/8 in. [22 mm] in thickness.

7.3.1 *Intermediate Cleats*—Boxes for Types 2 and 3 loads, having greater between-cleat dimensions than specified in Table 4, shall be reinforced with one or more rows of intermediate cleats, except as below. Rows of intermediate cleats are not required on boxes for Type 1 loads. The distance

TABLE 1 Tensile Strength of Binding and Staple Wire

Type	Tensile Strength/K		Use
	psi	MPa	
Twist binding	45–70	310–483	Twist closure
Medium binding	60–75	414–517	Groups I, II, and III woods
Hard binding	70–85	483–586	Group IV woods
Stapling wire	95–125	655–862	Group I, II, and III woods
Stapling wire special	Up to 180	Up to 1241	Group IV woods

TABLE 2 Minimum Thickness of Faceboards

Weight of Box Contents in lb [kg]		Group I Woods in. [mm]		
Exceeding	Not Exceeding	Type 1 Load	Type 2 Load	Type 3 Load
Class 1 Boxes				
0	85 [38.5]	$\frac{7}{32}$ [6]	$\frac{1}{4}$ [6]	$\frac{5}{16}$ [8]
85 [38.5]	125 [56.7]	$\frac{1}{4}$ [6]	$\frac{5}{16}$ [8]	$\frac{3}{8}$ [10]
125 [56.7]	200 [90.7]	$\frac{5}{16}$ [8]	$\frac{3}{8}$ [10]	$\frac{7}{16}$ [11]
200 [90.7]	300 [136.1]	$\frac{3}{8}$ [10]	$\frac{7}{16}$ [11]	A
300 [136.1]	400 [181.4]	A	A	A
400 [181.4]	500 [226.8]	A	A	A
Class 2 Boxes				
0	85 [38.5]	$\frac{5}{16}$ [8]	$\frac{3}{8}$ [10]	A
85 [38.5]	125 [56.7]	$\frac{3}{8}$ [10]	$\frac{3}{8}$ [10]	A
125 [56.7]	200 [90.7]	A	A	A
200 [90.7]	300 [136.1]	A	A	A
300 [136.1]	400 [181.4]	A	A	A
Class 3 Boxes				
0	85 [38.5]	$\frac{3}{8}$ [10]	$\frac{3}{8}$ [10]	A
85 [38.5]	125 [56.7]	A	A	A
125 [56.7]	200 [90.7]	A	A	A
200 [90.7]	500 [226.8]	A	A	A
Group II and III Woods in. [mm]				
Exceeding	Not Exceeding	Type 1 Load	Type 2 Load	Type 3 Load
Class 1 Boxes				
0	85 [38.5]	$\frac{1}{7}$ [4]	$\frac{1}{6}$ [4]	$\frac{3}{16}$ [5]
85 [38.5]	125 [56.7]	$\frac{1}{6}$ [4]	$\frac{3}{16}$ [5]	$\frac{7}{32}$ [6]
125 [56.7]	200 [90.7]	$\frac{3}{16}$ [5]	$\frac{7}{32}$ [6]	$\frac{1}{4}$ [6]
200 [90.7]	300 [136.1]	$\frac{7}{32}$ [6]	$\frac{7}{32}$ [6]	$\frac{1}{4}$ [6]
300 [136.1]	400 [181.4]	$\frac{1}{4}$ [6]	$\frac{1}{4}$ [6]	$\frac{5}{16}$ [8]
400 [181.4]	500 [226.8]	$\frac{5}{16}$ [8]	$\frac{5}{16}$ [8]	$\frac{3}{8}$ [10]
Class 2 Boxes				
0	85 [38.5]	$\frac{3}{16}$ [5]	$\frac{7}{32}$ [6]	$\frac{5}{16}$ [8]
85 [38.5]	125 [56.7]	$\frac{7}{32}$ [6]	$\frac{1}{4}$ [6]	$\frac{5}{16}$ [8]
125 [56.7]	200 [90.7]	$\frac{7}{32}$ [6]	$\frac{1}{4}$ [6]	$\frac{5}{16}$ [8]
200 [90.7]	300 [136.1]	$\frac{1}{4}$ [6]	$\frac{3}{8}$ [10]	$\frac{3}{8}$ [10]
300 [136.1]	400 [181.4]	$\frac{5}{16}$ [8]	$\frac{3}{8}$ [10]	$\frac{3}{8}$ [10]
Class 3 Boxes				
0	85 [38.5]	$\frac{1}{4}$ [6]	$\frac{1}{4}$ [6]	$\frac{5}{16}$ [8]
85 [38.5]	125 [56.7]	$\frac{1}{4}$ [6]	$\frac{5}{16}$ [8]	$\frac{5}{16}$ [8]
125 [56.7]	200 [90.7]	$\frac{1}{4}$ [6]	$\frac{5}{16}$ [8]	$\frac{3}{8}$ [10]
200 [90.7]	500 [226.8]	$\frac{5}{16}$ [8]	$\frac{3}{8}$ [10]	$\frac{3}{8}$ [10]
Group IV Woods in. [mm]				
Exceeding	Not Exceeding	Type 1 Load	Type 2 Load	Type 3 Load
Class 1 Boxes				
0	85 [38.5]	$\frac{1}{7}$ [4]	$\frac{1}{7}$ [4]	$\frac{1}{6}$ [4]
85 [38.5]	125 [56.7]	$\frac{1}{7}$ [4]	$\frac{1}{6}$ [4]	$\frac{3}{16}$ [5]
125 [56.7]	200 [90.7]	$\frac{1}{6}$ [4]	$\frac{3}{16}$ [5]	$\frac{7}{32}$ [6]
200 [90.7]	300 [136.1]	$\frac{3}{16}$ [5]	$\frac{7}{32}$ [6]	$\frac{1}{4}$ [6]
300 [136.1]	400 [181.4]	$\frac{7}{32}$ [6]	$\frac{1}{4}$ [6]	$\frac{5}{16}$ [8]
400 [181.4]	500 [226.8]	$\frac{1}{4}$ [6]	$\frac{1}{4}$ [6]	$\frac{5}{16}$ [8]
Class 2 Boxes				
0	85 [38.5]	$\frac{3}{16}$ [5]	$\frac{3}{16}$ [5]	$\frac{7}{32}$ [6]
85 [38.5]	125 [56.7]	$\frac{3}{16}$ [5]	$\frac{3}{16}$ [5]	$\frac{7}{32}$ [6]
125 [56.7]	200 [90.7]	$\frac{3}{16}$ [5]	$\frac{7}{32}$ [6]	$\frac{1}{4}$ [6]
200 [90.7]	300 [136.1]	$\frac{7}{32}$ [6]	$\frac{1}{4}$ [6]	$\frac{5}{16}$ [8]
300 [136.1]	400 [181.4]	$\frac{1}{4}$ [6]	$\frac{5}{16}$ [8]	$\frac{3}{8}$ [10]
Class 3 Boxes				
0	85 [38.5]	$\frac{1}{4}$ [6]	$\frac{1}{4}$ [6]	$\frac{1}{4}$ [6]
85 [38.5]	125 [56.7]	$\frac{1}{4}$ [6]	$\frac{1}{4}$ [6]	$\frac{5}{16}$ [8]
125 [56.7]	200 [90.7]	$\frac{1}{4}$ [6]	$\frac{1}{4}$ [6]	$\frac{5}{16}$ [8]
200 [90.7]	500 [226.8]	$\frac{1}{4}$ [6]	$\frac{5}{16}$ [8]	$\frac{3}{8}$ [10]

^A Group I Woods (low density hardwoods and softwoods) are not permitted.

TABLE 3 Minimum Faceboard Requirements

Resawn faceboard thickness not less than $\frac{1}{32}$ in. [1 mm] Less than specified in Table 2	Faceboard edge piece not less than 2- $\frac{1}{2}$ in. [63.5 mm] wide	Space between Faceboards not more than $\frac{1}{4}$ in. [6 mm]
Faceboards no less than 2 $\frac{1}{2}$ in. [63.5 mm] in width	One full piece of plywood thickness not less than 25 %	

between adjacent rows of cleats shall not exceed the distance indicated in [Table 4](#). In special designs for Types 2 and 3 loads, where required, size and location of intermediate cleats shall be specified (see [5.1.4](#)) If the use of intermediate cleats may be omitted but the thickness of faceboards shall be increased to the thickness specified for the between cleat dimension indicated in [Table 4](#).

7.3.2 Cleat Sizes—Unless otherwise specified in the contract or purchase order (see [5.1.9](#)), any of the sizes of cleats shown in [Table 5](#) shall be used for intermediate rows. No part of any intermediate cleat shall be more than $\frac{1}{32}$ in. [1 mm] less than the dimension shown in [Table 5](#), for dimensions exceeding $\frac{13}{16}$ in. [21 mm], or $\frac{1}{16}$ in. [2 mm] less than the dimensions exceeding $\frac{13}{16}$ in. [21 mm].

7.4 Battens—Battens shall be attached to the outside face of the end faceboard and may be positioned horizontal, vertical, or both horizontal and vertical. Battens made for Group I woods shall be not less than $1\frac{3}{4}$ in. [45 mm] wide and those made from Groups II, III, and IV woods shall be not less than $1\frac{3}{8}$ in. [35 mm] wide. Battens shall be the same thickness as the cleats on the boxes. No part of a batten shall be more than $\frac{1}{32}$ in. [1 mm] less than the specified thickness nor more than $\frac{1}{16}$ in. [2 mm] less than the specified width.

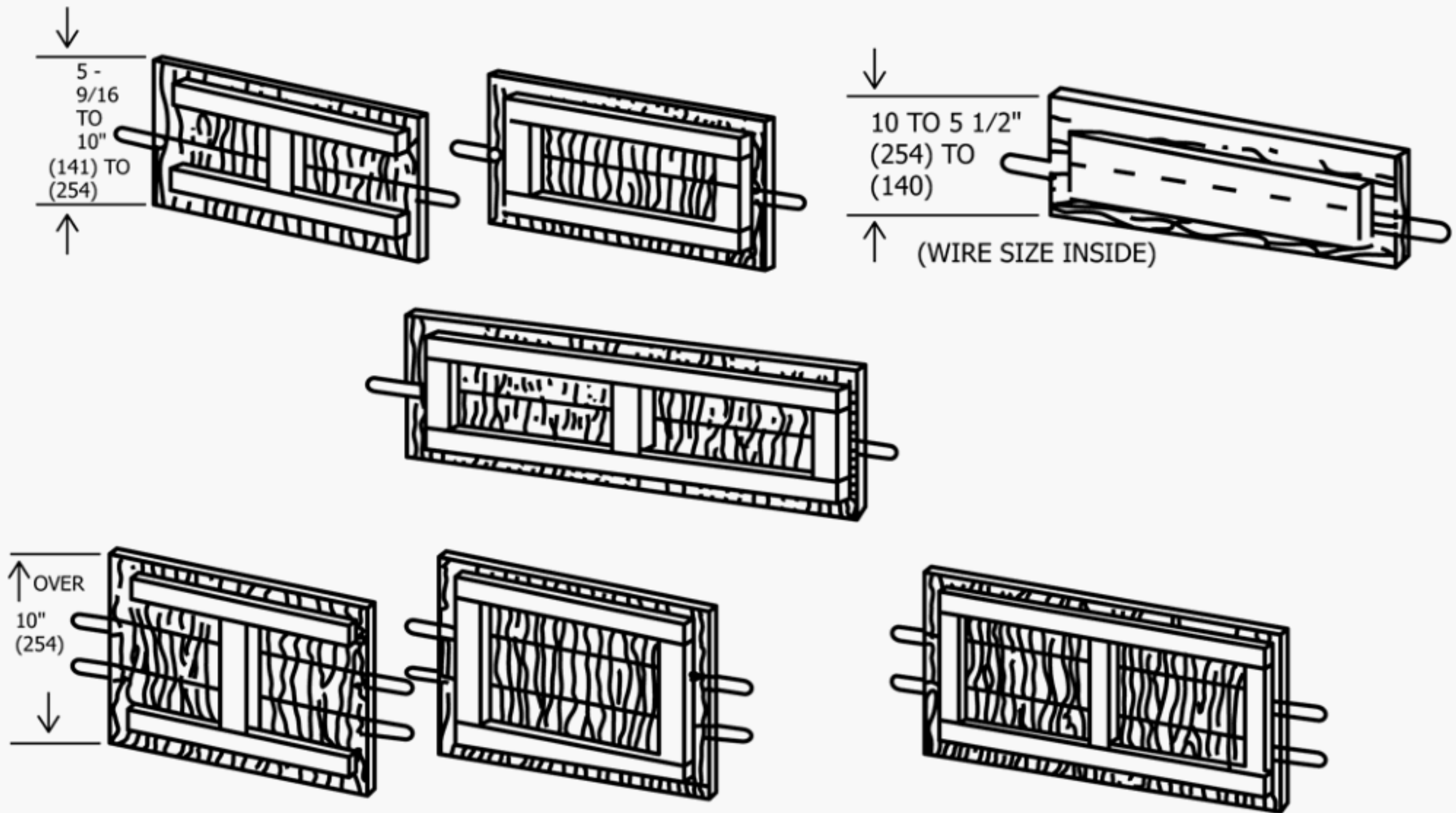
7.5 Liners—The grain of the liner shall be at right angles to the grain of the end face board. Liners for Styles 1 and 2 boxes shall always be vertical; liners for Style 3 boxes shall always be horizontal. When liners are attached to the edges of ends, the liners shall be not less than $1\frac{3}{16}$ in. [30 mm] wide. For Style 3 boxes more than 14 in. [356 mm] in depth, or having vertical battens, the liners shall be not less than $2\frac{7}{8}$ in. [73 mm] wide. The thickness of the liner shall be not less than the thickness of the end board, except that it need not exceed $\frac{1}{4}$ in. [6 mm], when the thickness of the end face board exceeds $\frac{1}{4}$ in. [6 mm]. Each edge and intermediate liner shall be fastened to the end face board by staples. Liners which are $2\frac{7}{8}$ in. [73 mm] wide shall have two rows of staples.

7.6 Ends:

7.6.1 Ends for Styles 1 and 2 Boxes—Battens shall be required on the ends of Styles 1 and 2 boxes, except that vertical liners are permitted in lieu of battens under the conditions specified in [7.11.2](#). The number and arrangement of battens or liners depend on the class of box, type of load, dimensions, and weight of contents. Vertical liners shall be required on ends made from sawed boards when battens are not used. When ends are made from one-piece plywood, no liner is required. Standard arrangements of battened ends and lined ends for Styles 1 and 2 boxes are shown in [Fig. 3](#).

7.6.2 Ends for Style 3 Boxes—Ends of Style 3 boxes shall have liners, battens, or both. The number and arrangement of battens, liners, and end-wires depend on the class of box, type of load, dimensions, and weight of contents. When ends shall be made from one-piece plywood, liners are not required. Standard arrangements of battens on the ends of Style 3 boxes are shown in [Fig. 4](#).

7.7 Wires—Each girth wire shall be continuous around the girth of the box. Whenever practicable, all girth wires shall be spaced uniformly, except that when rows of intermediate cleats



	Maximum Spacing of Vertical Battens in in. (mm)		
	Class 1	Class 2	Class 3
Type 1 Load [Easy]	18 [457]	15 [381]	12 [305]
Type 2 Load [Average]	16 [406]	13 [330]	10 [254]
Type 3 Load [Difficult]	14 [356]	11 [279]	7 [178]

NOTE 1—Wires may be placed on either side of face material.

FIG. 2 End Panel Patterns for Style 3 Boxes

TABLE 4 Maximum Distance Between Adjacent Rows of Cleats

Thickness of faceboards in fractional in. [mm] ^A	Type 2 Load [Average]			Type 3 Load [Difficult]		
in. [mm]	Group I Woods, in. [mm]	Groups II and III Woods, in. [mm]	Group IV Woods, in. [mm]	Group I Woods, in. [mm]	Group II and III Wood in. [mm]	Group IV Woods in. [mm]
Class 1 Boxes						
1/8 [4]	—	32 [813]	36 [914]	—	—	24 [610]
7/32 [6]	—	40 [1016]	44 [1118]	—	28 [711]	32 [813]
1/4 [6]	32 [813]	44 [1118]	48 [1219]	—	32 [813]	36 [914]
5/16 [8]	36 [914]	48 [1219]	48 [1219]	24 [610]	36 [914]	40 [1016]
3/8 [10]	36 [914]	48 [1219]	48 [1219]	24 [610]	40 [1016]	40 [1016]
Class 2 and 3 Boxes						
7/32 [6]	—	28 [711]	32 [813]	—	—	20 [508]
1/4 [6]	—	32 [813]	36 [914]	—	20 [508]	24 [610]
5/16 [8]	—	36 [914]	40 [1016]	—	24 [610]	28 [711]
3/8 [10]	32 [813]	40 [1016]	44 [1118]	—	28 [711]	32 [813]

^A When intermediate cleats are not desired (see 7.3.1). For Type 1 loads, intermediate cleats are not required.

TABLE 5 Sizes of Intermediate Cleats

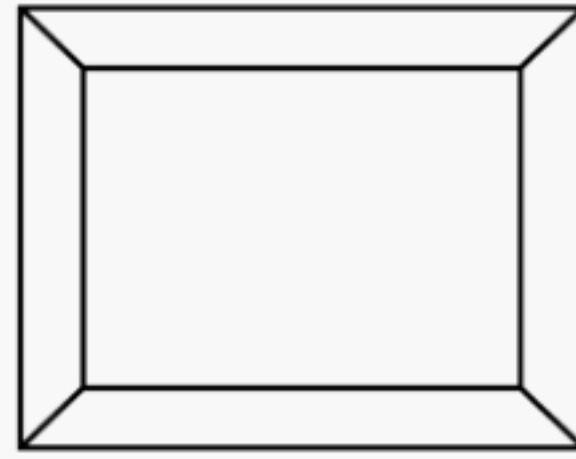
Width, in. [mm]	Thickness, in. [mm]
2 3/4 [70]	3/8 [10]
2 1/4 [57]	1/2 [13]
1 3/4 [45]	5/8 [16]
1 1/4 [32]	3/4 [19]
1 1/8 [21]	1 3/16 [21]

7.8. Splicing or welding of a binding wire during manufacture is acceptable. The number and gage of girth wires shall conform to the requirements of Table 6 for the weight of contents and inside length of box specified.

7.7.1 *Wire Gage*—The gage of end wires on Style 3 boxes shall conform to the requirements of Table 7 for the weight of contents and class of box specified.

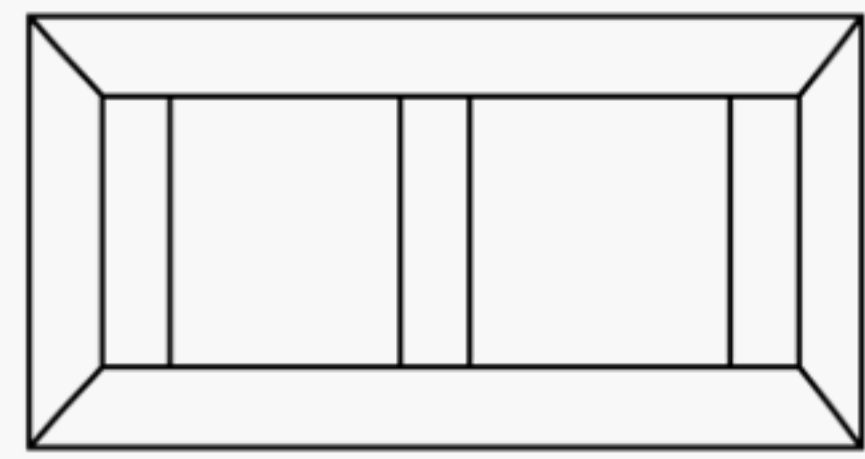
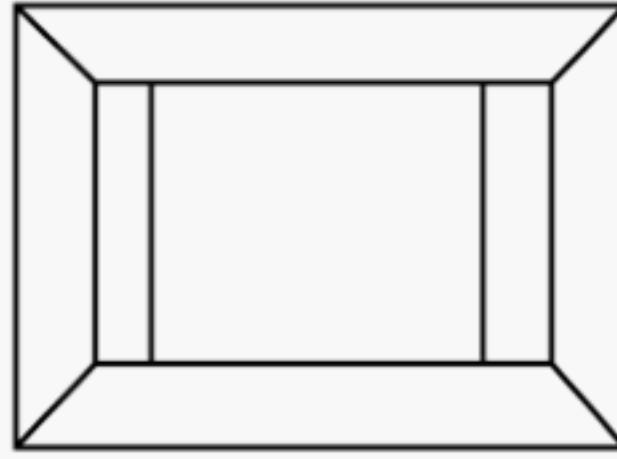
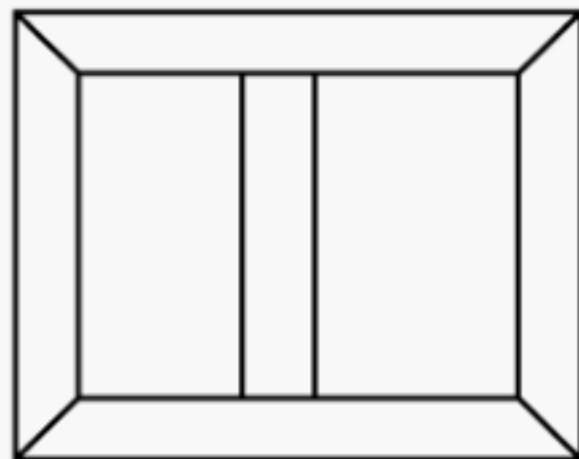
7.7.2 *Girthwise Wire Closure for Box Styles*—The length of girth wires for twisted and looped wire fasteners on Styles 1 and 2 boxes shall be such as to make satisfactory closure. The length of looped wire on the ends of Style 3 boxes shall be such as to make a satisfactory assembly of the box. On Style 1 boxes, for twisted wire closures, the ends of the girth wires shall not be less than 2 1/4 in. [57 mm] beyond the edge of the top boards and not less than 1 in. [25 mm] beyond the edge of the side boards. On Style 2 boxes, each end of each girth wire shall be a looped fastener formed by twisting the wires or by bending the wire back in the opposite direction, driving the

are used, a girth wire shall be placed over each row of cleats. On the ends of Style 3 boxes, each wire shall be continuous across the end. These wires should be generally stapled to the outside face of the end or may be stapled to the inside face if it is more practical to do so. Stapling shall be as specified in



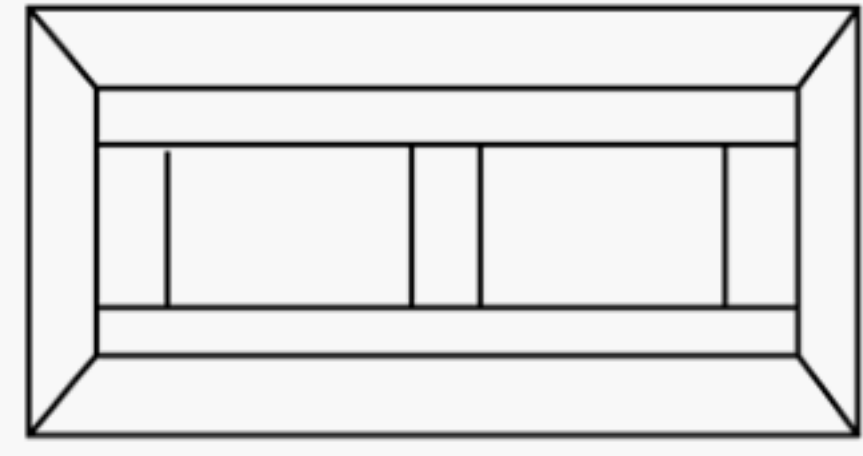
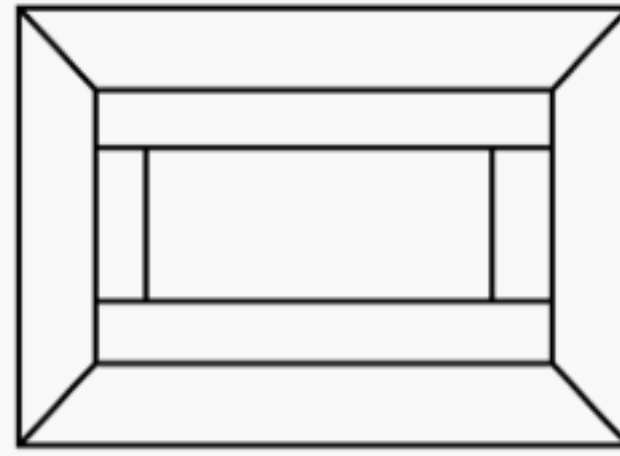
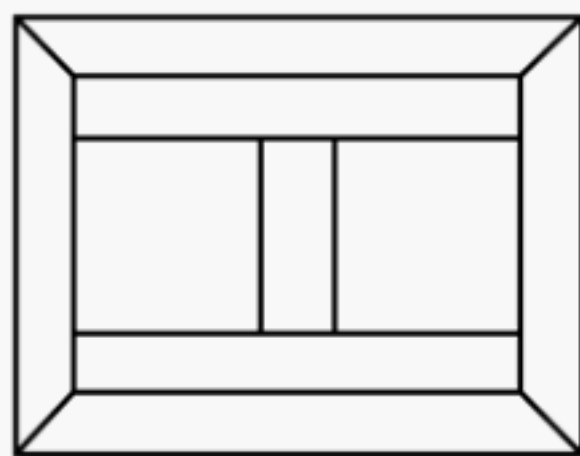
VL PATTERN VERTICAL LINERS

HORIZONTAL FACEBOARD GRAIN



VB PATTERN VERTICAL BATTENS

HORIZONTAL FACEBOARD GRAIN



HVB PATTERN HORIZONTAL & VERTICAL BATTENS

VERTICAL FACEBOARD GRAIN

	Maximum Spacing of Vertical Battens		
	Class 1 in. [mm]	Class 2 in. [mm]	Class 3 in. [mm]
Type 1 Load [Easy]	15 [381]	12 [305]	12 [305]
Type 2 Load [Average]	13 [330]	10 [254]	10 [254]
Type 3 Load [Difficult]	11 [2793]	7 [178]	7 [178]

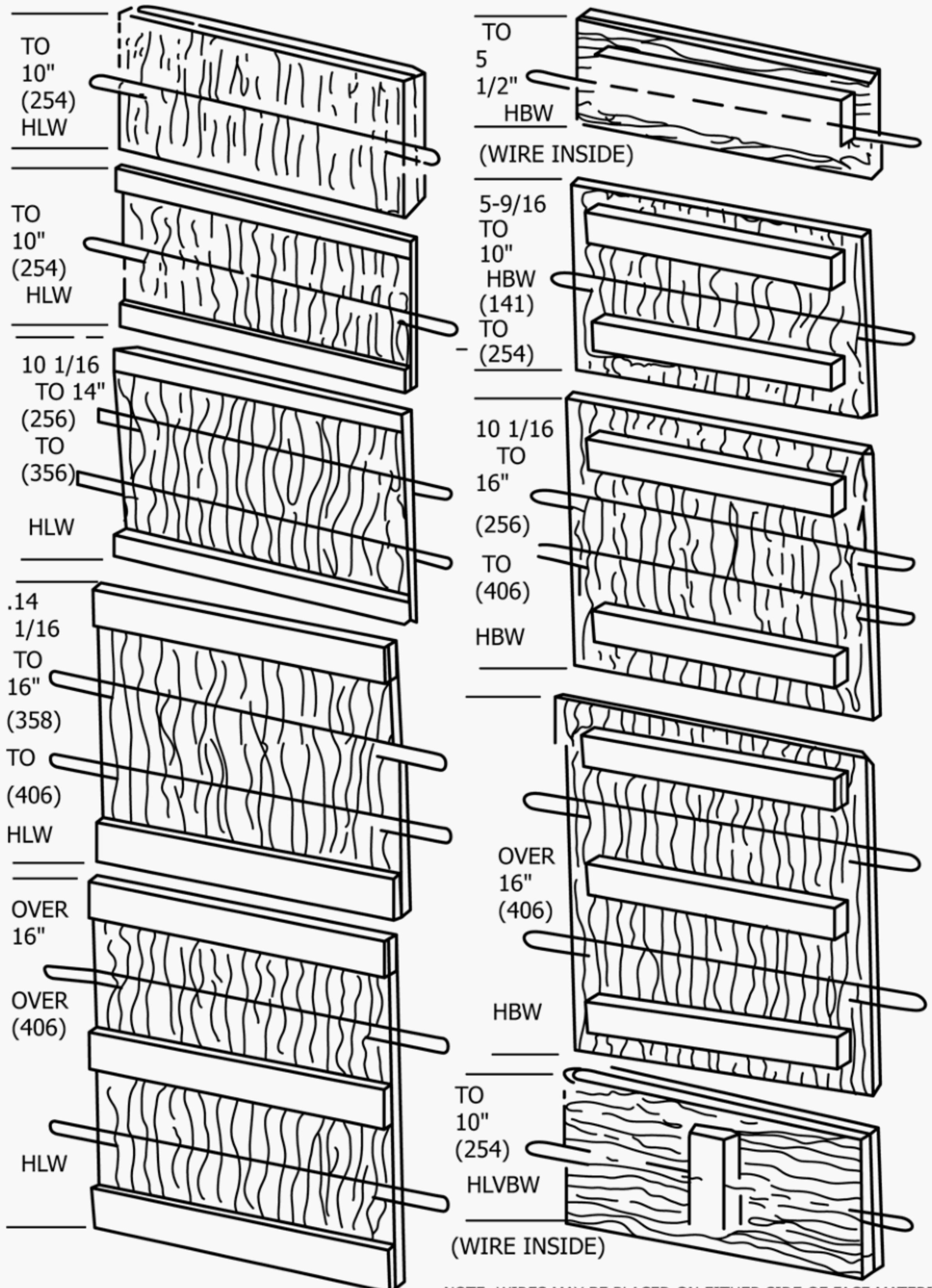
FIG. 3 End Panel Patterns for Styles 1 & 2 Boxes (see 7.11.1 – 7.11.3)

ends of the wire through the boards and clinching. The manner of forming the looped fastener shall be at the option of the manufacturer. On Style 3 boxes, each end of each end wire shall be a looped fastener formed by bending the wire back in the opposite direction, driving the end of the wire through the boards and clinching. When specified in the contract or purchase order (see 5.1.6), each end of each girth wire may be a twisted wire closure, as specified for Style 1 closures above.

7.8 Staples—Staples shall be used for fastening binding wires for both faceboards and cleats and for fastening liners to end faceboards. Staples also may be used for fastening end faceboards to battens. Binding wires shall be applied mechanically and be fastened by staples astride the wire. Staples shall pass through the faceboards and be clinched smooth, or shall pass through the faceboards and into the cleats. The points of the staples shall not protrude from the surface of the wood, but if driven through a board or cleat, they shall be clinched.

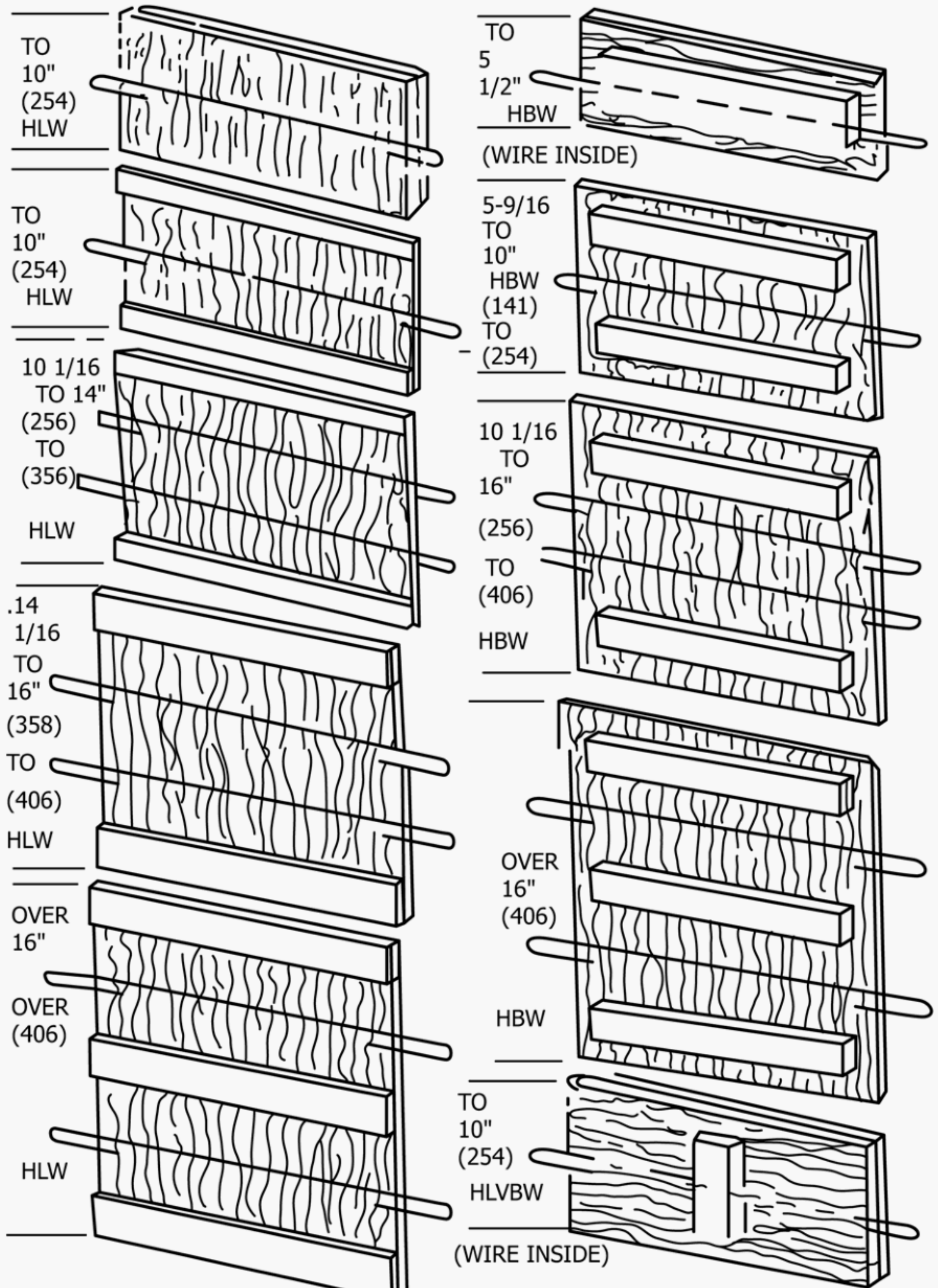
Spacing of staples shall not exceed 2 in. [51 mm] when driven over binding wires for Class 1 boxes. For Class 2 and 3 boxes, spacing of staples shall not exceed 1½ in. [38 mm], except where the requirements for positioning end wires or the length of the cleat requires more staples then the spacing shall not exceed 1½ in. [38 mm]. Staples driven over binding wires into faceboards only, shall be not less than 0.0475 in. in diameter 18-gage [1.20 mm]. The length of staples shall be not less than indicated in Table 8 and shall be long enough to penetrate the boards and be clinched smooth.

7.8.1 Staples for Securing Binding Wire to Cleats—Staples driven over binding wires and through faceboards into cleats shall be not less than 0.0625 in. diameter 16 gage [1.6 mm], except that staples driven into cleats 1⅞ in. [29 mm] wide × 1⅞ in. [29 mm] deep shall be not less than 0.072 in. diameter 15 gage [1.8 mm]. Staples shall not be deformed or protrude from the cleats, except that when the thickness of the



NOTE: WIRES MAY BE PLACED ON EITHER SIDE OF FACE MATERIAL

FIG. 4 Horizontal and Vertical Battens with Wires



NOTE: WIRES MAY BE PLACED ON EITHER SIDE OF FACE MATERIAL

FIG. 4 Horizontal and Vertical Battens with Wires

in such manner that shifting of contents will not occur during handling of shipment.

7.11 Styles 1 and 2 Boxes—Styles 1 and 2 boxes shall be constructed with end patterns shown in [Table 11](#) for the class of box, type of load, and weight of contents indicated. The end patterns shall be constructed with vertical liners (VL-pattern), vertical battens (VB-pattern), horizontal and vertical battens (HVB-pattern) as shown on [Fig. 3](#). The following additional provisions and limitations for these end patterns also shall apply.

7.11.1 VL-Pattern—The maximum inside width or depth of box for which VL-pattern ends may be used is 16 in. [406 mm] for Type 1 loads or 14 in. [350 mm] for Type 2 loads. VL-pattern end shall not be used for Type 3 loads, for Class 3 boxes, or when strapping is required (see the Supplementary Requirements section). When the box width or depth exceeds the dimensions permitted for the VL-pattern, the VB-pattern shall be used.

7.11.2 VB-Pattern—VB-pattern ends shall be used in lieu of VL-pattern ends when the box width or depth exceeds the dimensions permitted for the VL-pattern. When the inside depth or width exceeds 16 in. [406 mm], at least two vertical battens shall be used, with a batten placed adjacent to each side cleat. A single center vertical batten may be used only when the end faceboard is two-ply crossed veneer or plywood. At least two vertical battens shall be used for Type 3 loads in Class 1 boxes and for Type 2 or 3 loads in Class 2 or 3 boxes.

7.11.3 HVB-Pattern—HVB-pattern ends shall be used where indicated on [Table 11](#) and may be used in lieu of VB pattern ends. When the inside depth exceeds 16 in. [406 mm], or the inside width exceeds 24 in. [610 mm] for Type 1 or 2 loads or 18 in. [457 mm] for Type 3 loads, at least two vertical battens shall be used with a batten placed adjacent to each side cleat.

7.12 Style 3 Boxes—Style 3 boxes shall be constructed with ends of the pattern shown in [Table 12](#) for the class of box, type of load, and weight of contents shown. The end patterns shall be constructed with horizontal liners (HLW-pattern), horizontal battens (HBW-pattern), horizontal liners and vertical battens (HLVBW-pattern), or horizontal and vertical battens (HVBW-pattern), as shown on [Fig. 4](#). The maximum spacing between vertical battens shall be as shown in the [Table 12](#). In addition, the following provisions and limitations also shall apply:

7.12.1 HLW-Pattern—The HLW-pattern shall be used only when both the inside width and inside depth of box do not exceed 16 in. [406 mm], except that this pattern may be used for Class 1 boxes when the inside width or inside depth does not exceed 30 in. [762 mm], provided the edge cleats are increased to be not less than 1½ in. [28.6 mm] × 1½ in. [28.6

TABLE 12 Selection of End Pattern for Style 3 Boxes

Weight of Contents of Box in lb [kg]		Class 1 Box		
Exceeding	Not Exceeding	Type 1 Load	Type 2 Load	Type 3 Load
0	125 [56.7]	HLW	HLW	HLW
125 [56.7]	200 [90.7]	HLW	HLW	HLW
200 [90.7]	300 [136.1]	HLW	HLW	HBW
300 [136.1]	400 [181.4]	HLW	HBW	HVBW
400 [181.4]	500 [226.8]	HLVBW	HLVBW	HVBW
		Class 2 Box		
Exceeding	Not Exceeding	Type 1 Load	Type 2 Load	Type 3 Load
0	125 [56.7]	HLW	HLW	HLW
125 [56.7]	200 [90.7]	HLW	HLW	HBW
200 [90.7]	300 [136.1]	HLVBW	HLVBW	HVBW
300 [136.1]	400 [181.4]	HLVBW	HLVBW	HVBW
400 [181.4]	500 [226.8]			

mm] in size. When the box width or width and depth exceed the dimensions permitted for this pattern, the HBW-pattern shall be used. When only the box depth exceeds the dimensions permitted for this pattern, the HVBW-pattern shall be used (see [Fig. 2](#)).

7.12.2 HBW-Pattern—The HBW-pattern ends shall be used only when the inside depth of box does not exceed 30 in. [762 mm] for Class 1 boxes or 24 in. [610 mm] for Classes 2 and 3 boxes. When the box depth exceeds the dimensions permitted for this pattern, the HVBW-pattern shall be used (see [Fig. 4](#)).

7.12.3 HLVBW-Pattern—The HLVBW-pattern ends shall be used where indicated on [Table 12](#) and used in lieu of the HBW-pattern, or HLVBW-pattern when the box dimensions exceed the dimensions permitted for those patterns. When the inside depth exceeds 16 in. [406 mm], or the inside width exceeds 24 in. [610 mm] for Type 1 or 2 loads or 18 in. [457 mm] for Type 3 loads, at least two vertical battens shall be used. A vertical batten shall be placed adjacent to each side cleat (see [Fig. 4](#)).

7.12.4 HVBW-Pattern—The HVBW-pattern ends shall be used where indicated on [Table 12](#) and shall in be used in lieu of the HBW-pattern or HLVBW-pattern when the box dimensions exceed the dimensions permitted for those patterns. When the inside depth exceeds 16 in. [406 mm], or the inside width exceeds 24 in. [610 mm] for Type 1 and 2 loads or 18 in. [457 mm] for Type 3 loads, at least two vertical battens shall be used. A vertical batten shall be placed adjacent to each cleat (see [Fig. 2](#)).

7.13 Skids—Each box intended for use with loads having a gross weight in excess of 200 lb [90 mm] or when the box gross weight exceeds 100 lb [37.3 kg] and the length and width dimensions are 48 in. [1219 mm] × 24 in. [609 mm] or more, shall be provided with a minimum of two skids. Two skids will be attached and positioned to not exceed the inside parallel measurements of 48 in. [1219 mm] apart. Boxes exceeding the

TABLE 11 Selection of End Pattern for Styles 1 and 2 Boxes

Weight of Contents lb [kg]		Class 1 box				Class 2 box			Class 3 box	
Exceeding	Not Exceeding	Type 1 load	Type 1 load	Type 1 load	Type 1 load	Type 1 load	Type 1 load	Type 1 load	Type 1 load	Type 1 load
0	125 [56.7]	VL	VL	VB	VL	VL	VB	VB	VB	VB
125 [56.7]	200 [90.7]	VL	VB	VB	VB	VB	VB	VB	VB	VB
200 [90.7]	300 [136.1]	VB	VB	VB	VB	VB	VB	VB	VB	VB
300 [136.1]	400 [181.4]	VB	VB	HVB	VB	HVB	HVB		VB	HVB
400 [181.4]	500 [226.8]	VB	VB	HVB	—	—				

above maximum dimensions shall require additional skids. Additional skids, as required, shall be positioned so as to divide the area between the end skids into units of equal space. When bolt holes are provided in an end item or equipment, additional skids, if required, shall be located so as to enable the item to be bolted to the skids. The skids or built-up skids and rubbing strips shall be a minimum of 2½ in. [63.5 mm] high and 3½ in. [89 mm] wide. The skids shall be placed parallel to and extend the full width of the box (shortest dimension of the bottom of the box), and shall be set not less than 2½ in. [63.5 mm] or more than ¼ in. [4 mm] the box length from each end. When skids only are used, a bevel of 45 ± 5° shall be applied to the bottom third of the skid ends. When rubbing strips are used in conjunction with the skids, the skid ends shall not be beveled and the rubbing strips shall be set back from the ends of the skids a distance of 2½ to 4 in. [63.5 to 102 mm] to allow for sling placement. When four-way fork entry is required, skids shall be a nominal 4 × 4, placed lengthwise not less than 1½ in. [38 mm] nor more than 2½ in. [63.5 mm] from the container sides and cut out a minimum of 2 in. [51 mm] in depth and of such width as to accommodate forks and slings for handling. When specified (see 5.1.11), four-way fork entry shall be accomplished with built up skids and rubbing strips having minimum dimensions of 3½ in. [89 mm] in width and 4 in. [101.6 mm] in height with the cutouts being not less than 1½ in. [38 mm] in depth. Each skid shall be notched sufficiently to provide clearance for strapping. Filler cleats of the same thickness as the end or side cleats of the bottom panel of the shipping container. The skids shall be secured to the box by nails conforming to Type 2, Style 18 of Specification F1667, and shall be of such length as to penetrate a minimum of 75 % of the skid thickness. These nails shall be arranged in two rows in a staggered pattern, with spacing between nails in each row to be not more than 6 in. [152 mm]. Each row of nails shall be approximately 1¼ in. [32 mm] from the edge of the skid, and the nailing pattern shall begin and end approximately 1½ in. [38 mm] from the end of each skid and shall not be nailed through the strap notch.

7.14 *Assembly, Closure, and Strapping of Filled Boxes*—This information is contained in the Supplementary Requirements section.

7.15 *Preservative Treatment*—When specified Class 2 or 3 boxes shall be Grade A treated with one of the preservatives specified (see 6.1.5). Each preserved box shall be marked with the letters PA when preserved with preservative PQ 56 is used. When boxes are painted, wood preservative shall be applied and be dry prior to painting.

8. Performance Requirements

8.1 *Wood Moisture Content Test*—The moisture content of wood shall be specified in Practice D6199. Wood moisture content testing shall be performed on each sample unit in accordance with Test Methods D4442, Method A, Oven-Drying, or Test Method D4444, Moisture Meters. The sample unit shall be one piece of lumber obtained from each lot of lumber for each component to be used in constructing boxes.

8.2 *Wood Preservative Testing*—Completely assembled boxes shall be tested. An assembled box shall be placed on

either end with top open. Any failure to meet the color requirements specified in 8.2.1 and 8.2.2 shall be cause for rejection.

8.2.1 *Oxine Copper Preservative Test*—Two drops of a formulation containing ten parts, by weight, of sodium diethyldithiocarbamate trihydrate and 90 parts, by weight, of distilled water shall be applied to the wood surface. An immediate dark brown coloration and the drops spreading shall indicate the presence of treatment. An alternate method is to spray, over the dried wood surface, a solution of dissolved 0.5 g chrome azurol S concentrate and 5.0 g of sodium acetate in 80 mL of distilled water, and diluted further to 500 mL total distilled water. A deep blue color reveals the presence of copper (from oxine copper).

8.2.2 *Zinc Naphthenate Preservative Test*—Prepare a solution of 0.1 g of dissolved dithizone (diphenylthiocarbazone) in 100 mL of chloroform and spray evenly over dried wood. A pink color indicates the presence of zinc.

NOTE 1—The pink color fades with light.

8.2.2.1 An alternate method is to prepare a mixture of 10 mL each of three stock solutions and pour them in an atomizer [sprayer]. The first stock solution is comprised of 1 g of potassium ferricyanide dissolved in 100 mL of distilled water. The second solution is made of 1 g of soluble starch in about 5 mL of distilled water which is added to 100 mL of distilled water and boiled for one minute with constant stirring, and then cooled.

NOTE 2—This solution is subject to biodegradation and should not be used longer than three days.

8.2.2.2 Spray the mixture evenly over the dried wood surface. The solution will cause the treated wood to turn a deep blue immediately and the untreated part will retain its original color.

8.3 *Coating Adherence on Galvanized Wire Test*—Coating adherence on galvanized wire testing shall be performed on each sample unit to determine conformance to 6.1.3.1. The sample unit shall be one piece of wire of sufficient length to perform the test. Sample units shall be obtained from each wire lot used for binding wires and making staples.

8.3.1 *Test Procedure*—The wire shall be wrapped in a closed helix for at least two complete turns around a 3/16 in. [5 mm] diameter mandrel at a rate of not more than 15 turns per minute. The wrapped wire shall be observed for coating flaking and shall be rubbed with bare fingers to determine whether or not the coating peels.

8.4 *Tensile Strength of Wire Test*—The contractor shall certify that the binding wire specified in 6.1.3.1 and the staple wire specified in 6.1.4.2 meet the required tensile strengths.

9. Shipping Preparation

9.1 Boxes are to be shipped completely assembled or knocked down as specified (see 5.1.7). The boxes shipped knocked down shall be bundled, boxed, or crated in quantities that permit easy loading and handling. Boxes shall be packed in a manner to ensure carrier acceptance and safe delivery to the destination at the lowest rating in compliance with the rules

above maximum dimensions shall require additional skids. Additional skids, as required, shall be positioned so as to divide the area between the end skids into units of equal space. When bolt holes are provided in an end item or equipment, additional skids, if required, shall be located so as to enable the item to be bolted to the skids. The skids or built-up skids and rubbing strips shall be a minimum of 2½ in. [63.5 mm] high and 3½ in. [89 mm] wide. The skids shall be placed parallel to and extend the full width of the box (shortest dimension of the bottom of the box), and shall be set not less than 2½ in. [63.5 mm] or more than ¼ in. [4 mm] the box length from each end. When skids only are used, a bevel of 45 ± 5° shall be applied to the bottom third of the skid ends. When rubbing strips are used in conjunction with the skids, the skid ends shall not be beveled and the rubbing strips shall be set back from the ends of the skids a distance of 2½ to 4 in. [63.5 to 102 mm] to allow for sling placement. When four-way fork entry is required, skids shall be a nominal 4 × 4, placed lengthwise not less than 1½ in. [38 mm] nor more than 2½ in. [63.5 mm] from the container sides and cut out a minimum of 2 in. [51 mm] in depth and of such width as to accommodate forks and slings for handling. When specified (see 5.1.11), four-way fork entry shall be accomplished with built up skids and rubbing strips having minimum dimensions of 3½ in. [89 mm] in width and 4 in. [101.6 mm] in height with the cutouts being not less than 1½ in. [38 mm] in depth. Each skid shall be notched sufficiently to provide clearance for strapping. Filler cleats of the same thickness as the end or side cleats of the bottom panel of the shipping container. The skids shall be secured to the box by nails conforming to Type 2, Style 18 of Specification F1667, and shall be of such length as to penetrate a minimum of 75 % of the skid thickness. These nails shall be arranged in two rows in a staggered pattern, with spacing between nails in each row to be not more than 6 in. [152 mm]. Each row of nails shall be approximately 1¼ in. [32 mm] from the edge of the skid, and the nailing pattern shall begin and end approximately 1½ in. [38 mm] from the end of each skid and shall not be nailed through the strap notch.

7.14 *Assembly, Closure, and Strapping of Filled Boxes*—This information is contained in the Supplementary Requirements section.

7.15 *Preservative Treatment*—When specified Class 2 or 3 boxes shall be Grade A treated with one of the preservatives specified (see 6.1.5). Each preserved box shall be marked with the letters PA when preserved with preservative PQ 56 is used. When boxes are painted, wood preservative shall be applied and be dry prior to painting.

8. Performance Requirements

8.1 *Wood Moisture Content Test*—The moisture content of wood shall be specified in Practice D6199. Wood moisture content testing shall be performed on each sample unit in accordance with Test Methods D4442, Method A, Oven-Drying, or Test Method D4444, Moisture Meters. The sample unit shall be one piece of lumber obtained from each lot of lumber for each component to be used in constructing boxes.

8.2 *Wood Preservative Testing*—Completely assembled boxes shall be tested. An assembled box shall be placed on

either end with top open. Any failure to meet the color requirements specified in 8.2.1 and 8.2.2 shall be cause for rejection.

8.2.1 *Oxine Copper Preservative Test*—Two drops of a formulation containing ten parts, by weight, of sodium diethyldithiocarbamate trihydrate and 90 parts, by weight, of distilled water shall be applied to the wood surface. An immediate dark brown coloration and the drops spreading shall indicate the presence of treatment. An alternate method is to spray, over the dried wood surface, a solution of dissolved 0.5 g chrome azurol S concentrate and 5.0 g of sodium acetate in 80 mL of distilled water, and diluted further to 500 mL total distilled water. A deep blue color reveals the presence of copper (from oxine copper).

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NOTE 1—The pink color fades with light.

8.2.2.1 An alternate method is to prepare a mixture of 10 mL each of three stock solutions and pour them in an atomizer [sprayer]. The first stock solution is comprised of 1 g of potassium ferricyanide dissolved in 100 mL of distilled water. The second solution is made of 1 g of soluble starch in about 5 mL of distilled water which is added to 100 mL of distilled water and boiled for one minute with constant stirring, and then cooled.

NOTE 2—This solution is subject to biodegradation and should not be used longer than three days.

8.2.2.2 Spray the mixture evenly over the dried wood surface. The solution will cause the treated wood to turn a deep blue immediately and the untreated part will retain its original color.

8.3 *Coating Adherence on Galvanized Wire Test*—Coating adherence on galvanized wire testing shall be performed on each sample unit to determine conformance to 6.1.3.1. The sample unit shall be one piece of wire of sufficient length to perform the test. Sample units shall be obtained from each wire lot used for binding wires and making staples.

8.3.1 *Test Procedure*—The wire shall be wrapped in a closed helix for at least two complete turns around a 3/16 in. [5 mm] diameter mandrel at a rate of not more than 15 turns per minute. The wrapped wire shall be observed for coating flaking and shall be rubbed with bare fingers to determine whether or not the coating peels.

8.4 *Tensile Strength of Wire Test*—The contractor shall certify that the binding wire specified in 6.1.3.1 and the staple wire specified in 6.1.4.2 meet the required tensile strengths.

9. Shipping Preparation

9.1 Boxes are to be shipped completely assembled or knocked down as specified (see 5.1.7). The boxes shipped knocked down shall be bundled, boxed, or crated in quantities that permit easy loading and handling. Boxes shall be packed in a manner to ensure carrier acceptance and safe delivery to the destination at the lowest rating in compliance with the rules

TABLE S3.1 End Item Defects

Box Components	Visual Defects	Category	
		Major	Minor
Cleats, battens, and liners	Not an acceptable wood group		201
	Wood decay	101	
	Bark or Wane on cleat exceeds $\frac{3}{8}$ in. [10 mm] [any long edge]		202
	Bark or Wane on batten exceeds $\frac{3}{8}$ in. [10 mm] [any edge]		203
	Knotholes or knots exceed one quarter of the width or depth or closer than $1\frac{1}{4}$ in. [32 mm] from end		204
	Knotholes or knots in liner exceeds $\frac{1}{2}$ -in. diameter or closer than $1\frac{1}{4}$ in. [32 mm] from end		205
	Cleat is not a single piece of wood		207
	Ends of cleat not mitered or mortised and tenoned	102	
	Faceboards		
	Sound knots exceeding $1\frac{1}{2}$ in. [38 mm] in diameter or exceeding $\frac{1}{3}$ the width of the board		208
Wire coating Construction	Loose knots or knotholes exceeding 1 in. ² [645 mm ²] or more than one per face between adjacent binding wires	103	
	Sound knots closer than 1 in. [25 mm] to any edge of the board		209
	Not the specified material	104	
	Knot clusters exceed 2 in. [51 mm] in diameter or encompass $\frac{1}{3}$ or more of the width of the board		210
	Wood decay	105	
	Slope of grain exceeds 1 in. [25 mm] in 8 in. [203 mm] length in sawed lumber		211
	Grain of end faceboards not horizontal for Styles 1 and 2 boxes		212
	Sound knots closer than 1 in. [25 mm] to any edge		209
	Not the material specified	104	
	Knot cluster exceed 2 in. [51 mm] in diameter or exceed $\frac{1}{3}$ of the width of the board		210
	Decay in wood	105	
	Slope of grain exceeds 1 in. [25 mm] in 8 in. [203 mm] sawed lumber length		211
	Grain of end faceboards not horizontal for Styles 1 and 2 boxes		212
	Opening more than $\frac{3}{8}$ in. [10 mm] between faceboards		213
	Grain of end faceboards not vertical for Style 3 box		214
	Built-up ends for Style 3 boxes not constructed as specified		215
	Grain of ply of built-up ends of Style 3 boxes to which end wires are stitched not vertical	108	
	Binding wire for Class 2 and 3 boxes not galvanize	109	
	Intermediate cleats not as specified	110	
	Less than the required number of cleats	111	
	Binding wire not continuous around girth of box	112	
Skids Marking Preservation treatment	Girth wires not spaced as specified		217
	Ends of girth wire extend less than $2\frac{1}{4}$ in. [57 mm] beyond edge of top boards or less than 1 in. [25 mm] beyond edge of sideboard [Style 1 box]	113	
	Ends of wires not formed to loop fastener for Style 2 box	114	
	Ends of girth or end wire not loop fastener formed for Style 3 boxes	115	
	Wire not continuous across the ends of Style 3 boxes	116	
	Battens not properly positioned	117	
	Staples or nails not spaced as specified or not clinched where required		218
	Batten or liner missing when required	118	
	Grain of liner not at right angles to end faceboard		219
	Binding wire loose		220
	Staples or nails not fully driven		221
	Staple or nail points protruding	119	
	When skids are required; missing or not positioned as specified	120	
	Omitted, illegible, incomplete, incorrect, or wrong size, type or location		222
	Missing when specified	121	

S3.1.6 Type of preservative, if required (see 5.1.10).

S4. Workmanship

S4.1 Boxes shall be free of loose or protruding nails or staples. There shall be not splinters or loose pieces of wood or wire.

S5. Assembly, closing, and strapping

S5.1 *Box Assembly*—Styles 1 and 2 boxes shall be assembled in the following manner: the end boards shall be fastened to each side cleat by either nails or staples as shown on Fig. S6.1. Staples shall be not less than 0.0625 in. diameter 16 gage [1.5 mm]. Unless otherwise specified in the contract or

order, staples for Class 2 or 3 boxes shall be galvanized. Nails shall not be less than 0.076-in. diameter [14½ gage] [2 mm]. The length of each fastening shall be not less than the thickness of the end boards plus three quarters the thickness of the cleats or battens. The points of the fastening shall not protrude from the cleats or battens, but if driven through they shall be clinched. The average spacing of the fastenings shall not exceed $2\frac{1}{2}$ in. [63.5 mm]. See Fig. S6.2 for closures.

S5.2 *Style 3 Boxes*—Style 3 boxes shall be assembled by bending the looped end wires at right angles to the end, passing the loops through notches in the cleats, and bending back the looped wire over and around the girth wire, as shown in Fig. S6.3.

TABLE S3.2 End Item Packing and Marking Defects

Examine	Visual Defects	Category	
		Major	Minor
Packing	Not tied in bundles	101	
	Bundles do not contain the number of boxes specified		201
	Ends, when not attached to knock-downed boxes, not tied in bundles of 40 ends or less, or alternately stacked in sufficient number of set-up boxes	102	
	Small unattached parts or components not packed in set-up boxes	103	
Workmanship	Not securely, neatly, and uniformly tied in bundles		202
Marking	Bundles or set-up boxes not marked in accordance with Fed-Std-123 or MIL-HDBK, or Customer's Contract Requirements	104	
		Major	Minor
Finished dimension	Length, width, or height exceeds specified maximum requirement		203
Palletization	Loads not interlocked		204
	Load not bonded with required straps		
Weight	Exceeds maximum load limits		205
Marking	Omitted; incorrect; illegible; of improper size, location, sequence or method of application		206

S5.3 Assembly Nailing—In addition to the assembly requirements, the following assembly nailing shall be provided, except that when specified, this nailing may be omitted for Types I and Type II loads. Boxes having vertical battens adjacent and parallel to cleats, and having no horizontal battens (VB- and HLVBW-patterns), shall be fastened by nailing through the side faceboards and cleats into the battens. Boxes having both vertical and horizontal battens adjacent and parallel to cleats shall be fastened by nailing through the bottom faceboards and cleats into the battens only. Spacing of nails not exceed 5 in. [127 mm]. Boxes having intermediate vertical battens butting directly against side cleats, shall be fastened by driving one nail through the bottom or side faceboards and cleats into each end of each batten. Nails shall conform to Specification **F1667** or other industry standards.

S5.4 Style 3 Box Closing—Style 3 boxes shall be closed with a Sallee Closer as shown in **Fig. S6.4**, by bringing the top cleats in contact with the side cleats and by inserting the side loop through the top loop and binding it down and against the side of the box. That portion of the top loop which is bent down shall be essentially parallel to the side of the box and the end of the side loop shall be not more than ¼ in. [6 mm] away from the side of the box.

S5.5 Closure Nailing—In addition to the closure requirements, the following closure nailing shall be provided, except that when specified, this nailing may be omitted for Types 1 and 2 loads: Boxes having horizontal battens adjacent to and parallel to the top cleats (HVB-, HBW-, and HVBW-patterns) shall be closed by nailing through the top faceboards and cleats into the battens. Spacing of nails shall not exceed 5 in. [127 mm]. Boxes having intermediate vertical battens butting directly against the top cleats (VB- and HLVBW-patterns) shall be closed by nailing through the top faceboards and cleats into the battens. Spacing of nails shall not exceed 5 in. [127 mm]. Boxes having intermediate vertical battens butting directly against the top cleats (VB- and HLVBW-patterns) shall be closed by driving one nail through the top faceboards and cleats into the end of each batten. Nails shall be seven penny cement-coated or chemically-etched cooler or sinker nails conforming to Specification **F1667**.

S5.6 Strapping Application—Where strapping is required, the top cleats shall be brought into contact with the side cleats and strapping applied before wires at closing edges are twisted

or looped. This eliminates occasional slack, which may develop when strapping is applied after closure is made.

S5.6.1 Strapping—Strapping shall be performed by the activity by which the box is packed. The strapping is not to be furnished by the boxmaker unless specifically required by the contract or order. Straps shall be applied straight, at right angles to the edges of the box, and under sufficient tension to firmly grip the edges of the faceboard material. Straps shall be joined using steel seals securely crimped.

S5.6.2 Class 1 Boxes—Strapping when specified herein for Class 1 boxes, shall be ⅝-in. × 0.020-in. [16 × 0.51-mm] Type 1 finish flat strapping, (uncoated) conforming to Specification **D3953**, or shall be 0.0915-in. [2.3-mm] diameter 13-gage [2.3-mm] uncoated (bare) round wire strapping conforming to Specification **D3953**.

S5.6.3 Classes 2 and 3 Boxes—Strapping, when specified herein for Classes 2 and 3 boxes, shall be ⅝ × 0.02 in. [16 × 0.51 mm] Type 1, Finish A, or Type 1, Finish B, Grade 2 conforming to Specification **D3953**, or shall be 0.0915-in. diameter (13-gage) [2.3-mm], Type 1, Finish B (zinc-coated) round-wire strapping.

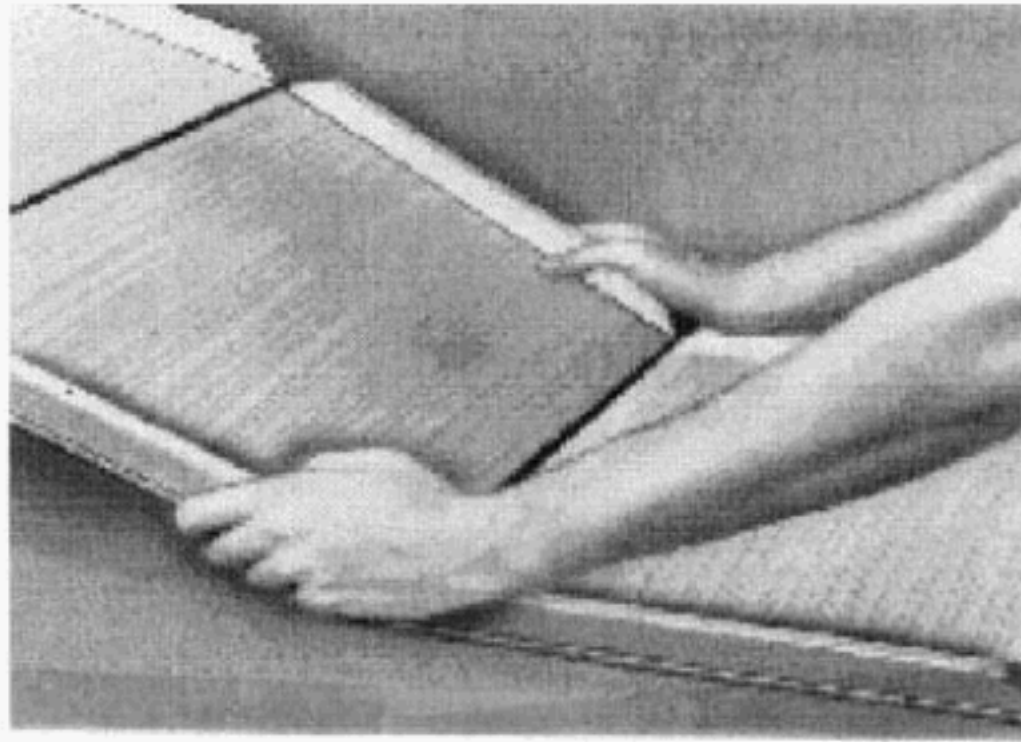
S5.6.4 Joint Strength—The breaking strength of the joint for joined metal bands shall be at least 75 % of the required breaking strength of the band only, when tested as specified in.

S5.6.5 Lengthwise Strapping—Boxes shall be reinforced with one flat or round lengthwise strap under the following conditions for Class 1 boxes.

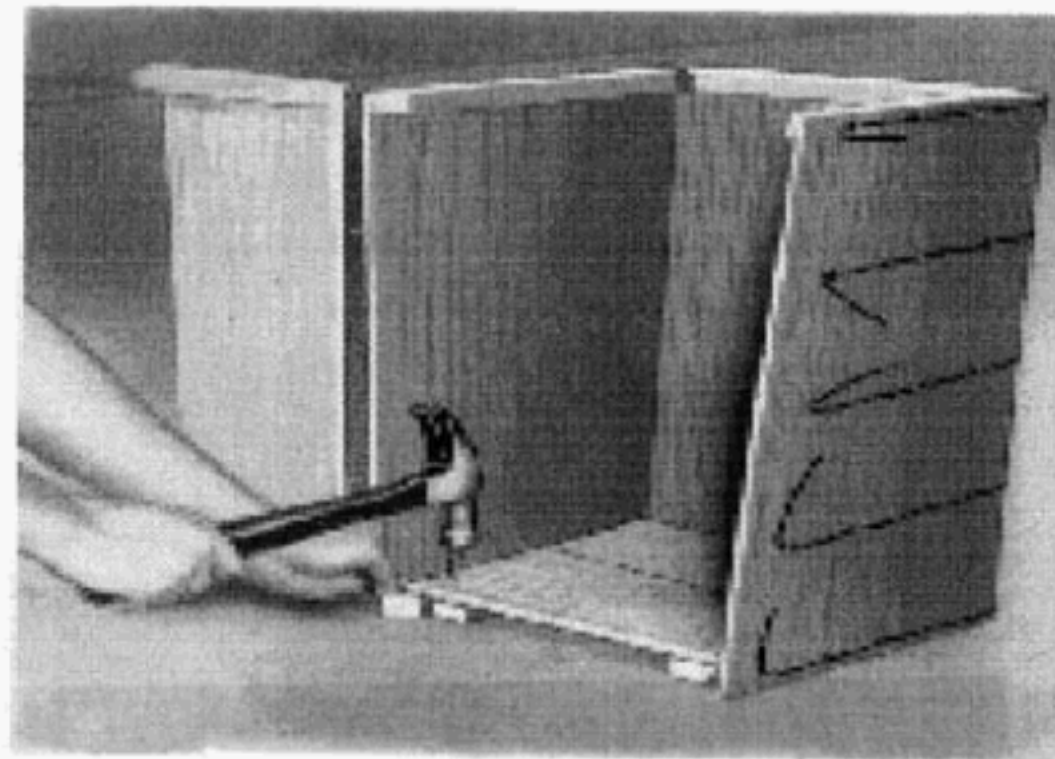
S5.6.5.1 All boxes where the weight of contents exceeds 400 lb [181.4 kg].

S5.6.5.2 On Style 1 or 2 boxes having 1⅜ × ⅞-in. [21 × 22-mm] cleats, where the length of top cleat exceeds the amount indicated below for the weight of box contents.

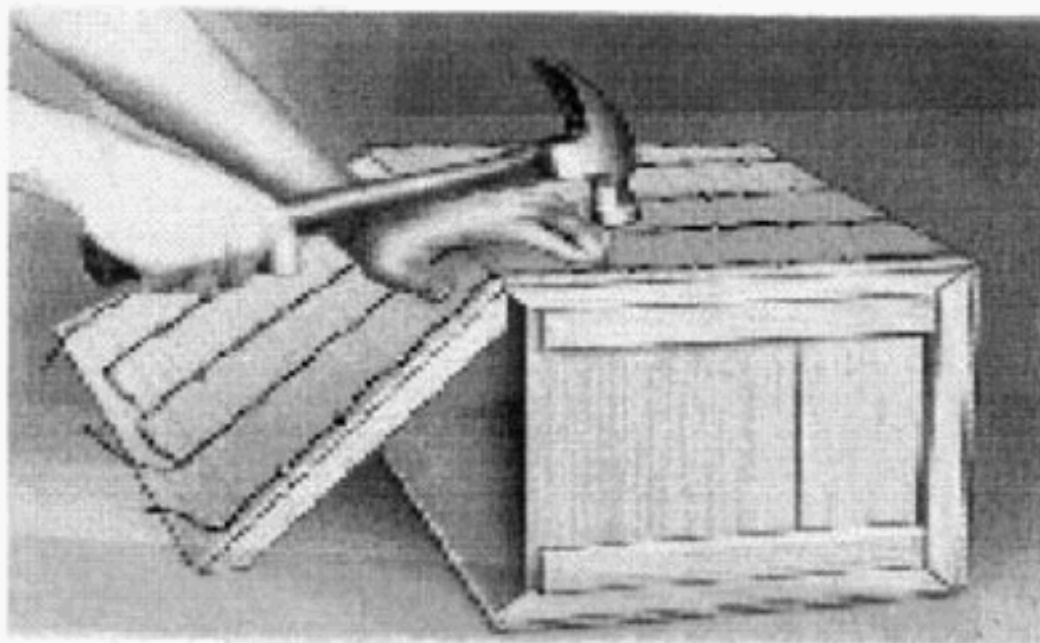
S5.6.6 Special Lengthwise Strapping—On Styles 1, 2, and 3 boxes having a center vertical batten, the strap shall be applied lengthwise over the center of the top, bottom, and ends of the box. If an intermediate batten is not in the center, the strap shall be applied over the intermediate batten closest to the center and toward the closing edge of the box. On Style 3 boxes having horizontal battens only, the strap shall be applied lengthwise over the center of the side and ends of the box. If the lengthwise strap does not pass over a batten on each end of the box, such battens shall be applied.



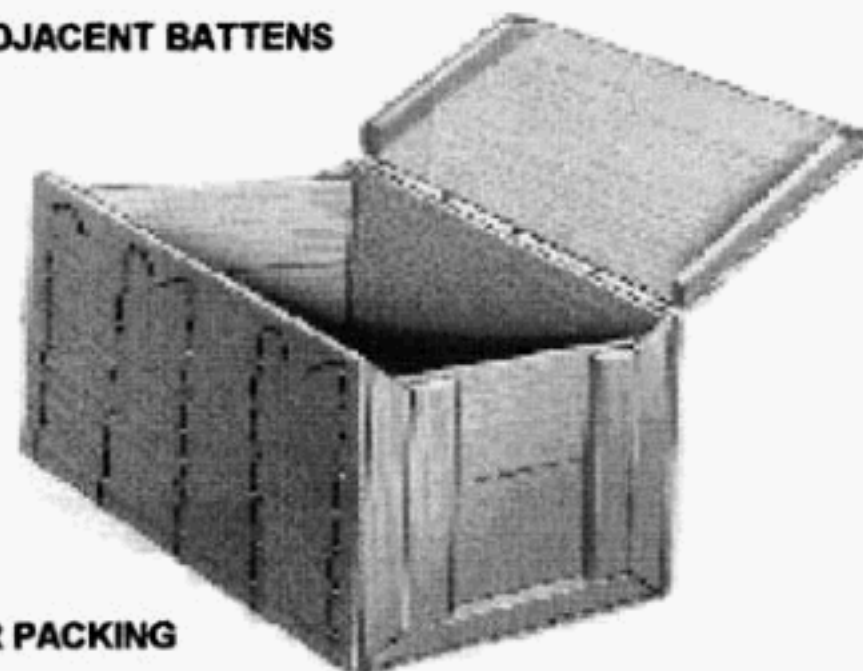
FORM BOX BY RAISING SIDES AT RIGHT ANGLES TO BOTTOM



NAILING ENDS TO SIDE CLEATS



NAILING SIDE CLEATS TO ADJACENT BATTENS



COMPLETED SET-UP READY FOR PACKING

Boxes arrive from the manufacturer in a knockdown condition and are stored 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.

(1) Lift the sides of the blank slightly before folding. Fold the box by raising the sides at right angles to the bottom.

(2) Fasten the ends to the side cleats using steel nailing table or an end-stapling machine.

(a) Ends are fastened to side cleats by either staples or cement coated and chemically etched nails. Unless otherwise specified, Class 3 boxes use galvanized fasteners.

(b) 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.

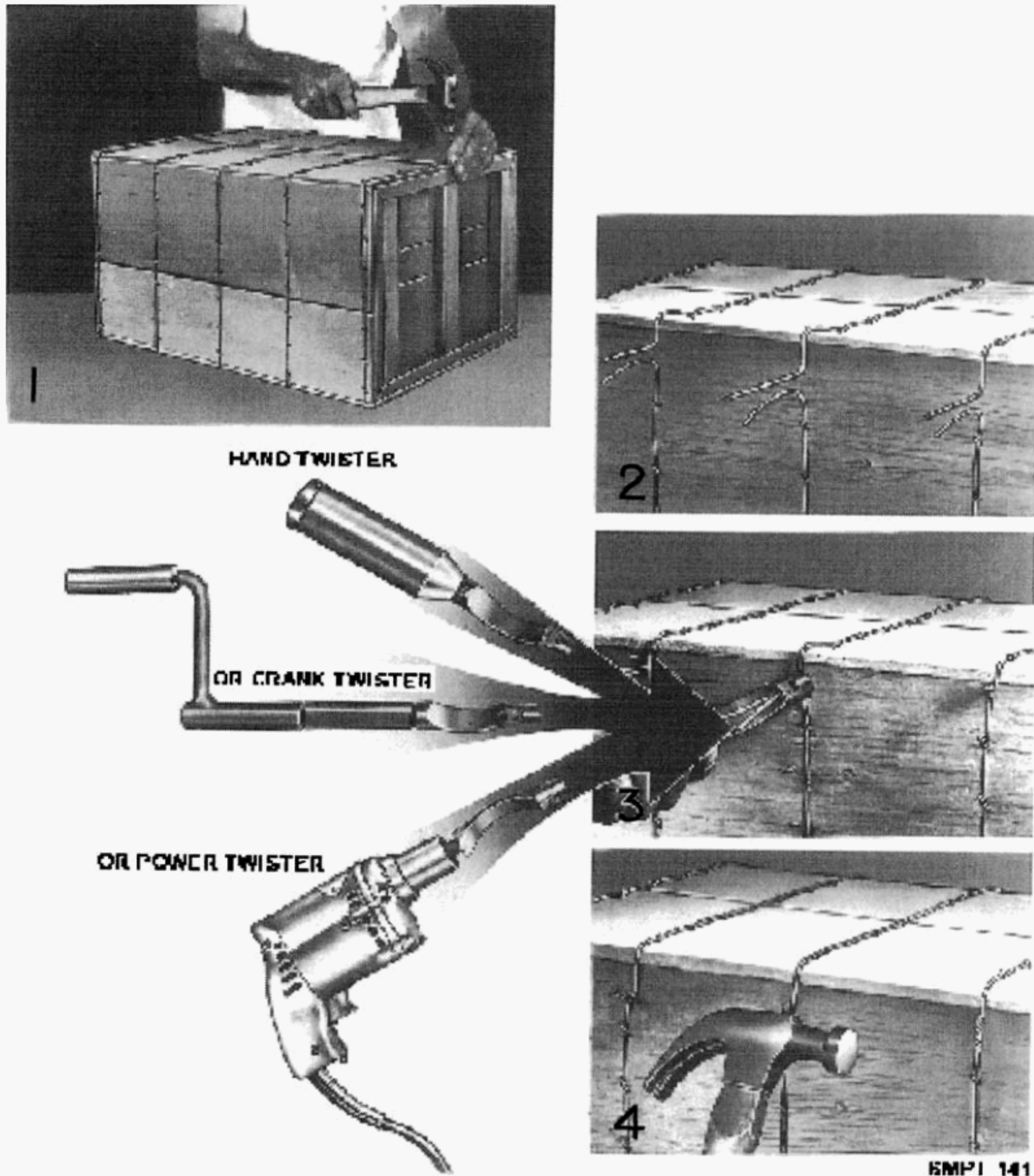
(c) The points of the fastenings will not protrude from the cleats or battens, but, if driven through, they must be clinched.

(d) The average spacing of the fastenings will not exceed 2½ in. [64 mm].

(3) Drive appropriate fastener through side cleats into adjacent battens and bottom cleat into intermediate batten.

(4) Nailing through bottom faceboards and cleats into the battens only should fasten boxes having both vertical and horizontal battens adjacent and parallel to cleats. The spacing of nails driven into adjacent battens will not exceed 5 in. [127 mm].

FIG. S6.1 Assembly of a Wirebound Set-Up Box Style 1 and 2



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(1) Using one of the special closure tools illustrated above closes Style 1 boxes. When intermediate battens are used on the ends of the Style 1 box, one nail is driven through the top board and cleat and into the end of each intermediate batten. This step is done prior to making the closures of the binding wires.

(2) With the wires in this position, the twister tool is inserted over the two wires.

(3) Using one of the hand tools shown above, the wires are twisted together three or more wraps. Care should be taken to prevent over torque of the wire wrap causing the closure to break off.

(4) With the side of a hammer, the wire wrap can be pushed down against the faceboard. Visually examine the wraps to make sure no sharp end wires are exposed to personnel handling the box.

FIG. S6.2 Tools Used to Close Style 1 Twist Wire Closure Boxes

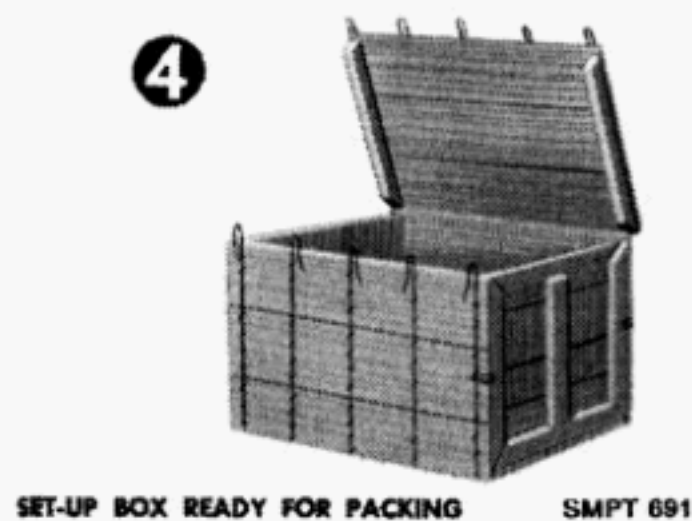
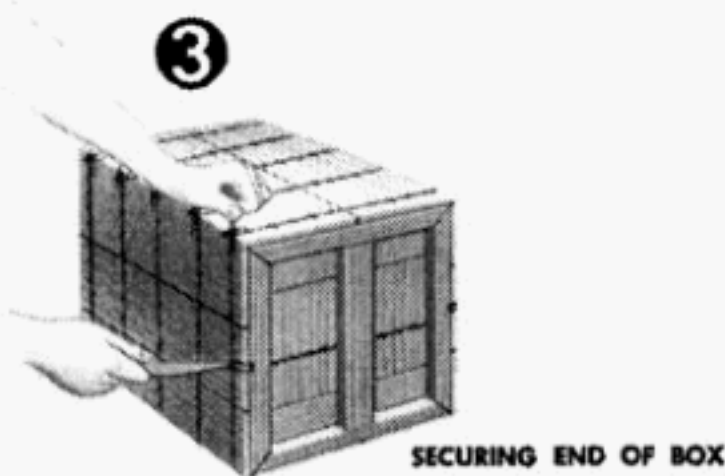
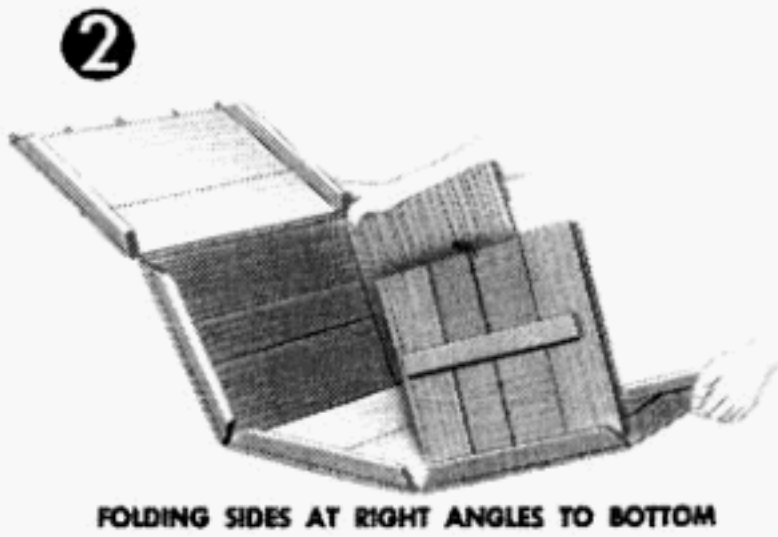
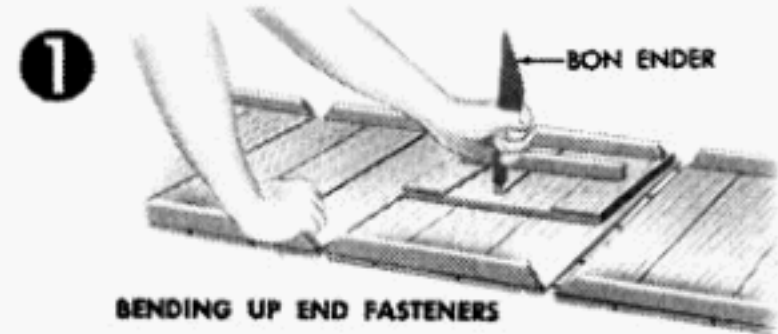
S5.6.7 Girthwise Strapping—On all styles of boxes, and for all types of loads, two flat or round wire straps shall be placed girthwise around the top, sides, and bottom when the weight of contents exceeds 350 lb [130.6 kg] for Class 2 boxes or 250 lb [113 kg] for Class 3 boxes. Straps shall be placed as near as practicable but not more than 3 in. [76 mm] from each end edge of the box.

S5.6.8 Intermediate Cleats Application—On boxes having rows of intermediate cleats, an additional flat or round wire strap shall be applied directly over each row of cleats and located next to the binding wire girthwise around the top, sides, and bottom of the box when the weight of contents exceeds:

S5.6.8.1 400 lb [181.4 kg] for Class 1 boxes.

S5.6.8.2 250 lb [113 kg] for Class 2 boxes.

S6.6.8.3 150 lb [68 kg] for Class 3 boxes.



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(1) Bend up looped end wires of ends using the hollow end of a bon ender.

(2) Lift sides of the blank slightly before folding and raise sides at right angles to bottom

(3) Pass the bent end loops through notches in the cleats. Using the tapered end of the bond ender, bend back the looped wire over and around the binding wire of the side.

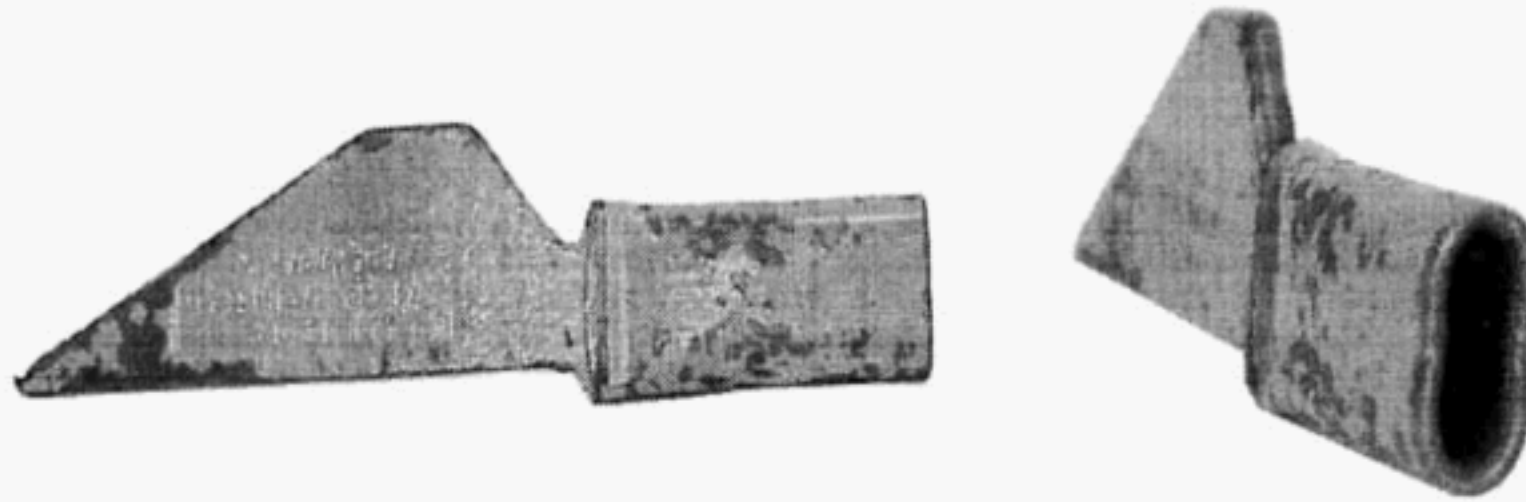
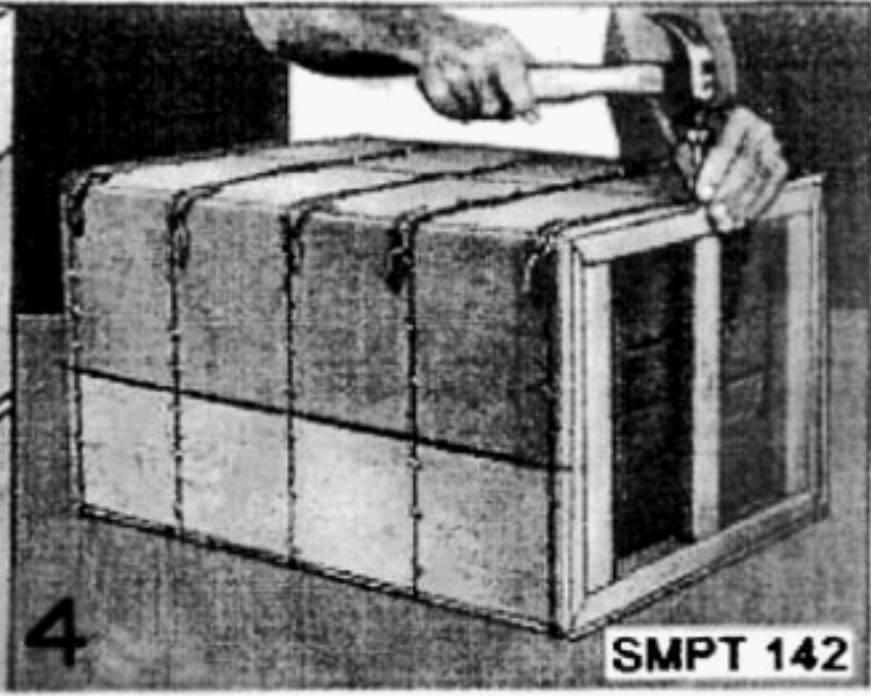
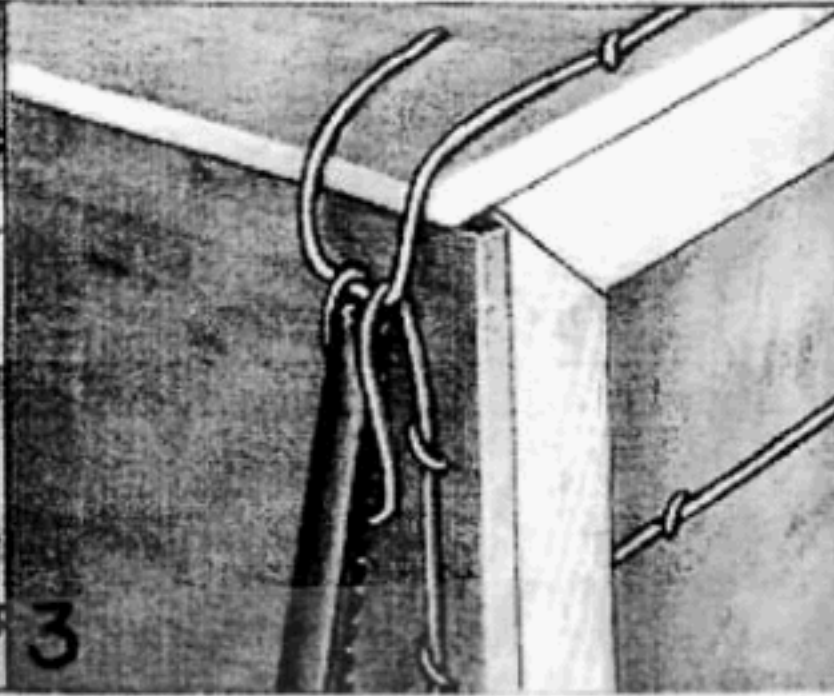
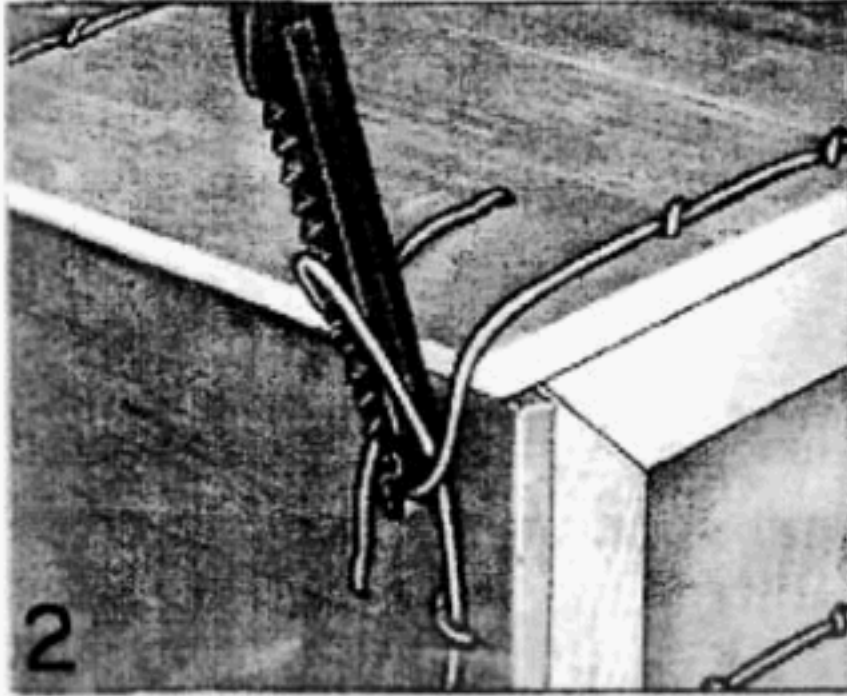
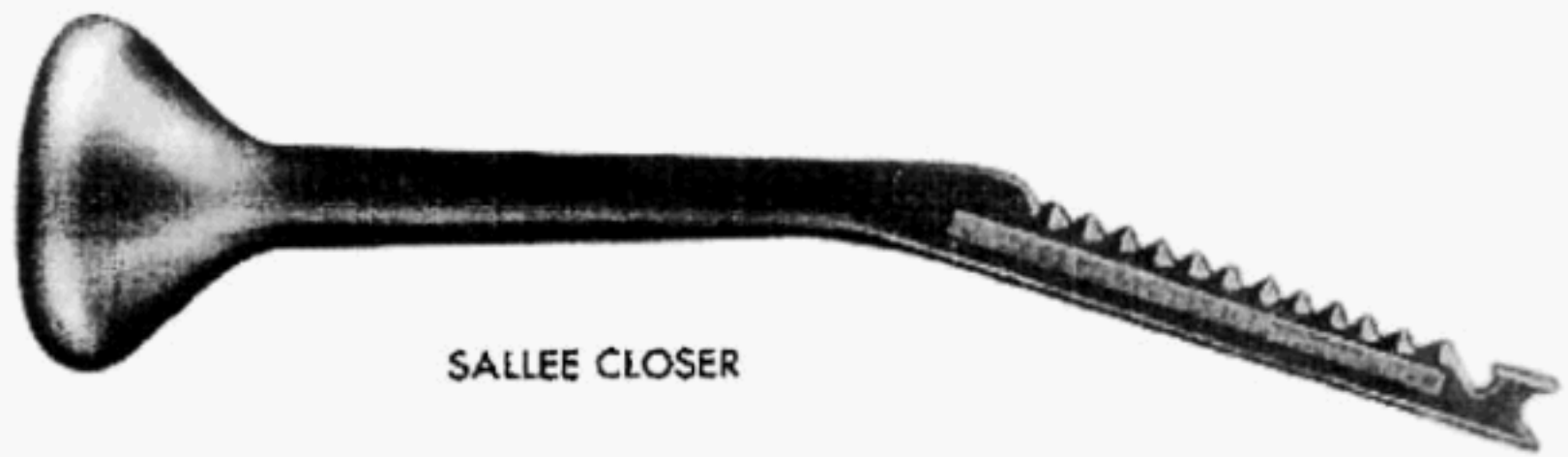
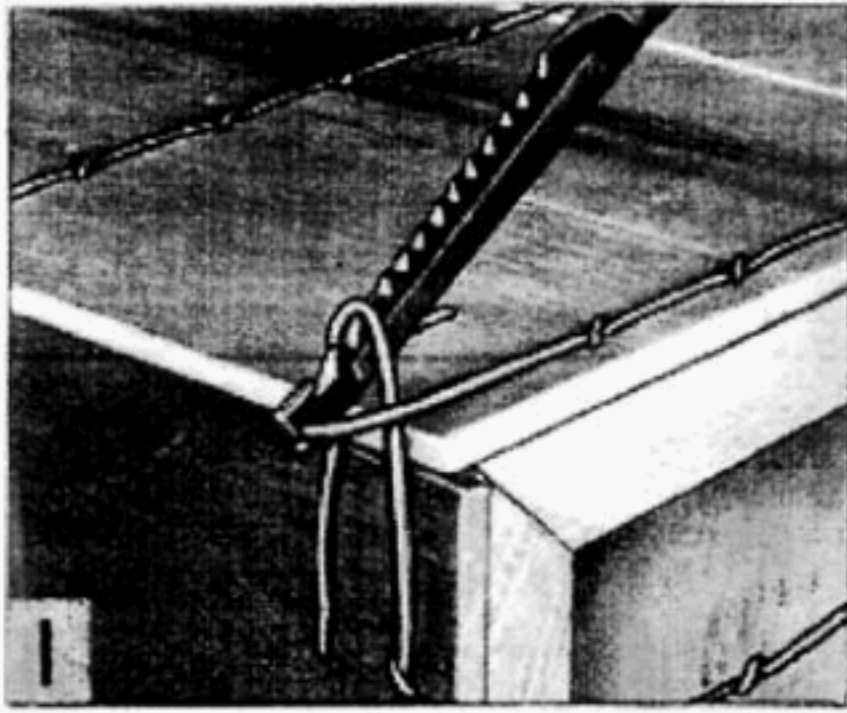
(4) When battens are used on the ends of Style 3 boxes, the following applies:

(a) Battens adjacent to batten cleats are nailed into adjacent batten.

(b) Spacing of nails will not exceed 5 in. [127 mm]

(5) Intermediate battens are secured by appropriate nail through the board and cleat into the end of the intermediate batten.

FIG. S6.3 Assembly of a Wirebound Set Up Box Style 3



Bon Ender

- (1) Insert the Sallee closer through the side loop and catch the top loop in the notch on the end of the tool.
- (2) 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.
- (3) Complete closing by swinging the handle of the Sallee closer down as far as possible.
- (4) 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 1—The applicable tools for making closures are illustrated. Correct tools are available from the 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 personnel safety hazard.

FIG. S6.4 Closure Tools for Style 2 and 3 Boxes

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