



# Standard Specification for Wirebound Pallet-Type Wood Boxes<sup>1</sup>

This standard is issued under the fixed designation D6254/D6254M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope

1.1 This specification covers the fabrication of new fully enclosed wirebound pallet-type wood boxes intended for use as containers for domestic and overseas shipment of general materials and supplies, not exceeding 2500 lb [1134 kg] (see 4.1 and 10.1).

1.2 Wirebound pallet-type wood box performance is dependent on its fabricated components; therefore, a variety of types, classes, and treatments reflecting varied performance are specified (see 4). This specification, however, does not cover wirebound pallet-type wood box performance under all atmosphere, handling, shipping, and storage conditions.

1.3 The use of other construction methods or techniques is acceptable and permitted (see 5.1.11), provided the resulting packaging systems shall be of equal or better performance than would result from the use of these specified materials and procedures. The appropriate distribution cycle provided in Practice D4169 can be used to develop comparative procedures and criteria.

1.4 *Units*—The values stated in either inch-pound or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. 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 nonconformance with the standard. See 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 appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

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

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## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

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-Base 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

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:<sup>3</sup>

CFR Parts 107–180, Title 49, Hazardous Materials Regulations

### 2.3 National Institute of Standards and Technology (NIST) Standard:<sup>4</sup>

PS 1–07 Structural Plywood

PS 20–05 American Softwood Lumber Standard

### 2.4 Hardwood Plywood and Veneer Association Standard:<sup>5</sup>

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

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from U.S. Government Printing Office, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, [www.access.gpo.gov](http://www.access.gpo.gov).

<sup>4</sup> Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, [www.nist.gov](http://www.nist.gov).

<sup>5</sup> Available from Hardwood Plywood and Veneer Association (HPVA), P.O. Box 2789, Reston, VA 22090-0789, [www.hpva.org](http://www.hpva.org).



2.5 *National Motor Freight Traffic Association*.<sup>6</sup>

**National Motor Freight Classification**

2.6 *Uniform Classification Committee Standard*.<sup>7</sup>

**Uniform Freight Classification**

2.7 *American Wood Protection Association (AWPA)*.<sup>8</sup>

**AWPA P36 Standard for Copper Naphthenate (CuN)**

**AWPA P37 Standard for Oxine Copper (Copper-8-Quinolinolate) (Cu8)**

2.8 *Material Handling Industry of America (MHIA)/ANSI Standard*.<sup>9</sup>

**MHIA/ANSI MH1–2005 Pallets, Slip Sheets, and Other Bases for Unit Loads**

2.9 *International Standard*<sup>10</sup>

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

2.10 *U.S. Army Research, Development and Engineering Center (ARDEC)*<sup>11</sup>

**MIL-DTL-2427H Box, ammunition packing: Wood, nailed**

### 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*—reinforcement used to hold the 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 *blank*—a flat unassembled wirebound box exclusive of pallet base and top.

3.2.4 *cleat*—lumber piece which forms the wirebound box framework and to which the faceboards are stapled.

3.2.5 *deckboard*—the material used to make up the pallet base top and bottom surfaces referred to as top and bottom deckboards.

3.2.6 *faceboard*—the material used for the front, end, bottom, sides, and top.

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 *stringer*—a runner to which the riser batten and deckboards are attached and which serves as a spacer between top and bottom deckboards to permit mechanical handling equipment entry.

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

### 4. Classification

4.1 *Type*:

4.1.1 *Type I*—Sheathed lumber, 2500-lb [1134-kg] maximum load (see Fig. 1).

4.1.2 *Type II*—Sheathed lumber and veneer, 1500-lb [680-kg] maximum load (see Fig. 2).

4.1.3 *Type III*—Sheathed lumber and veneer with two different length sidewalls, 1500-lb [680-kg] maximum load (see Fig. 3).

4.1.4 *Type IV*—Sheathed plywood, 2500-lb [1134-kg] maximum load (see Fig. 4).

4.2 *Class*:

4.2.1 *Class 1*—Partial four-way entry base (see Fig. 5).

4.2.2 *Class 2*—Two-way entry base (see Fig. 5).

4.2.3 *Class 3*—Partial four-way entry base with two different length sidewalls (see Fig. 6).

4.2.4 *Class 4*—Two-way entry base with two different length sidewalls (see Fig. 6).

4.3 *Treatment*:

4.3.1 *Treatment A*—Without water-repellent preservative (see 6.1.6).

4.3.2 *Treatment B*—With water-repellent wood preservative (see 6.1.6).

### 5. Ordering Information

5.1 Purchasers should select the preferred permitted options and include the following information in procurement and purchase order documents:

5.1.1 Specification title, number, and date.

5.1.2 Box type, class, and treatment required (see 4.1 – 4.3 and 7.1).

5.1.3 Contents weight.

5.1.4 Modifications to container manufacturer's identification (see 7.5).

5.1.5 Box dimensions specified in order of length × width × depth (see 7.6 and Fig. 7).

5.1.6 When preservative treatment is required (see 4.3 and 6.1.6).

5.1.7 Whether boxes are to be shipped assembled or knocked down (see 9.1).

5.1.8 Whether additional markings are required (see 9.2).

5.1.9 Whether different strapping materials are required (see S2.2).

5.1.10 Whether additional support is required (see S2.2.3).

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

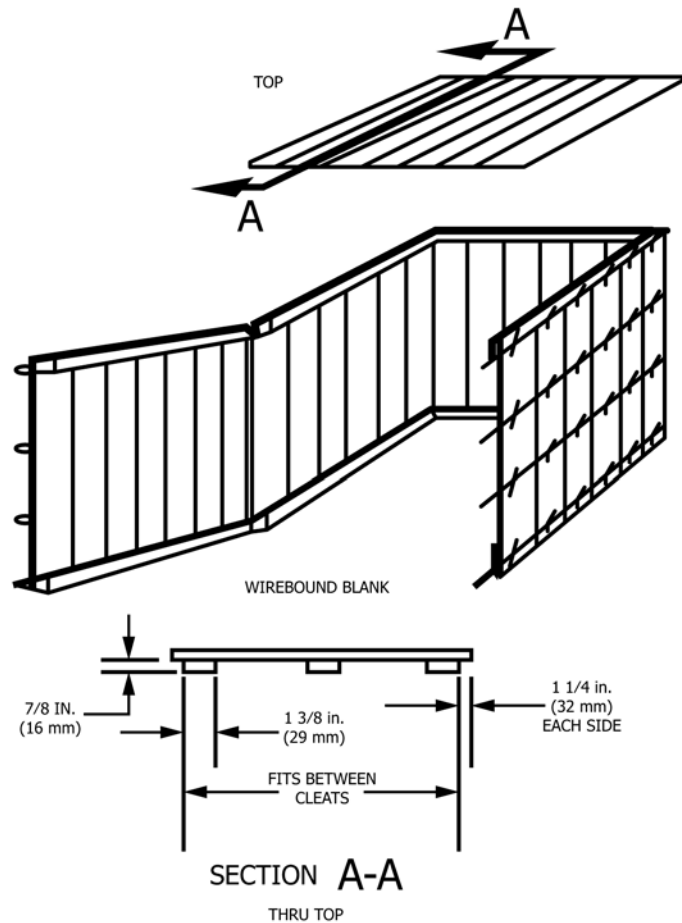
<sup>7</sup> Available from the Uniform Classification Committee, Tariff Publishing Officer, 151 Ellis St., N.E. Suite 200, Atlanta, GA 30335.

<sup>8</sup> Available from American Wood Protection Association (AWPA), P.O. Box 361784, Birmingham, AL 35236-1784, awpa.com.

<sup>9</sup> Available from Material Handling Industry of America (MHIA) MH1 Secretariat, 8720 Red Oak Blvd., Suite 201, Charlotte, NC 28217, www.mhiastore.org.

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

<sup>11</sup> Available from ASSIST Quicksearch, assist.daps.dla.mil/quicksearch



NOTE 1—All cleats (see Figs. 5 and 7),  $\frac{1}{16} \times \frac{7}{8}$  in. nominal [16 × 16 mm].  
Select Class 1 or 2 Base from Fig. 5.

FIG. 1 Type I Wirebound Box-Sheathed Lumber

5.1.11 Whether other construction methods or techniques and proof are acceptable and permitted.

5.1.12 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 components 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.

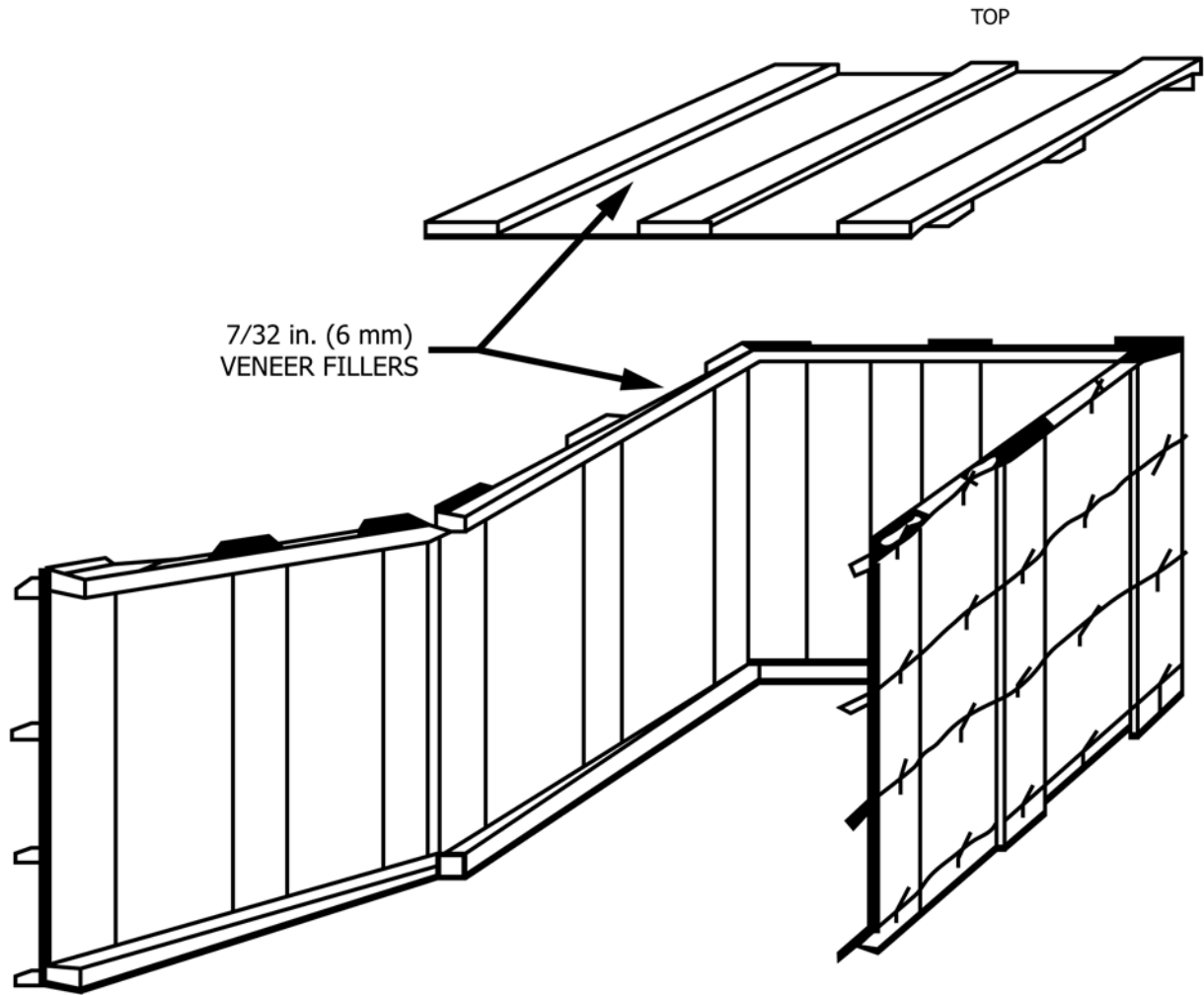
6.1.1.1 *Lumber Quality*—Grain divergence (grain slope), whether on a lumber face or edge, shall not exceed 1 in. [25 mm] per 10-in. [254-mm] length for pallet base and box frame members and shall not exceed 1 in. [25 mm] per 8-in. [203-mm] length for face boards. Members shall be free from decay and sufficiently smooth on the exterior surface to permit legible markings. Stains and discoloration not associated with

decay will be permitted provided they are not so pronounced as to obscure markings. Lumber components shall be free from all defects that will interfere with specified stapling and nailing. Each lumber component shall be a single wood piece without any joints.

6.1.1.2 *Cleat and Batten Knots*—Any cleat or batten knot width shall not exceed  $\frac{1}{4}$  the width. Knots shall be sound and tight with no part within  $1\frac{1}{4}$  in. [32 mm] of the cleat or batten end. Loose knots and knot holes shall not be permitted in cleats and battens. Group I Woods (low density hardwoods and softwoods) listed in Practice D6199 shall not be permitted for cleats.

6.1.1.3 *Faceboard and Deckboard and Stringer Knots*—Any faceboard, deckboard, or stringer knot width shall not exceed  $1\frac{1}{2}$  in. [38 mm] nor  $\frac{1}{3}$  the width. Knots shall be sound and tight with no part of any knot within 1 in. [25 mm] of the end. Loose knots or knot holes not more than 1 in. [25 mm] wide shall be permitted, provided they are not within 1 in. [25 mm] of the end.

6.1.1.4 *Splits Extending Entire Board Length*—Splits extending the entire board length shall be permitted for sides, top, bottom, and ends, provided the width of the narrowest piece of the board measured from the split is  $1\frac{1}{2}$  in. [38 mm] or greater, and a staple holds each piece end in place.



WIREBOUND BLANK

NOTE 1—Top battens (see Fig. 1 and Fig. 7)  $\frac{7}{8} \times 1 \frac{3}{8}$  in. nominal [16 × 29 mm].  
 All cleats (see Fig. 5 and Fig. 7)  $\frac{1}{16} \times \frac{7}{8}$  in. nominal [16 × 16 mm].  
 Corner and intermediate faceboards 4 in. nominal ×  $\frac{3}{8}$  in. [90 × 8 mm] (width × thickness).  
 Select Class 1 or 2 Base from Fig. 5.

FIG. 2 Type II Wirebound Box-Sheathed Lumber and Veneer.

6.1.1.5 *Splits Diverging to Board Edge*—Splits diverging to an outer box edge shall not be permitted. Splits extending less than the entire board length and not diverging to a board edge shall be permitted for sides, top, bottom and ends, provided that if the split were extended, the resulting boards would comply with the minimum requirements of 6.1.1.4.

6.1.1.6 *Splits Extending Through Staple or Nail Holes*—Board-end slits, caused by a fastener, which are not longer than 3 in. [76 mm], are acceptable provided the split does not terminate in the board edge.

6.1.1.7 *Wane or Bark*—Wane along any lumber edge will be permitted for the full length provided it does not exceed  $\frac{3}{8}$  in. [10 mm] in either direction from the edge. Bark shall not be permitted on any lumber component.

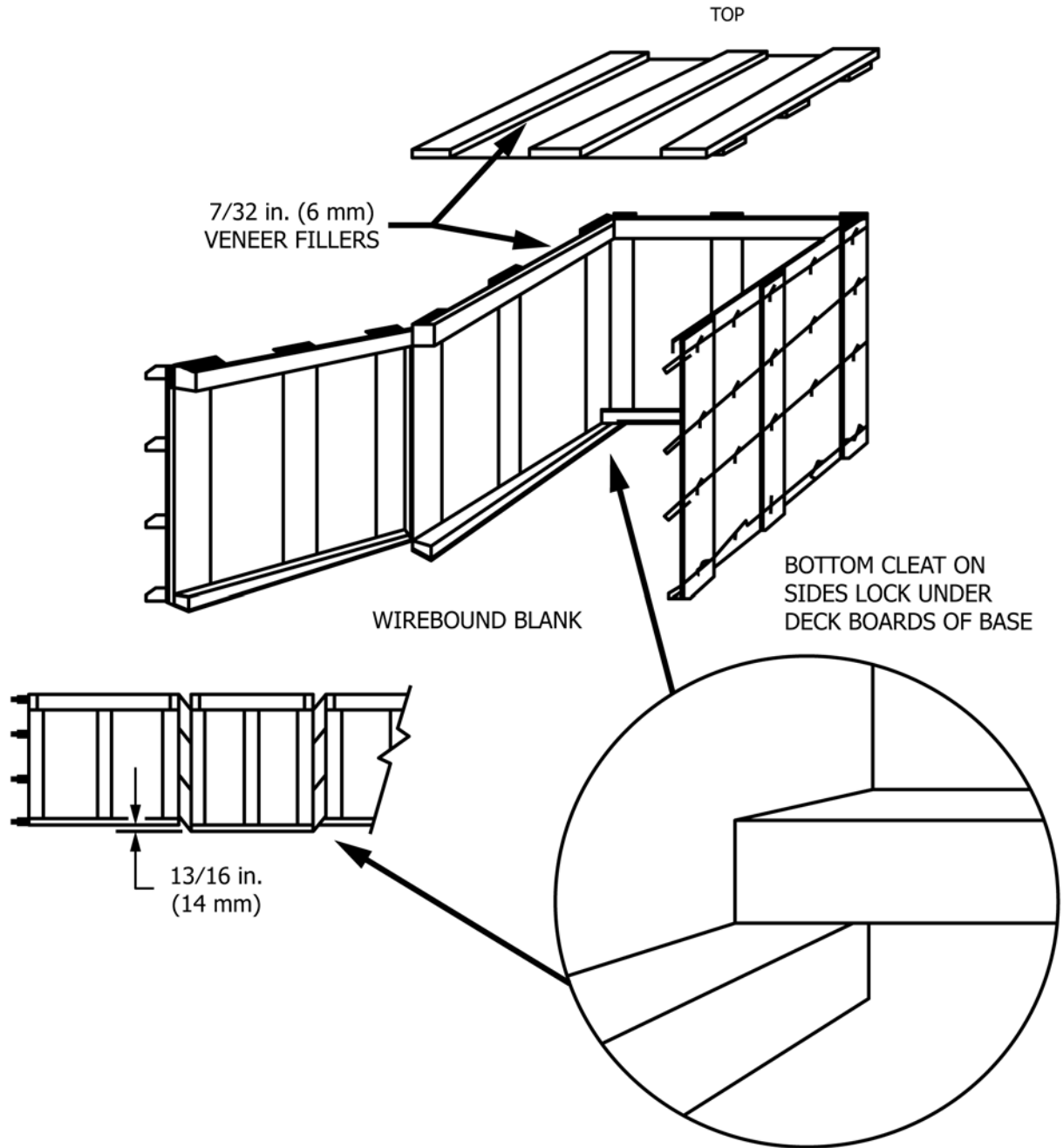
6.1.1.8 *Moisture Content*—At the time of box fabrication, wood member moisture content shall be in accordance with Practice D6199 except that there shall be no restriction on pallet base stringer's moisture content.

6.1.2 *Plywood*—Type IV boxes shall use plywood conforming to ANSI/HPVA HP-1-2004 or PS1-07, 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 *Binding Wire*—Binding wire shall be as a minimum, 13-gage, 0.0915-in. [2.324 mm] diameter, low carbon, annealed steel wire. The wire's physical properties shall permit satisfactory forming of the loop closures without fracturing the wire. The wire tensile strength shall be from 60 000 to 85 000-lb/in.<sup>2</sup> [413 685 to 586 054 kPa].

6.1.3.1 *Coating*—The binding wire surface shall be galvanized. The galvanized coating shall be smooth and shall not flake nor peel when the wire is wound around a  $\frac{3}{16}$ -in. [5-mm] diameter mandrel (see 8.2).

6.1.4 *Staples*—Staples have either round-wire or approximately square-wire legs, referring to the cross-sectional shape of the wire. Staples shall be made from low carbon steel wire.



NOTE 1—Top cleat  $1\frac{3}{16} \times 1\frac{5}{8}$  in. nominal [16 × 35 mm].  
 Bottom cleat  $1\frac{3}{16} \times \frac{7}{8}$  in. nominal [16 × 16 mm].  
 Top battens  $\frac{7}{8} \times 1\frac{3}{8}$  in. nominal [16 × 29 mm] (thickness × width).  
 Corner and intermediate faceboards 4 in. wide nominal ×  $\frac{3}{8}$  in. thick [90 × 8 mm].  
 Select Class 3 or 4 Base from Fig. 6.

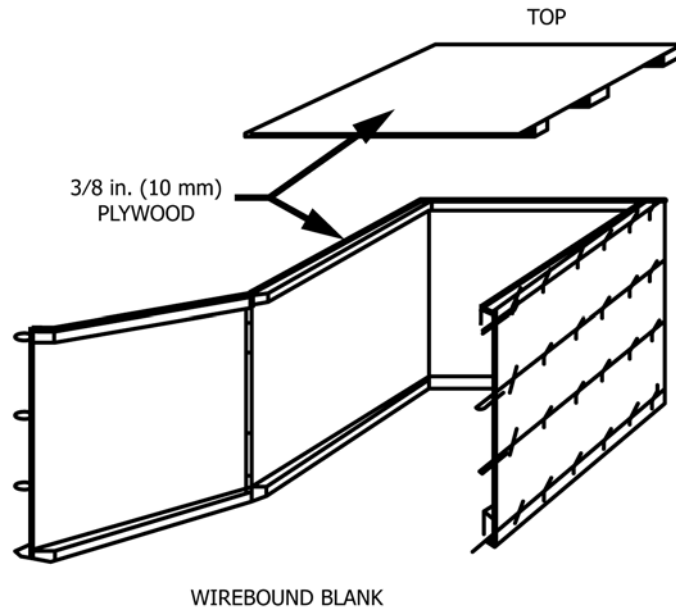
**FIG. 3 Type III Wirebound Box-Sheathed Lumber and Veneer with Two Different Length Sidewalls.**

The wire tensile strength shall be from 95 000 to 125 000 lb/in.<sup>2</sup> [655 002 to 861 844 kPa]. Staples shall be in accordance with Specification F1667, Type IV, Style 3—Flat Top Crown Staples.

6.1.4.1 *Coating*—The staple wire surface shall be galvanized. The galvanized coating shall be smooth and shall not

flake nor peel when the wire is wound around a  $\frac{3}{16}$ -in. [5-mm] diameter mandrel (see 8.2).





NOTE 1—Top battens (see Fig. 1 and Fig. 7)  $\frac{7}{8} \times 1\frac{3}{8}$  in. nominal [16 × 29 mm].  
All cleats (see Fig. 5 and Fig. 7)  $1\frac{5}{16} \times \frac{7}{8}$  in. nominal [16 × 16 mm]  
Select Class 1 or 2 from Fig. 5

FIG. 4 Type IV Wirebound Box Sheathed Plywood.

6.1.5 *Nails*—Nails shall conform to Specification F1667 or other industry standards. Nails are classified as plain-shank, helically threaded, annularly threaded, fluted, or twisted square wire.

6.1.6 *Water-Repellent Wood Preservative*—Water-repellent wood preservative shall be a solution containing either copper naphthenate conforming with Practice D6253, MIL-DTL-2427H and AWPA P36 with a minimum concentration of 2.0% copper metal, oxine copper (formerly referred to as copper-8-quinolinolate) conforming with Practice D6253, MIL-DTL-2427H and AWPA P37 with a minimum concentration of 1.8% copper metal, or 3 % zinc naphthenate conforming with Practice D6253 and MIL-DTL-2427H.

## 7. Construction

7.1 *Box Type and Class*—A partial four-way or two-way entry base may be used with each box type as specified (see 4.2 and 5.1.2).

7.1.1 *Type I Boxes*—Type I boxes shall conform to Fig. 1. Type I boxes shall be limited to 48-in. [1219-mm] maximum inside depth (load height). The inside length or width shall not exceed 60 in. [1524 mm], and when added together, shall not exceed 102 in. [2591 mm]. Bases shall conform to Fig. 5.

7.1.2 *Type II Boxes*—Type II boxes shall conform to Fig. 2. Type II boxes shall be limited to 40-in. [1016-mm] maximum inside depth (load height). The inside length and width dimensions, when added together, shall not exceed 96 in. [2438 mm]. Bases shall conform to Fig. 5.

7.1.3 *Type III Boxes*—Type III boxes shall conform to Fig. 3 and to the dimensional limitations of Type II boxes (see 7.1.2). Bases shall conform to Fig. 6.

7.1.4 *Type IV Boxes*—Type IV boxes shall conform to Fig. 4. Type IV boxes shall be limited to 48-in. [1219-mm]

maximum inside depth (load height). The inside length shall not exceed 96 in. [2438 mm]. The inside width shall not exceed 48 in. [1219 mm]. The inside length and width dimensions, when added together, shall not exceed 128 in. [3251 mm]. Bases shall conform to Fig. 5.

### 7.2 Wirebound Blank:

7.2.1 *Cleats*—Cleats shall be made of Group II (medium density softwoods), III (medium density hardwoods), or IV (high density hardwoods and softwoods) woods listed in Practice D6199. All cleat ends, except the bottom cleats for Type III boxes, shall be mitered. The bottom cleats for Type III boxes shall be butt-end. The cleat width and thickness shall be as shown on the applicable figure with a  $\pm \frac{1}{32}$ -in. [ $\pm 1$ -mm] width dimensional tolerance and the minimum thickness shall be  $\frac{7}{8}$  in. [16 mm].

7.2.2 *Faceboards*—Face boards shall be made from any of the wood species permitted in Practice D6199. Face boards, where required by the applicable figures, shall be  $\frac{3}{8} \pm \frac{1}{32}$ -in. [ $10 \pm 1$ -mm] thick. Type I box face board minimum width shall be  $2\frac{1}{2}$  in. [51 mm], except at the box blank leading and trailing edges, which shall be 4-in. [90-mm] nominal width.

7.2.3 *Corner and Intermediate Face Boards*—All Type II and III box corner and intermediate face boards shall be nominal 4 in. [90 mm] wide and  $\frac{3}{8}$  in. [8 mm] thick. Wood veneer  $\frac{7}{32}$  in. [6 mm] thick shall be used between the face boards. The veneer thickness shall be not less than 95 % of the specified thickness.

7.2.4 *Plywood Face Boards*—Type IV box plywood face boards for sides and top shall be  $\frac{3}{8}$ -in. [10-mm] thick. The box sides outer ply grain direction shall be vertical to the base. The plywood thickness shall be not less than 95 % of the specified

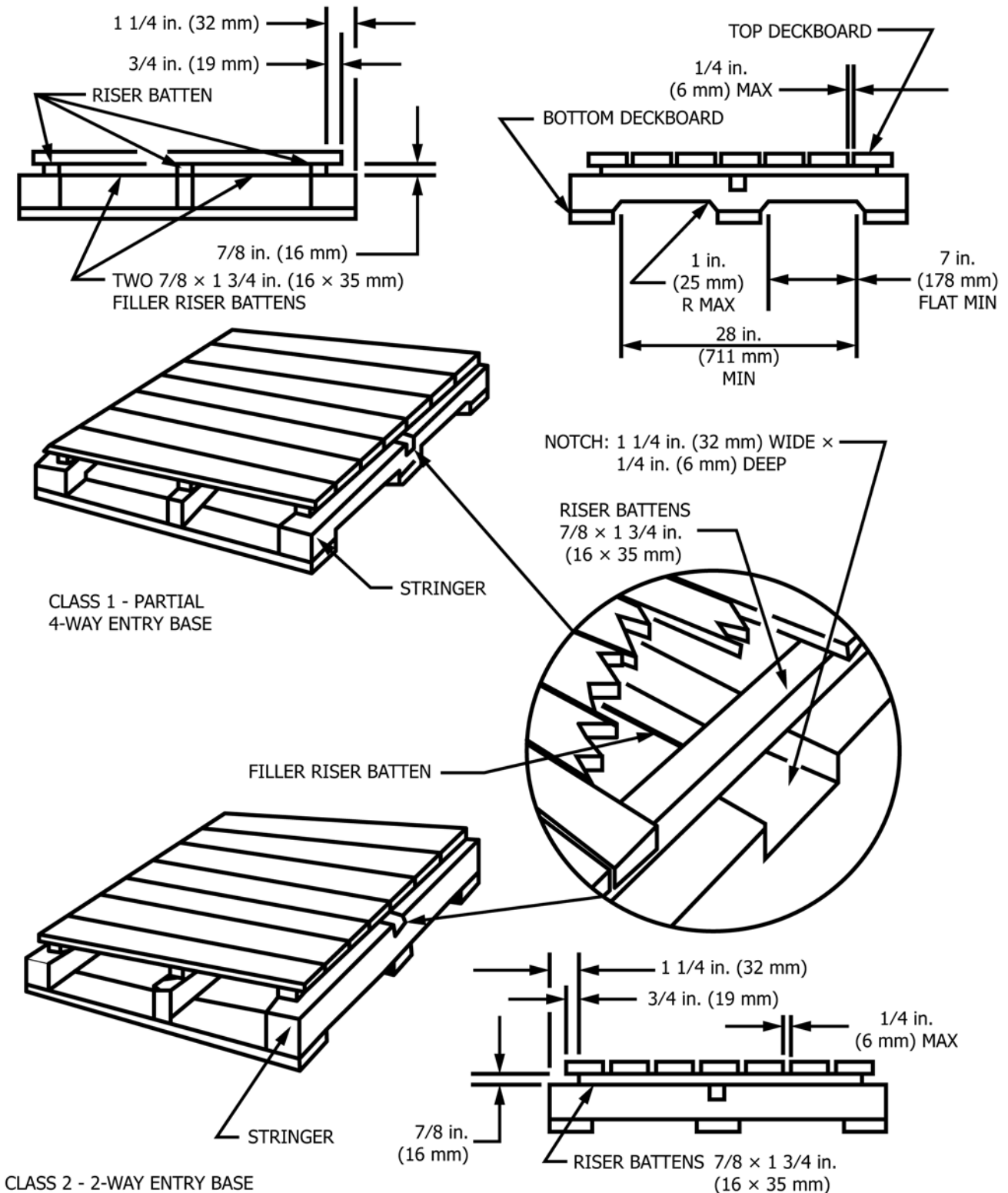
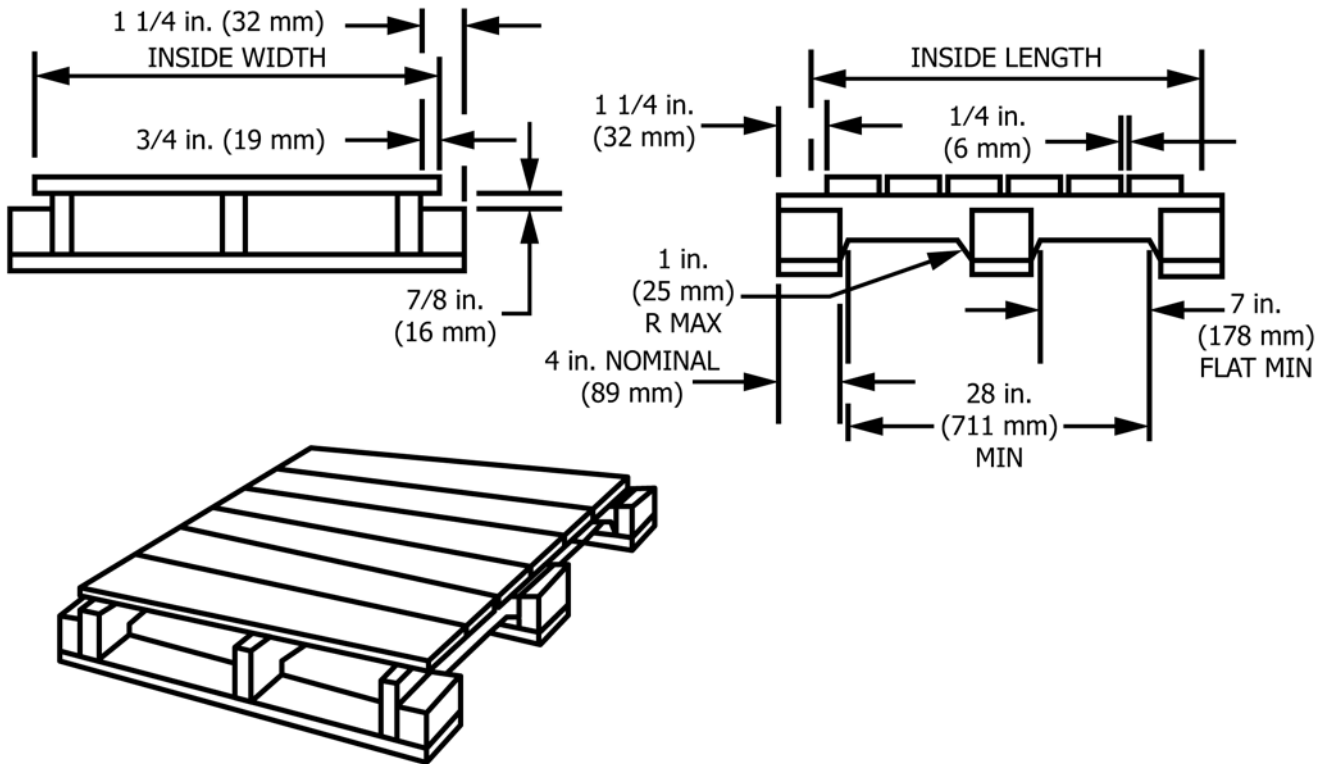


FIG. 5 Class 1 and 2—Pallet Bases (for Types I, II, and IV Boxes)

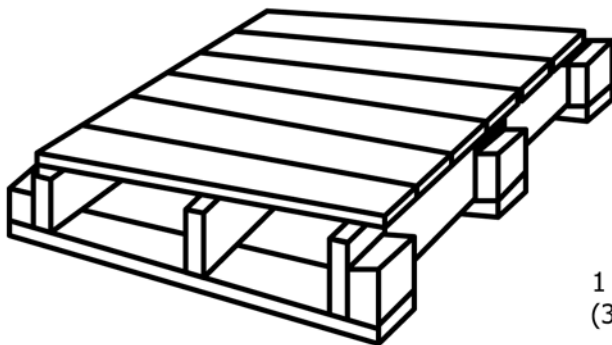
thickness. When a box panel width does not exceed 48 in. [1219 mm], the plywood used shall be one piece.

**7.2.5 Binding Wire**—Each binding wire shall be continuous around the box girth. Wire shall conform to the requirements of 6.1.3. The minimum number of binding wires shall be as

specified in Table 1. One binder wire shall be placed over each row of cleats. When possible, the remaining wires shall be spaced uniformly between the wires that are placed over each row of cleats (see Fig. 7). Binding wire splicing or welding during manufacture is permissible.



CLASS 3 - PARTIAL 4-WAY ENTRY BASE  
WITH TWO DIFFERENT LENGTH SIDEWALLS



CLASS 4 - 2-WAY ENTRY BASE  
WITH TWO DIFFERENT LENGTH  
SIDEWALLS

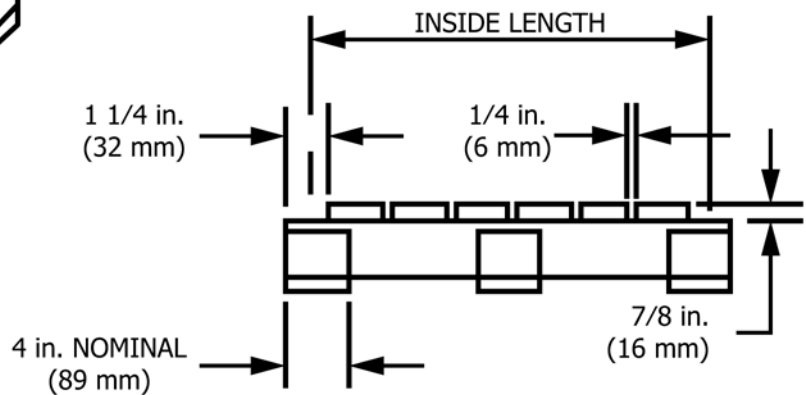
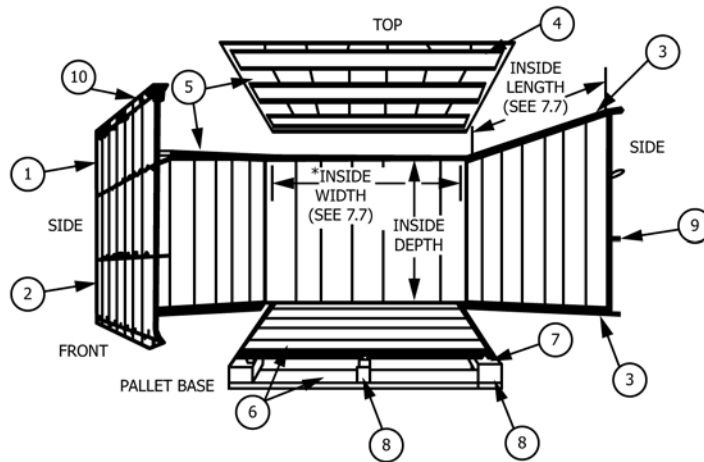


FIG. 6 Class 3 and 4—Pallet Bases (for Type III Boxes)

7.2.6 *Staples*—Staples shall conform to the requirements specified in 6.1.4 and Table 2. Staples shall be used for fastening binding wires to face boards, veneer, and cleats.

7.2.6.1 *Stapling Over Binding Wires into Cleats*—The staples shall pass through the face boards or veneer and into the cleats and shall not be deformed or protrude from the cleat





NOTE 1—Inside width is normally greater than inside length.

NOTE 2—See 7.6 for definitions of inside dimensions.

**FIG. 7 Wirebound Pallet-Type Wood Box Nomenclature**

**TABLE 1 Minimum Number of Binding Wires**

Face Board Length in. [mm]	Minimum Number of Binding Wires
20 – 27 <sup>5</sup> / <sub>16</sub> [508 – 702]	4
27 <sup>1</sup> / <sub>16</sub> – 36 [703 – 914]	5
36 <sup>1</sup> / <sub>16</sub> – 42 <sup>5</sup> / <sub>16</sub> [916 – 1083]	6
42 <sup>1</sup> / <sub>16</sub> – 50 [1084 – 1270]	7

sides. Any staple point that protrudes through a cleat shall be clinched. Staples shall be driven at a spacing not to exceed 1<sup>3</sup>/<sub>4</sub> in. [45 mm]. When the cleat length requires interruption of the nominal spacing, this interrupted space shall not exceed 2<sup>1</sup>/<sub>2</sub> in. [64 mm]. The minimum number of staples in any cleat shall be three. At each box corner, the distance from the cleat end to the nearest staple shall not exceed 1<sup>5</sup>/<sub>8</sub> in. [41 mm].

**7.2.6.2 Stapling Over Binding Wires into the Faceboards or Only Veneer**—Staples driven over binding wires into face boards or only veneer shall penetrate the face board or veneer and the staple points shall be clinched. Staple spacing shall conform to 7.2.6.1.

**7.2.7 Closures**—Closures shall be either looped wire or twisted loop wire closures conforming to Fig. 8. The length of looped fasteners or girth wires shall be approximately 4<sup>1</sup>/<sub>2</sub> times the inside box length to make a satisfactory closure as detailed in Fig. 8. For looped wire closures, each girth wire end shall be formed by bending the wire back in the opposite direction with the wire ends driven through the boards and clinched.

### 7.3 Top

**7.3.1 Battens**—Lumber for battens shall be as specified in 6.1.1. The top battens shall be 1<sup>3</sup>/<sub>8</sub> +0, -<sup>1</sup>/<sub>16</sub>-in. [29 +0, -2-mm] wide and <sup>7</sup>/<sub>8</sub> +0, -<sup>1</sup>/<sub>16</sub>-in. [16 +0, -2-mm] thick. Top battens shall run parallel with the box width (see Fig. 7). There shall be a minimum of three top battens with the center or intermediate batten at the top centerline. When the box length exceeds 36 in. [914 mm], an additional top batten shall be added with the intermediate battens uniformly spaced between the two outer battens.

**7.3.2 Top Faceboards and Veneer**—Face boards and veneer shall conform to 6.1.1, 7.2.2, 7.2.3, and 7.2.4. Top face boards minimum width shall be nominal 4 in. [90 mm]. Unless otherwise specified, top face boards shall project beyond the batten ends by at least 1<sup>1</sup>/<sub>4</sub> in. [32 mm]. Openings between face boards or face boards and veneer shall not exceed <sup>1</sup>/<sub>4</sub> in. [6 mm]. Face boards and veneer shall be fastened to battens with not less than 16-gage [1.588 mm] staples or 14<sup>1</sup>/<sub>2</sub> gage [1.930 mm] cement-coated, or chemically-etched nails and shall protrude through the battens and be smooth clinched. The staple crown bearing surface shall be not less than <sup>5</sup>/<sub>16</sub> in. [8 mm] long. Face boards not greater than 4 in. [90 mm] wide shall be fastened to each batten with not less than two nails or staples. The nail or staple spacing shall not exceed 2<sup>1</sup>/<sub>2</sub> in. [64 mm].

**7.4 Pallet Base**—Pallet bases shall conform to Figs. 5 and 6 as applicable to the box type specified. Lumber shall be as specified in 6.1.1.

**7.4.1 Stringers**—For Types I, II, and IV boxes, the outside stringers shall be nominal 4 × 4-in. [90 × 90-mm] minimum lumber and the center stringers shall be nominal 2 × 4-in. [40 × 90-mm] minimum lumber. For Type III boxes, all stringers shall be nominal 2 × 4-in. [40 × 90-mm] minimum lumber. For all box types and classes, when the box width does not exceed 24 in. [610 mm], the center stringer is not required. When the box width exceeds 50 in. [1270 mm], two intermediate stringers shall be used, uniformly spaced. Stringers for Types I, II, and IV boxes shall be notched as shown in Fig. 5.

**7.4.2 Riser Battens**—Riser battens shall be 1<sup>3</sup>/<sub>4</sub> +0, -<sup>1</sup>/<sub>16</sub> in. [35 +0, -2 mm] wide and <sup>7</sup>/<sub>8</sub> in. [16 mm] thick, minimum. The batten thickness shall allow the cleat to fit snugly in place when the box is assembled. Riser battens shall be fastened to each stringer with a minimum of three nails or at a nail spacing not to exceed 12 in. [305 mm]. Nails at the batten outer ends shall be set back from the end 2 in. [51 mm], but not greater than 4 in. [102 mm]. Riser batten nails shall be Type I, Style 18, 2<sup>1</sup>/<sub>2</sub> in. [64 mm] long pallet nails as prescribed in Specification F1667 or in MHIA/ANSI MH1–2005. See 7.4.3 for alternate fabrication.



TABLE 2 Minimum Staple Length and Gage

Board Thickness or Board, Cleat, or Batten Combined Thickness in. [mm]	In-Boards Only		In-Boards Over Wire	
	Length in. [mm]	Gage [mm]	Length in. [mm]	Gage [mm]
$\frac{7}{32}$ [4]	....	....	$\frac{1}{2}$ [13]	18 [1.207]
$\frac{3}{8}$ [8]	$\frac{1}{2}$ [13]	18 [1.207]	$\frac{9}{16}$ [14]	18 [1.207]
1 $\frac{1}{8}$ – 1 $\frac{3}{8}$ [22 – 29]	1 $\frac{1}{4}$ <sup>1</sup> [32]	16 [1.588]	1 $\frac{1}{4}$ <sup>A</sup> [32]	16 [1.588]

<sup>A</sup> 1  $\frac{1}{8}$  in. [29-mm] long, 16 gage [1.588-mm] staples permissible into Group IV wood cleats.

**7.4.3 Deckboards**—Top and bottom deck boards shall be  $\frac{3}{4} \pm \frac{1}{16}$  in. [ $16 \pm 2$  mm] thick and  $3\frac{3}{4} \pm \frac{1}{16}$  in. [ $83 \pm 2$  mm] wide. When specified, for Type IV boxes, the deck boards may be one piece of  $\frac{3}{8}$ -in. [10-mm] thick plywood. Openings between the top deck boards shall not exceed  $\frac{1}{4}$  in. [6 mm]. Top deck boards shall be attached by driving  $3\frac{1}{2}$ -in. [89-mm] long pallet nails spaced approximately  $2\frac{1}{4}$  in. [57 mm] apart, through deck boards and riser battens into the stringers. For boards up to  $4\frac{5}{8}$  in. [105 mm] wide, a minimum of two nails shall be placed through each deck board into each stringer. Alternately, the deck boards may first be fastened to the riser battens with 14 gage [2.032 mm],  $1\frac{7}{8}$ -in. [48-mm] long staples or 2-in. [51-mm] long nails spaced not more than 2 in. [51 mm] apart. The above assembly then shall be attached to the stringers using not less than  $3\frac{1}{2}$ -in. [89-mm] long pallet nails spaced approximately 4 in. [102 mm] apart.

**7.5 Container Manufacturer's Identification**—Unless otherwise specified (see Section 5), each wirebound pallet-type wood box shall be marked with the following information and arranged in the following pattern as closely as possible:

7.5.1 Specification D6254/D6254M.

7.5.2 Box type, class, and treatment.

7.5.3 Box manufacturer's name and address.

7.5.4 Maximum contents weight (lb, kg, or both).

7.5.5 Mod (when required, to designate that the box is in accordance with the specification requirements except for modification authorized in a contract or order).

7.5.6 All markings shall be permanent and legible and shall be limited to a 24-in.<sup>2</sup> [15 484-mm<sup>2</sup>] area placed on a side panel lower corner in letters and numerals approximately  $\frac{5}{16}$  in. [8 mm] high, except that the box specification number shall be approximately  $\frac{3}{4}$  in. [19 mm] high. When letters and numerals are indented, the indentation shall be not more than  $\frac{1}{16}$  in. [2 mm] below the wood surface.

**7.5.7 Water-Repellent Wood Preservative Identification**—The letters PA shall be permanently marked on all Treatment B boxes treated with oxine copper with a minimum concentration of 1.8% copper metal in accordance with 6.1.6. The letters PB shall be permanently marked on all Treatment B boxes treated with 3% zinc naphthenate in accordance with 6.1.6. The letters PC shall be marked in all Treatment B boxes treated with copper naphthenate with a minimum concentration of 2.0% copper metal in accordance with 6.1.6.

**7.6 Box Sizes**—Box sizes shall be as specified (see Section 5.1.5). Box sizes shall be in terms of the inside box dimensions as specified herein (see Fig. 7) and shall be cited in sequence of length, width, and depth. The box inside length and width

shall be the assembled box cleats inside dimensions with a  $\pm \frac{1}{8}$ -in. [ $\pm 3$ -mm] tolerance. The inside depth specified shall be the distance from the top of the pallet deck boards to the underside of the assembled box top cleat with a  $\pm \frac{1}{4}$ -in. [6-mm] tolerance. The inside width normally will be greater than the length (see Fig. 7).

**7.7 Interchangeability**—All like components of all boxes of the same type, class, treatment, and size procured under a specific contract shall be interchangeable.

**7.8 Filled Boxes Assembly, Closure, and Strapping**—Where this specification is referenced as a requirement for shipping of an item or items in a contract, order, or specification, the Supplementary Requirements Section shall be a mandatory part of this specification.

**7.9 Workmanship**—The boxes shall be free from slivers and any other handling hazards, as well as any defects affecting appearance and serviceability.

## 8. Performance Requirements

**8.1 Wood Moisture Content Test**—Wood moisture content shall be as 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, except pallet base stringers, to be used in constructing boxes.

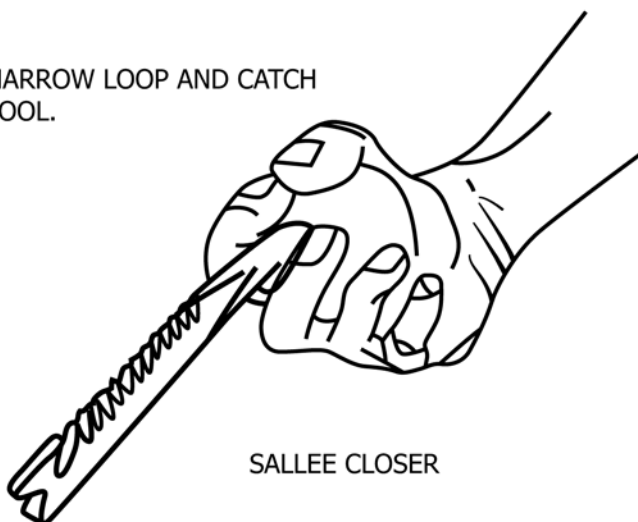
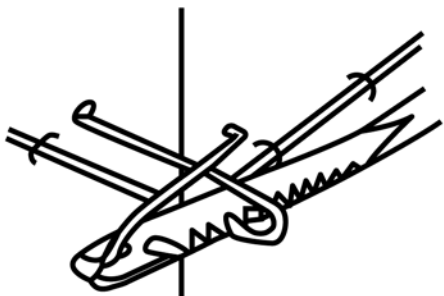
**8.2 Coating Adherence on Galvanized Wire Test**—Coating adherence on galvanized wire testing shall be performed on each sample unit to determine conformance to 6.1.3.1 and 6.1.4.1. The sample unit shall be one piece of wire of sufficient length to perform the test. Sample units shall be obtained from each wire lot used for binding wires and making staples.

**8.2.1 Test Procedure**—The wire shall be wrapped in a closed helix for at least two complete turns around a  $\frac{3}{16}$ -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.

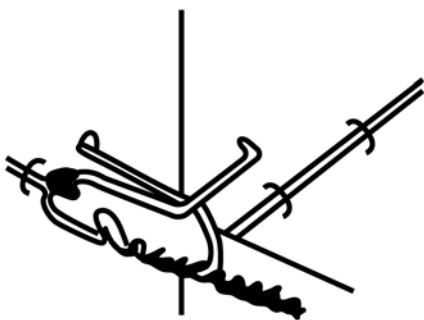
**8.3 Tensile Strength of Wire Test**—The contractor shall certify that the binding wire specified in 6.1.3 and the staple wire specified in 6.1.4 meet the required tensile strengths.

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

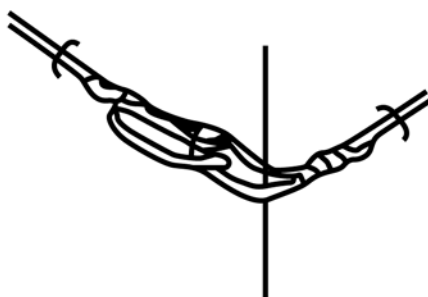
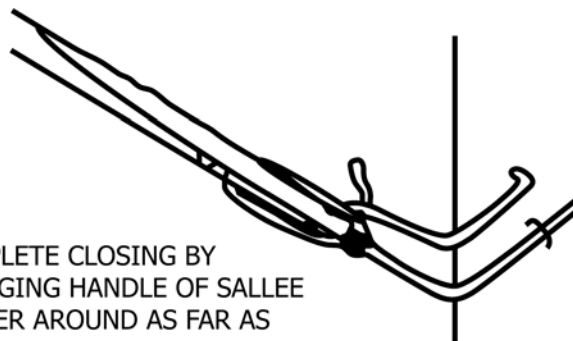
1. INSERT SALLEE CLOSER THROUGH NARROW LOOP AND CATCH WIDE LOOP IN NOTCH ON END OF TOOL.



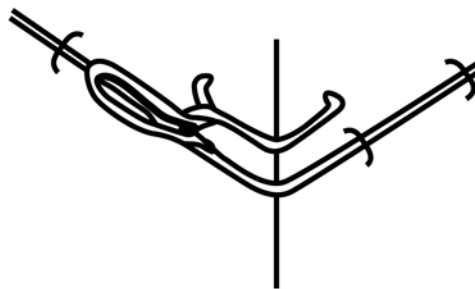
2. PUSH WIDE LOOP AGAINST SURFACE OF BOX FACE, ENGAGE NARROW LOOP IN TEETH OF TOOL AND START SWING.



3. COMPLETE CLOSING BY SWINGING HANDLE OF SALLEE CLOSER AROUND AS FAR AS POSSIBLE.



TWISTED LOOP CLOSURE



LOOPED WIRE CLOSURE

FIG. 8 Loop Closure Method

either end with top open. Any failure to meet the color requirements specified in 8.4.1 and 8.4.2 shall be cause for rejection.

8.4.1 *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 chome 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).



**8.4.2 Zinc Napthenate Preservative Test**—Prepare daily 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.

**8.4.2.1** 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 1 min with constant stirring, and then cooled.

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

**8.4.2.2** 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.

## **9. Shipping Preparation**

**9.1** Boxes are to be shipped completely assembled or knocked down as specified (see Section 5.1.7). The pallets and like-sized panels for 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 of the National Motor Freight Classification. Preserved assembly instructions,

if required, shall be secured in a protected location on the bundle, box, or crate of complete boxes, pallets, or component panels.

**9.2 Packing and Marking**—Assembled or knocked down boxes shall be packed and marked in accordance with Practice D3951. Other special marking requirements may be required in the contract or purchase order.

**9.3 Phytosanitation**—Phytosanitary treatment and marking must conform to Practice D6253 and ISPM 15.

## **10. Notes**

**10.1 Intended Use**—Boxes covered by this specification are used for domestic and overseas shipment of general material and supplies. Irregular shaped items or those that require special protection should receive an intermediate stage of packing, wrapping, or bolting to the base to prevent item movement within the box. These boxes can be used interchangeably; however, in humid areas, Treatment A and B boxes should be specified for prolonged outdoor storage.

**10.2 Regulated Commodities Shipments**—Regulated commodities shipments may require stronger constructed boxes than those specified herein. When the US Department of Transportation regulates commodities, all boxes must conform to the requirements of CFR Parts 107–180 Title 49, Hazardous Materials Regulations or appropriate international modal regulations.

## **11. Keywords**

11.1 blank; box; fasteners; ISPM 15; nails; packaging; pallet; panelboard; shipping container; skid; staples; wire; wirebound; wood

## **SUPPLEMENTARY REQUIREMENTS**

### **S1. Scope**

**S1.1** These Supplementary Requirements cover assembly, closure, and steel strapping of wirebound pallet boxes. In the event of a conflict between this specification and the referenced documents cited herein, this specification takes precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

### **S2. Requirements**

**S2.1 Wirebound Pallet-Type Wood Box Assembly**—Partial box assembly would normally precede, but may follow, depending on the contents, packing the wirebound pallet-type wood box. For example, carton loads could be evenly stacked on the base and the blank applied around the load.

**S2.1.1 Types I, II, and IV Wirebound Box Assembly**—The wirebound blank front, back, and sides are in a preassembled form consisting of four sections, which fold around the base forming the four sidewalls. Apply the blank to the base (see Fig. 7). The bottom blank cleat fits on top of the stringer and

into the channel-shaped opening between the top of the stringer and the bottom of the deck boards.

**S2.1.1.1 Sidewalls to Base Assembly**—Secure the two outside loops temporarily by hand. Square the sidewalls with the base and drive two equally spaced 2½-in. [64-mm] pallet nails, adjacent to the wire, through each side bottom cleat into the base riser batten. Toenail one 2½-in. [64-mm] pallet nail through the center of the rear bottom cleat into the center stringer. The front section may be left open to ease packing, if desired.

**S2.1.1.2 Top Assembly**—When packed, thread all loops and partially bend the loops by hand. Toenail one 2½-in. [64-mm] pallet nail through the center of the front bottom cleat into the center stringer. Insert the top and drive two equally spaced 2½-in. [64-mm] pallet nails through each upper cleat of the wirebound blank into the adjacent top battens and one 2½-in. [64-mm] pallet nail into each center batten.

**S2.1.1.3 Box Closure**—When strapping is required, the strapping shall be applied before the loops at the blank closing edge are finally closed. This eliminates slack, which may



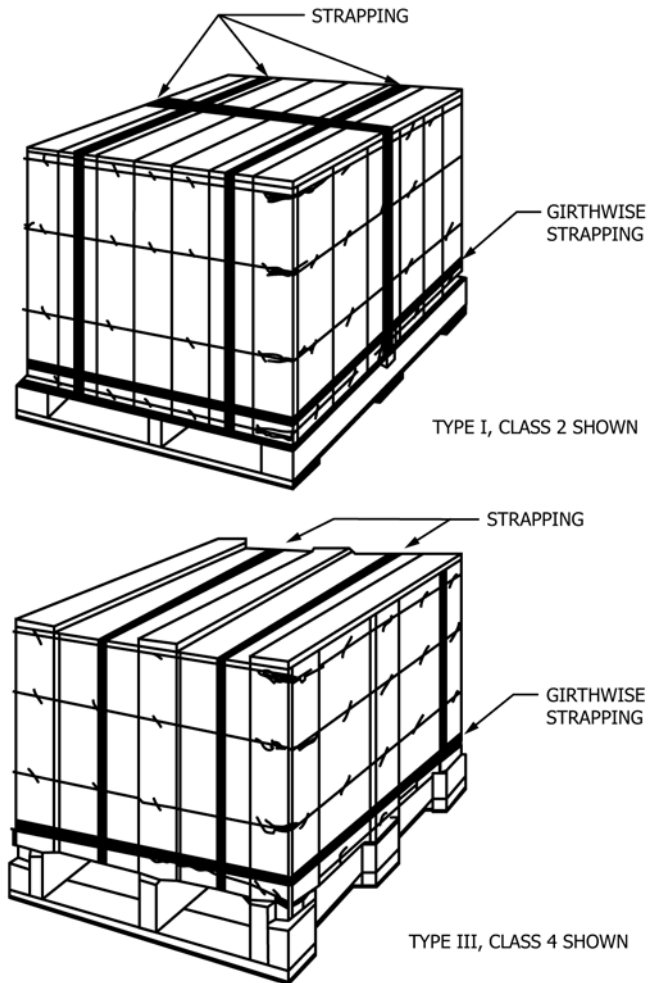


FIG. S1.1 Strapping Details

develop when strapping is applied after closure is made. For best performance, a tight loop closure is essential. Loop final closure shall be made with the hand tool as illustrated in Fig. 8.

**S2.1.2 Type III Wirebound Box Assembly**—For Type III box assembly, the wide cleat is at the top of the box. The sidewalls are applied to the base by offsetting the sections as shown in Fig. 3. The side bottom cleats lock under the pallet base overhanging deckboards. Drive two (minimum) 2½-in. [64-mm] long pallet nails, adjacent to each side bottom wire, through the cleat into the stringer. Two (minimum) 2½-in. [64-mm] long pallet nails shall be driven through each of the top cleats, which are backed up by the top battens.

**S2.2 Strapping**—Box type, configuration, and contents weight should be considered when determining strapping requirements.

**S2.2.1 Strapping Size**—Strapping shall be applied before blank closing edge is finally closed (see S2.1.1.3). All strapping shall conform to Specification D3953, Type I, Finish B, Grade 2 and shall be ¾ by 0.023 in. [19.05 by 0.58 mm].

**S2.2.2 Strapping Procedure**—Strapping shall be tensioned to sink into the box edges not more than ⅛ in. [3 mm]. It is possible to over-tension strapping with forces greater than stacking loads to be encountered. This can cause the sidewalls to bow and should be avoided.

**S2.2.3 Additional Support**—Unless otherwise specified, wirebound pallet boxes shall be strapped as shown in Fig. S1.1. When the longest box dimension falls between 48 and 96 in. [1219 and 2438 mm], additional nails shall be driven through the side bottom cleats into the base riser battens and additional straps shall be added to maintain equivalent spans between fasteners as required in S2.1.1.1.





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