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MILITARY STANDARD  
QUALITY OF WOOD MEMBERS FOR  
CONTAINERS AND PALLETS

AMSC N/A

FSC 8115

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## MIL-STD-731A

### 1. SCOPE

1.1 Purpose. This standard covers quality requirements for three classes of wood members employed in the construction of boxes, crates, pallets, and blocking and bracing within containers for domestic and overseas shipments.

#### 1.2 Quality classification:

Class 1 - Structural (highly stressed members).

Class 2 - Structural (members with moderate stress).

Class 3 - Nonstructural (members ordinarily unstressed).

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DEPARTMENT OF DEFENSE

Washington, DC 20301

Quality of Wood Members for Containers and Pallets  
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1. This Military Standard is approved for use by all Departments and Agencies of the Department of Defense.
2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer (Code 156), Naval Construction Battalion Center, Port Hueneme, CA 93043-5000, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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### FOREWORD

This standard provides quality standards for three classes of wood members of containers and pallets. It is intended that it will be used as a material reference in container and pallet specifications. The intended use is further described in 10.1 and tables III and IV.

Each wood member contains a combination of characteristics which affects the performance of the container or pallet in which it is used. The requirements for classes, herein specified, have been established as these characteristics are related to the functional application of the members in container and pallet construction and to the service which the container or pallet may be called upon to perform.

Any other specific requirements or limitations peculiar to a particular container or pallet construction or use, such as prohibiting knotholes or loose knots to provide siftproofness, limitation to certain wood groups or species, and the selection of applicable classes for specific members or types of containers or pallets shall be the responsibility of the container or pallet specification custodian or of the requisitioning agency.

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## 2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specification and handbook. The following specification and handbook form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

## FEDERAL SPECIFICATION

MMM-A-188 - Adhesive; Urea-Resin-Type (Liquid and Powder).

(Unless otherwise indicated, copies of federal and military specification, standards, and handbooks are available from the Standardization Document Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following document(s) form a part of this standard to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

## DEPARTMENT OF COMMERCE

PS 20-70 - American Softwood Lumber Standard

(Application for copies should be addressed to the Superintendent of Documents, US Government Printing Office, Washington, DC 20402.)

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

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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## 3. DEFINITIONS

3.1 Wood member. A single solid, wood component of a box, crate, pallet, or blocking, or a component built up according to the provisions in 5.5.

3.2 Boxes.

3.2.1 Cleats.

3.2.1.1 Nailed wood box cleats are members that reinforce and tie together the boards in the ends of a shook or box and provide improved nailing.

3.2.1.2 Wirebound box cleats are members that form the framework to which face boards of the top, bottom, and sides are stapled.

3.2.1.3 Cleated-panel box cleats are members that form a reinforcing framework for additional strength and stacking resistance. They also provide surfaces for panel and box assembly nailing.

3.2.2 Battens.

3.2.2.1 Nailed wood box battens are reinforcing members added either to the inside or outside of tops, bottoms, sides, and ends of a shook or box to reduce the unsupported span of the boards.

3.2.2.2 Wirebound box battens are members to which end face boards are fastened and are attached to the outside faces of the end face boards.

3.2.3 Skids.

3.2.3.1 Box skids are members attached to the bottoms of boxes which serve to support the load to provide for forklift handling, sometimes replace the outside bottom battens, and may be longitudinal or transverse.

3.3 Crates.

3.3.1 Frame members are those parts which form the fundamental structure upon which the strength and rigidity of crates depend.

3.3.2 Longitudinal frame members are horizontal members of the side, end, and top panels.

3.3.3 Diagonals are frame members placed at angles of nearly 45 degrees to other frame members and serve as braces to insure rigidity in the crate.

3.3.4 Struts are vertical frame members, placed between the upper and lower frame members of the side and end panels, and serve as columns for supporting vertical stacking loads.

3.3.5 Skids are horizontal members attached to the bottom of the crate which serve to support the load. Outside skids also serve as fastening members for the side panels.



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3.3.6 Headers are transverse members at each end of a skid-type base which serve to hold the base together as a unit, to transfer loads to the skids, and to provide a fastening member for end panels.

3.3.7 Load-bearing floorboards are transverse members of bases which provide a means for anchoring and transferring loads evenly to the skids.

3.3.8 Sills form the framework of sill-type bases, carry and transfer loads to side panels, and serve as fastening members.

3.3.9 Bridging consists of members that are inserted at right angles to sills or joists to prevent lateral turning or buckling.

3.3.10 Rubbing strips are longitudinal members nailed to the underside of skids or sill based to provide for sling and forklift truck handling.

3.3.11 Joists are members extending across the crate underneath the top to support and transfer vertical stacking loads to the side panels.

3.3.12 Joist supports are members that serve to support the joists and transfer stacking loads to the side panels.

3.3.13 Lumber sheathing consists of boards nailed to frame members to enclose the crate.

3.4 Pallets. Pallets are materials-handling platforms consisting of one or two faces separated or supported by structural members that provide clearance for slings and the forks of lift trucks.

3.4.1 Deck boards make up the faces of a pallet and are referred to as top or bottom deck board.

3.4.2 Stringers are wooden runners to which deck boards are fastened. They serve as spacers to permit entry of the forks of lift trucks.

3.4.3 Posts are rectangular or round blocks employed on some two-way entry and four-way entry pallets in place of stringers, and serve the same purpose.

3.4.4 Stringer boards are boards that tie the blocks together and to which the top deck boards are fastened in a four-way block-type pallet.

3.5 Defects. Defects are any irregularities or imperfections occurring in or on wood that may lower its strength.

3.5.1 Knots are cross sections of branches visible on the surface of a piece of wood.

3.5.2 Sound knots are solid across their faces, are at least as hard as the surrounding wood, and show no indication of decay.

3.5.3 Loose Knots because of growth conditions or moisture changes are separated from the surrounding wood and cannot be relied upon to remain in place.

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3.5.4 Knotholes are holes in wood from which knots have fallen.

3.5.5 Knot clusters are three or more knots in very close proximity to each other, the fibers of the wood being deflected around the entire unit. They are separated by a distance no greater than their average width, figure 1. A group of single knots is not a knot cluster.

3.5.6 Tandem knots are three or more knots close to each other and on lines approximately parallel to the edges of a board, figure 1. When knots are in tandem or partially so, as in figure 1, the measurement a shall be used instead of the sum of the individual widths.

3.5.7 Decay is disintegration of wood due to action of fungi.

3.5.8 Stain and discoloration are often caused by fungi, but normal color variations in healthy wood are often confused with decay. Heavy fungus stain is usually an indication of incipient decay. Other discolorations not associated with decay are chemical stains occurring during seasoning; oxidation of the surfaces of some woods; purplish stain from contact with iron; mineral stain; and the stains of oils, solvents, and some glues.

3.5.9 Checks, splits, and shakes are lengthwise grain separations of the wood.

3.5.9.1 Checks usually result from stresses set up during seasoning. Through checks extend through the full thickness of the members.

3.5.9.2 Splits extend through the full thickness of the members and often take a radial direction.

3.5.9.3 Shakes are separations between rings of annual growth that extend through the full thickness of the members.

3.5.10 Wane is bark or lack of wood from any cause on the edge or corner of a piece of wood.

3.5.11 Warp is any distortion in a member from plane surface. Warp includes bow, crook, cup, and twist, or any combination.

3.5.11.1 Bow is the distortion in a member that deviates from a plane surface lengthwise but not across its face. The amount of bow is the greatest distance of the surface of the member from the plane.

3.5.11.2 Crook is the distortion in a member that deviates edgewise from a straight line from end to end. The amount of crook is the greatest distance of edge of the piece from the line.

3.5.11.3 Cup is the distortion in a member that deviates flatwise from a plane surface across its width. The amount of cup is the greatest distance of the surface of the member from the plane.

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3.5.11.4 Twist is the distortion in a member caused by the turning of its edges so that the four corners of any face are no longer in the same plane. The amount of twist is the distance the end of an edge is raised above a horizontal flat surface when both edges are resting snugly at the opposite end.

3.6 Grain. Grain is the direction, size, arrangement, appearance, or quality of the fibers in wood.

3.6.1 Cross grain is not parallel with the longitudinal axis of the piece, figure 2. It may be either diagonal or spiral grain or a combination of the two.

3.6.2 Diagonal grain is a condition where the annual rings are at an angle with the longitudinal axis of the piece as a result of sawing at an angle other than parallel with the bark of the tree, figure 2.

3.6.3 Spiral grain is a type of growth in which the fibers take a spiral course about the bole of a tree instead of the normal vertical course, figure 2.

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## 4. GENERAL REQUIREMENTS

4.1 Species of wood. The species of wood which may be used for wood members of containers or pallets are classified in groups as specified herein. When it is stipulated that members shall be of a particular wood group, the species within the group may be mixed together or used interchangeably. When a group or species is not specified, any group may be used at the option of the contractor and the species within that group used interchangeably. Characteristics of the wood group are described in 6.3.

## Group I

Aspen (popple)  
Basswood  
Buckeye  
Cedar  
Chestnut  
Cottonwood  
Cypress

Fir (true firs)  
Magnolia  
Pine (except southern yellow pine)  
Redwood  
Spruce  
Willow  
Yellow-poplar  
Red alder

## Group II

Douglas-fir  
Hemlock  
Southern yellow pine

Tamarack  
Western larch

## Group III

Ash (except white ash)  
California black oak  
California maple  
Soft elm

Soft maple  
Sweetgum  
Sycamore  
Tupelo

## Group IV

Beech  
Birch  
Hackberry  
Hard maple  
Hickory

Oak  
Pecan  
Rock elm  
White ash

4.2 Surfacing. Rough lumber shall be permitted for bases of all crates and for framing of sheathed crates. At least one surface of all other wood members shall be sufficiently smooth (surfaced or smooth sawn) to permit legible marking.

4.3 Inspection procedures. Inspection procedures shall be conducted in accordance with the requirements in the specification referencing this standard.

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## 5. DETAILED REQUIREMENTS

(When this standard is referenced, the following detailed requirements shall apply unless the specification referencing this standard specifies otherwise.)

5.1 Dimensional limitations. Where nominal sizes<sup>1</sup> are specified, the minimum sizes<sup>2</sup> in table 1 shall govern. When sizes of wood members other than listed are specified, occasional undersize in thicknesses and widths, due to mismanufacture, shall be permitted in not more than 10 percent of the pieces. However, these parts shall be no thinner than 7/8 of the required thickness and no part shall be narrower than 1/4-inch less than the required width. If wood members for nailed wood boxes 3/8-inch or more in thickness are surfaced on both sides (to protect the contents), the thickness may be 1/32-inch less than required. When nominal 2 inch thick lumber is resawn to obtain nominal 1 inch thick members, the resulting minimum allowable thickness shall be 11/16-inch for dry lumber. This thickness will be acceptable for class 2 structural and class 3 nonstructural applications as indicated in table III. The minimum dimensions shown in table I for nominal 1 inch thickness shall apply to class 1 structural components.

TABLE I. Relation of nominal to minimum allowable dimensions of softwood lumber<sup>1</sup>

Thickness <sup>2</sup> (smaller dimensions)		Width <sup>2</sup> (larger dimensions)	
Nominal	Minimum	Nominal	Minimum
Inches	Inches	Inches	Inches
1	3/4	2	1-1/2
2	1-1/2	3	2-1/2
3	2-1/2	4	3-1/2
4	3-1/2	5	4-1/2
5 and thicker	1/2 off	7	6-1/2
		8 and wider	3/4 off

<sup>1</sup>Hardwood lumber is bought and sold on actual rather than nominal sizes. The minimum allowable sizes are applicable to hardwoods.

<sup>2</sup>Dimensions indicated are American Lumber Standard minimums for dry lumber. Green lumber minimums are somewhat greater for both thickness and width.

<sup>1</sup>The rough-sawn commercial size by which soft wood lumber is known and sold in the market.

<sup>2</sup>The minimum permissible size of rough-sawn commercial lumber after shrinking and machining.

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5.2 Moisture content. Moisture contents shall be determined by electric type moisture meter (5.2.3.1) or by the oven-drying method (5.2.3.2).

5.2.1 Moisture content in container members and wood pallet members. Wood members in containers and pallets shall have a moisture content at time of fabrication not greater than 19 percent, nor less than 9 percent of their oven-dry weight.

5.2.3 Methods of determining moisture content.

5.2.3.1 Moisture meters. Meters measuring moisture contents ranging as high as 30 percent shall be used to determine moisture content of group IV pallet members. Meters measuring moisture contents as high as 23 percent shall be used for all other wood members. In the 7 to 25 percent moisture content range, meter accuracy when properly calibrated shall be within 1 percent, either way, of true moisture content. When electric-type moisture meters are used on roughsawn wood members, they shall be of the resistance type. When electric-type moisture meters are used on surfaced wood members, they may be either the resistance type, capacity type, or the radio frequency power loss type. Readings on the resistance-type moisture meter shall be made only when the pins have penetrated to a depth of one-fourth of the thickness of the member.

5.2.3.2 Oven-drying method. A small sample preferably not less than 1 ounce, shall be cut from the piece to be tested. It shall be weighed immediately on a scale that is accurate to 1/2 of 1 percent. This shall be the original weight. The sample shall be dried in an oven maintained at 212 degrees to 221 degrees F. (100 to 106 degrees C.) until constant weight is attained. This shall be the oven-dry weight. The percent moisture content shall be computed by the following formula:

$$\frac{(\text{Original weight}) - (\text{Oven-dry weight})}{(\text{Oven-dry weight})} \times 100 = \text{percent moisture content}$$

5.3 Defects.

5.3.1 General. Wood members shall be so selected and cut that allowable defects of imperfections will not occur in positions that would interfere with the prescribed fabrication or assembly of the container or pallet (see 3.5 for definitions of defects).

5.3.2 Decay. Any form of visible decay shall not be permitted except in knots. Stains and discoloration not associated with decay will be acceptable, except that discoloration that interferes with marking on the outside of the container will not be permitted. Decay can usually be detected and differentiated from harmless stains and discoloration by use of the pick test. The pick test is performed with a knife or chisel by lifting up some of the grain or fibers in suspicious looking areas. If the material is softer, more punky, or more brash (breaks without splintering) than healthy wood of the same species, it is probably decayed. Suspicious areas usually are abnormally brown, bleached looking, or mottled and indicated by the absence of luster that is present in normal wood.

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5.3.3 Through checks, splits and shakes. Through checks, splits, and shakes that are longer than the width of the member will not be permitted. Seasoning checks that do not extend through the full thickness of the members are permitted. For some containers, the limitations on checks, splits, and shakes may be more liberal, especially if repaired in an approved manner, but these requirements shall be so stated in the applicable container specification.

5.3.4 Warp. The bow in a member shall not exceed 1/8-inch per foot of length. The crook in a member shall not exceed 1/16-inch per foot of length. The cup in a member shall not exceed 1/4-inch in an 8 inch width, 1/8-inch in a 4 inch width, or a like proportion in other widths. The twist in a member shall not exceed 1/4-inch per foot of length in an 8 inch width, 1/8-inch per foot of length in a 4 inch width, or a like proportion in other widths.

5.3.5 Knots. Sound knots, loose knots, knotholes, knot clusters, and knots containing decay shall be measured and restricted as specified for knots. The width of the wood member, perpendicular to the length of the piece, figure 1. Knots shall be limited in width in accordance with table II. The sum of the widths of the knots within a length equal to the width of the wood member in which they occur shall not exceed the maximum allowable width of a single knot for that piece.

5.4 Cross grain. The slope of the cross grain, resulting either from diagonal sawing or from twisted or spiral grain in the log or both, shall be limited in accordance with table II. Slope of cross grain shall be measured by the angle between the general direction of the grain and the longitudinal axis of the wood member and shall be expressed as a ratio. Slight local deviations of grain direction shall be disregarded. When a wood member contains both diagonal and spiral grain, figure 2, the combined damaging effect shall be taken into account (see 10.3 for measuring and calculating the combined slope).

5.5 Built-up sheathing members. Members to be used for sheathing of sides, end, tops, or bottoms of boxes or of crates may be built up by joining pieces together at their edges by the following methods: (1) Linderman joint and glue, (2) butt joint and glue, and (3) tongue and groove joint and glue. The glue used shall be urea-resin glue conforming to Specification MMM-A-188. To be acceptable, the joints shall be sampled and shall pass the test described in 5.6.1.

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TABLE II. Classes of wood member for containers and pallets.

Class	Maximum allowable width of knots	Maximum allowable slope of cross grain
1. Structural	2 inches, but not over 1/4 of the width of the wood member.	No steeper than 1 in 10.
2. Structural	3 inches, but not over 3/8 of the width of the wood member.	No steeper than 1 in 10.
3. Non-Structural	4*inches, but not over 1/2 of the width of the wood member.	No steeper than 1 in 8.

\* The maximum allowable width of knots in face boards of wirebound boxes shall be 1-1/2 inches.

#### 5.6 Quality control.

5.6.1 Quality control test of members built up of edge-joined pieces. Fifteen samples shall be cut at random from each lot of built-up members (all members cut for one type and order of container shall be considered a lot). The samples shall be 2 inches  $\pm$  1/8-inch wide (parallel to the grain direction) by a length (perpendicular to the grain direction) equal to the width of the member. Any sample that contains a visible split, shake, pitch pocket, or check across the entire width shall be discarded and a new sample shall be chosen to replace it. Samples shall be picked so that the joint to be tested is at least 2 5/8-inches from the edge of the board. The 15 chosen samples shall be tested as cantilever beams as shown in figure 3. The length of the sample shall be placed perpendicular to the top edge of the vise. The size of the block and the position of the cleat shall be selected so that the lever is parallel to the sample. The lever shall be at least 30 inches long. The sample shall be positioned vertically so that the joint is 0.4 times the clear span, L, above the top face of the vise. A slow, even pull shall be applied to the top of the lever until the sample fails in bending. The position of the break with respect to the joint shall be recorded. Any break that is wholly or partially at the joint shall be recorded as joint failure. In order for the lot of members to pass this test, at least 12 of the samples shall fail in the wood and below the joint.



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6. NOTES

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

6.1 Intended use. Wood members covered by this standard are for boxes, crates, pallets, and blocking and bracing within containers, according to the recommended use in tables III and IV. The quality is defined with respect to maximum permissible defects or imperfections for the intended use and consequently does not coincide with the quality standards of commercial lumber. There are, however, grades of such lumber, from which pieces conforming to the requirements of this specification, may be economically cut. When lumber is to be procured by the Government for container or pallet manufacture, reference should be made to the recommendations in section 11 of Military Handbook, MIL-HDBK-7. "Lumber and Allied Products." The tables in that section recommend the lowest suitable grades for this purpose.

6.2 Issue of DODISS. When this standard is used in acquisition, the applicable issue of the DODISS must be cited in the solicitation (see 2.1.1, and 2.2).

6.3 Wood groups.

6.3.1 Group I embraces the softer woods of both the coniferous and the broad-leaved species. These woods are relatively free from splitting in nailing, have moderate nail-holding power, moderate strength as a beam, and moderate shock-resisting capacity. They are soft, light in weight, easy to work, hold their shape well after manufacture, and as a rule, are easy to dry.

6.3.2 Group II consists of the heavier coniferous woods and includes no hardwood species. These woods usually have a pronounced contrast in the hardness of the springwood and the summerwood. They have greater nail-holding power than the group I woods, but are more inclined to split and the hard summerwood bands occasionally deflect the nails and cause them to run out at the side of the piece.

6.3.3 Group III consists of hardwoods of medium density. No coniferous species are included. These woods have about the same nailholding power and strength as a beam as the group II woods, but are less inclined to split and shatter under impacts. Group III species are the most useful woods for box ends and cleats. They also furnish most of the rotary-cut veneer for wirebound and plywood boxes.

6.3.4 Group IV woods are hardwood species. They have both the greatest shock-resisting capacity and the greatest nail-holding power, but because of their extreme hardness, they present difficulties with respect to the driving of nails and also have the greatest tendency to split at the nails. They are the heaviest and hardest domestic woods and are difficult to work. They are especially useful where high nail-holding power is required and many of them make excellent rotary-cut veneer for wirebound and plywood boxes.

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6.4 Measuring and calculating the combined slope of cross grain. A convenient method of measuring slope of cross grain is by using a sharply pointed steel scribe. Figure 4 illustrates four scribes that are satisfactory for this purpose. The scribe should be drawn in the direction in which the grain seems to run; enough pressure must be applied so that the point will penetrate the wood slightly; and enough freedom of lateral movement must be allowed to permit the point to follow the grain. The combined damaging effect of slope of cross grain can be computed by combining the apparent slope of grain on two adjacent faces of a member. When each of the slopes are expressed as a ratio to 1, i.e., 1 in 18 and 1 in 12, the combined slope is the square root of the sum of the squares of the slopes (combined slope = square root of  $(1/18)^2 + (1/12)^2 = 0.1000$  or 1 in 10).

6.5 Subject term (key word) listing.

- containers
- pallets
- knot clusters
- tandem knots
- cross grain
- wood group
- species of wood
- lumber

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

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TABLE III. Wood member classes for component parts of container and pallets for multiple handling and shipment (including indeterminate storage and worldwide distribution).

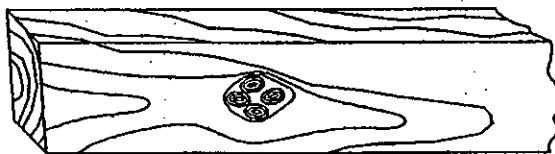
Container	Class 1 structural	Class 2 structural	Class 3 nonstructural
Nailed wood bases.	Cleats Battens	Tops Bottoms Sides	Ends Skids
Cleated-panel bxs.		Cleats	
Wirebound boxes...	Cleats	Battens	Sawed boards
Fiberboard lined boxes	Cleats	Tops Bottoms Sides	Ends
Triple-wall boxes.	Cleats		
Sheathed crates...	Load-bearing floorboards Top joists	Skids Sills Headers Struts Diagonals Longitudinal framing members Joist supports	Sheathing & nonload bearing floorboards Rubbing strips Sill bridging
Open crates.....	Load-bearing floorboards Skids All other framing members		Rubbing strips Nonload-bearing floorboards
Light duty crates.	Load-bearing floorbearing Skids	Longitudinal framing members Headers Struts Diagonals	Rubbing strips Nonload-bearing floorboards
Pallets.....		Deck boards Stringer boards Stingers Posts	
Blocking & Bracing within containers.	Structural		Nonstructural

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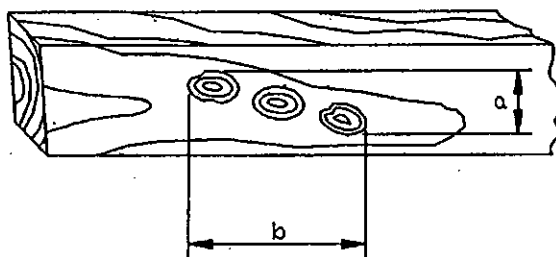
TABLE IV. Wood member classes for component parts of containers and pallets for domestic shipment and use of containers at first destination.

Container	Class 1 structural	Class 2 structural	Class 3 nonstructural
Nailed wood box...		Cleats Battens Tops Bottoms Sides	Ends
Cleated-panel bxs		Cleats	
Wirebound boxes...		Cleats Battens	
Fiberboard-lined boxes		Cleats	Tops Bottoms Sides Ends
Triple-wall boxes.		Cleats	Ends
Sheathed crates...	Load-bearing floorboards	Top joists Skids Sills Headers Longitudinal framing member	Struts Diagonals Sheathing Nonload-bearing floorboards Joist support Rubbing strips Sill bridging
Open crates.....	Load-bearing floorboards	Skids All other framing members	Rubbing strips Nonload-bearing floorboards
Light duty crates.	Load-bearing floorboards	Skids All other framing members	Rubbing strips Nonload-bearing floorboards
Pallets.....		Deck boards Stringer boards Stringers	Posts
Blocking & bracing within containers.	Structural		Nonstructural

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KNOT CLUSTER



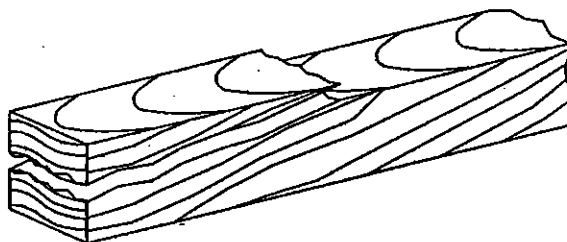
TANDEM KNOTS

Note:

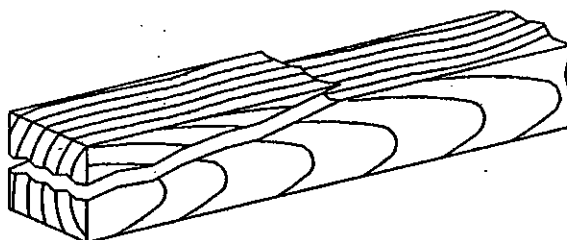
1. The distance a is taken as the width when b is twice the width of the piece or less.

FIGURE 1. Knot clusters and tandem knots.

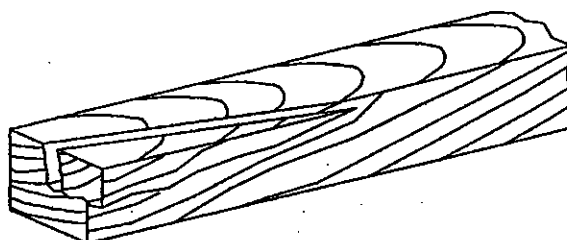
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DIAGONAL GRAIN



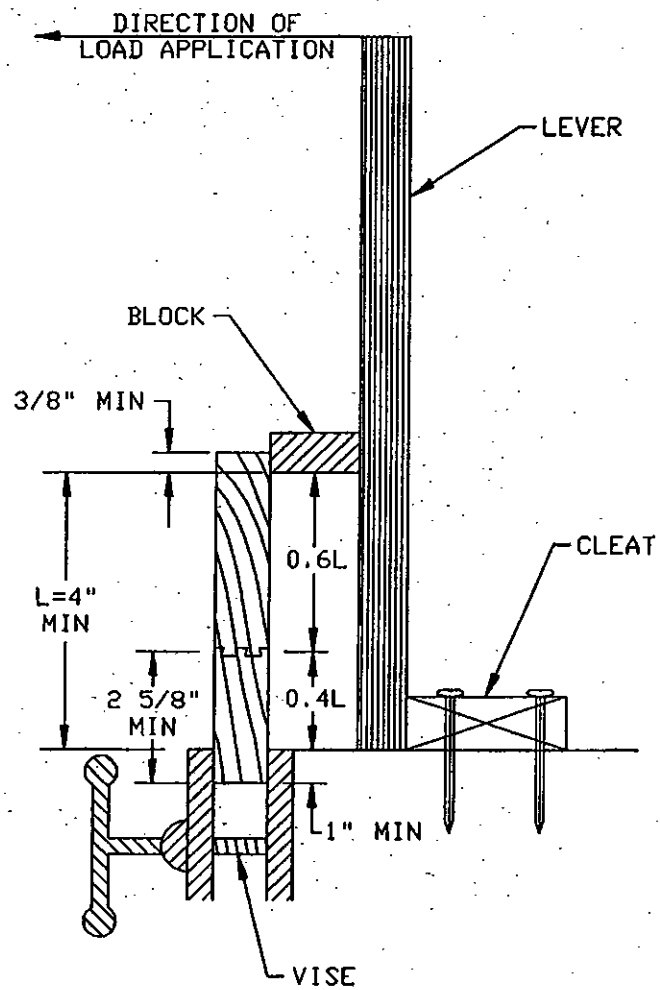
SPIRAL GRAIN



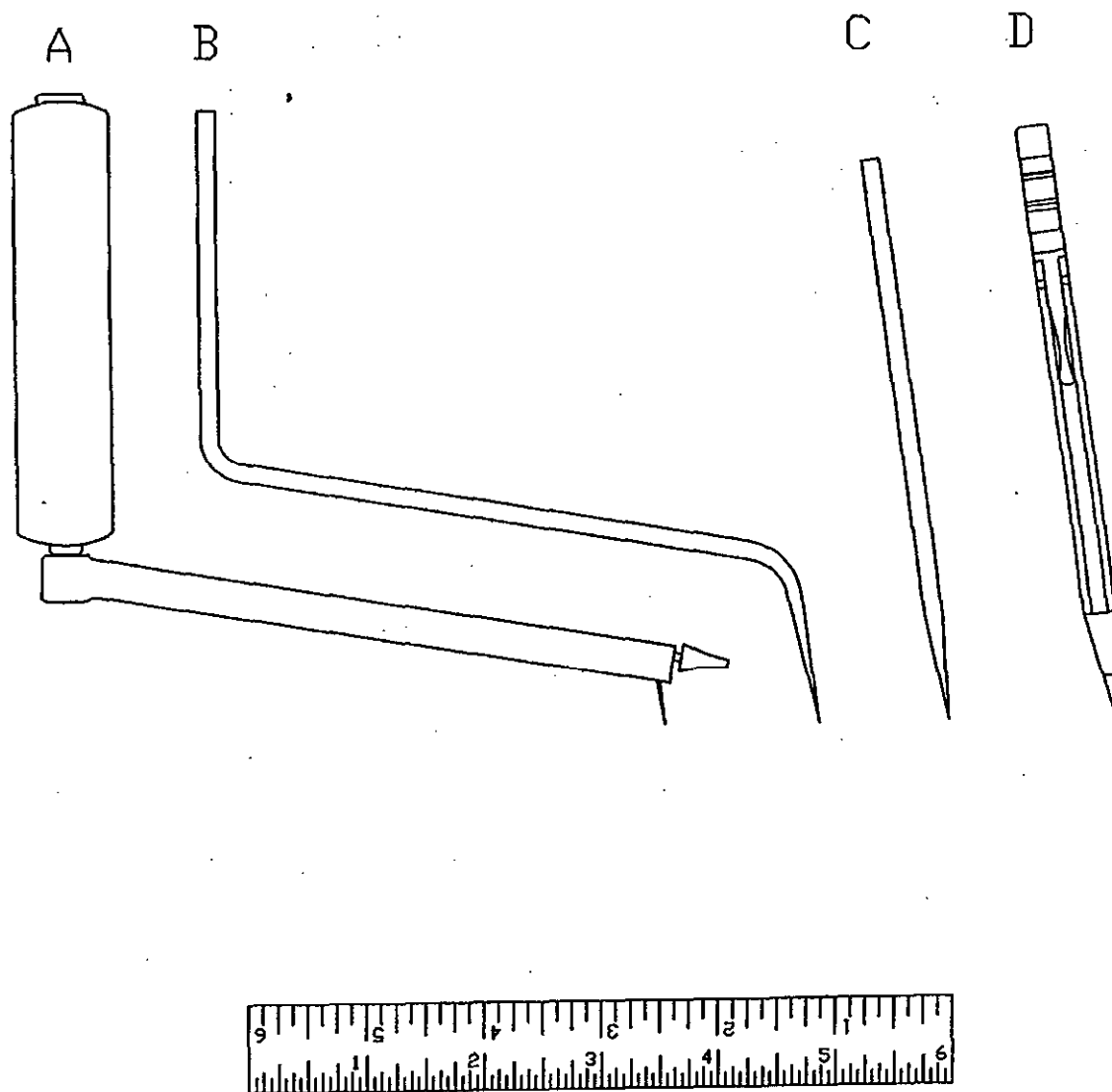
SPIRAL AND DIAGONAL GRAIN  
IN COMBINATION

FIGURE 2. Cross grain.

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FIGURE 3. Setup for testing quality of edge points.

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- A. SWIVEL-HANDLED SCRIBE WITH PHONOGRAPH NEEDLE POINT.  
B. ONE-PIECE DRILL ROD BENT TO SHAPE AND POINT SLIGHTLY HARDENED.  
C. A STRAIGHT PIECE OF DRILL ROD WITH POINT SLIGHTLY HARDENED.  
D. MECHANICAL PENCIL WITH PHONOGRAPH NEEDLE POINT.

FIGURE 4. Scribes for determining direction of the fibers on the surface of wood.



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CONCLUDING MATERIAL

Custodians:

Army - ME

Navy - YD

Air Force - 69

Preparing activity:

Navy - YD

(Project 8115-0511)

Review Activities:

Army - ME, SM, MI, GL

Navy - SA, OS, MC

Air Force - 71, 80

DLA - CS

User Activity:

Navy - SH