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NBS Voluntary Product Standard

PS 1-66

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Softwood Plywood Construction And Industrial

U.S.
DEPARTMENT
OF
COMMERCE

National
Bureau
of Standards

Developed by Producers,
Distributors, and Users
With the Cooperation of the
National Bureau of Standards

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VOLUNTARY PRODUCT STANDARDS

Voluntary Product Standards are standards developed under procedures established by the Department of Commerce (15 CFR Part 10, as amended, May 28, 1970). The standards may include (1) dimensional requirements for standard sizes and types of various products; (2) technical requirements, and (3) methods of testing, grading, and marking. The objective of a **Voluntary Product Standard** is to establish requirements which are in accordance with the principal demands of the industry and, at the same time, are not contrary to the public interest.

Development of a VOLUNTARY PRODUCT STANDARD

The Office of Engineering Standards Services of the National Bureau of Standards has been assigned by the Department of Commerce the responsibility to work closely with scientific and trade associations and organizations, business firms, testing laboratories, and other appropriate groups to develop **Voluntary Product Standards**. The Bureau has the following role in the development process: It (1) provides editorial assistance in the preparation of the standard; (2) supplies such assistance and review as is required to assure the technical soundness of the standard; (3) acts as an unbiased coordinator in the development of the standard; (4) sees that the standard is representative of the views of producers, distributors, and users or consumers; (5) seeks satisfactory adjustment of valid points of disagreement; (6) determines the compliance with the criteria established in the Department's procedures cited above; and (7) publishes the standard.

Industry customarily (1) initiates and participates in the development of a standard; (2) provides technical counsel on a standard; and (3) promotes the use of, and support for, the standard. (A group interested in developing a **Voluntary Product Standard** may submit a written request to the Office of Engineering Standards Services, National Bureau of Standards, Washington, D.C. 20234.)

A draft of a proposed standard is developed in consultation with interested trade groups. Subsequently, a Standard Review Committee is established to review the proposed standard. The committee, appropriately balanced, includes qualified representatives of producers, distributors, and users or consumers of the product being standardized. When the committee approves a proposal, copies are distributed for industry consideration and acceptance. When the acceptances show general industry agreement, and when there is no substantive objection deemed valid by the Bureau, the Bureau announces approval of the **Voluntary Product Standard** and proceeds with its publication.

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The adoption and use of a **Voluntary Product Standard** is completely voluntary. **Voluntary Product Standards** have been used most effectively in conjunction with legal documents such as sales contracts, purchase orders, and building codes. When a standard is made part of such a document, compliance with the standard is enforceable by the purchaser or the seller along with other provisions of the document.

Voluntary Product Standards are useful and helpful to purchasers, manufacturers, and distributors. Purchasers may order products that comply with **Voluntary Product Standards** and determine for themselves that their requirements are met. Manufacturers and distributors may refer to the standards in sales catalogs, advertising, invoices, and labels on their product. Commercial inspection and testing programs may also be employed, together with grade labels and certificates assuring compliance, to promote even greater public confidence. Such assurance of compliance promotes better understanding between purchasers and sellers.

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Voluntary Product Standard PS 1-66

(Supersedes CS 45-60, CS 122-60, and CS 259-63)

SOFTWOOD PLYWOOD, CONSTRUCTION AND INDUSTRIAL

Effective November 1, 1966 (See page 24.)

(This voluntary Standard, initiated by the American Plywood Association, has been developed under the **Procedures for the Development of Voluntary Product Standards**, published by the Department of Commerce, as a revision and consolidation of Commercial Standards CS 45-60, CS 122-60, and CS 259-63. See **History of Project** for further information.)

Reprinted July, 1970 to include Amendments 1 through 6

1. Purpose

1.1—The purpose of this Product Standard is to establish nationally recognized standards of quality for the principal types, grades and sizes of construction and industrial plywood made primarily from species of softwood timber.¹ General adoption and use of this voluntary Standard throughout the industry should provide a better understanding between buyer and seller, and thereby facilitate marketing and procurement. Architects, engineers, home builders, retailers, contractors, industrial users, and home owners will also be able to specify the proper item for their needs by the use of nationally recognized quality standards.

1.2 Definition—Softwood plywood is a flat panel, built-up generally of an odd number of thin sheets or veneers of wood in which the grain direction of each ply or layer is at right angles to the one adjacent to it. Face and back plies and all odd numbered plies generally are oriented with grain direction parallel to the long dimension of the panel. The sheets of veneer are united under pressure by a bonding agent to create a laminated panel with an adhesive bond as strong as, or stronger than, the wood. The alternating of the direction of the grain of each contiguous layer of wood veneer and the odd numbered plies equalizes the strains, and minimizes shrinkage and warping of the panel and prevents splitting. Overlaid plywood is produced in a like manner with special resin treated surfacing material added over the panel faces. Throughout this Product Standard the term "plywood" is understood to mean all plywood to which this Standard applies. Panels not conforming to all provisions of this Product Standard are beyond the scope of the standard.

2. Scope and Classification

2.1 Scope—This Product Standard covers the principal types, grades and sizes of plywood. Requirements are specified for wood species, veneer grading, overlays, glue bond, panel construction, moisture content, dimensions and tolerances, as well as

(1) This Product Standard also covers construction and industrial hardwood plywood of red and white lauan (Philippine mahogany), tanoak, red alder and Western poplar all produced with face veneers meeting minimum thickness requirements of paragraph 3.3.6. For appearance and other grades of hardwood plywood, see latest edition of Commercial Standard CS35, Hardwood Plywood. Grading rules for appearance grades of ponderosa pine, sugar pine, and Idaho white pine are given in the latest edition of Commercial Standard CS157.

sampling and inspection procedures, test methods to determine compliance, and a glossary of trade terms and definitions. A quality certification program is provided for herein, whereby qualified testing agencies inspect, sample and test products identified as complying with this Standard.

2.2 Classification of Standard Grades and Common Uses—Table 1 lists the standard grades of plywood that are commonly used for the various applications indicated. For reasons of convenience, availability, and individual end-use considerations, grades other than those listed for a specific application are often used. For more complete information on uses, see Appendix A1.

2.2.1 Wood Species—Plywood produced under this Product Standard is available in five species classifications, Groups 1, 2, 3, 4, and 5. The species used for the face and back plies is at the option of the manufacturer and may be from any group. See paragraph 3.2.1 for panel group classification. (The species covered in each group are listed in Table 2. In addition, other softwood or hardwood species having an average specific gravity of 0.41 or more, based on green volume and oven dry weight, may be used for inner plies as provided in paragraph 3.2.2.) (As amended 9/20/69, and 5/10/70.)

2.3 Types—Plywood covered by this Product Standard is classified into two types, Interior and Exterior. Type refers to the exposure capability of the panel, which is a function of veneer grade and adhesive durability. Within each type there are a number of panel grades based on the quality of the veneers of the panel. Additionally, there are three levels of adhesive durability within the Interior type classification. (As amended 6/30/69.)

2.3.1 Interior Types—The grades of Interior type plywood generally available are given in Table 3. Adhesive quality levels for Interior types of plywood are as follows and are listed in increasing order of durability:

- (a) Bonded with Interior glue. Plywood of this type is moisture resistant. It is intended for all interior applications where it may be temporarily exposed to the elements. Adhesive performance requirements are provided in paragraphs 3.6.1 and 4.3.

Table 1. General Applications and Corresponding Grades of Softwood Plywood Commonly Used

Typical Applications	Grades Commonly Used	
	Interior Type	Exterior Type
CONSTRUCTION Cabinets, Built-ins	N-N, N-A, N-B, A-A, A-B, A-D	High Density Overlay, Medium Density Overlay, A-C
Concrete Forms	—	High Density Concrete Form Overlay Class I and Class II B-B Concrete Form Class I and II
Engineered Components, Box Beams, Stressed Skin Panels, etc.	STRUCTURAL I C-D STRUCTURAL II C-D { Bonded with Exterior glue }	STRUCTURAL I A-C ¹
Farm Structures	—	A-C, B-C, C-C (Plugged), C-C
Paneling	N-D, A-D, Decorative Panels ²	—
Sheathing, Wall and Roof and Subflooring	STANDARD, STANDARD with Exterior glue, C-D (Plugged)	C-C, C-C (Plugged)
Siding Soffits	—	Medium Density Overlay, A-C Decorative Panels ²
Underlayment	Underlayment	C-C (Plugged)
INDUSTRIAL Agricultural Equipment	—	High Density Overlay, A-A, A-B, A-C, B-C, C-C (Plugged), C-C
Containers, Crates, Pallets, Tote Bins	STANDARD, STANDARD with Exterior glue, C-D (Plugged)	B-C, C-C (Plugged), C-C
Linings, Box Car and Truck	—	A-C, B-C, C-C (Plugged)
Marine	—	Marine (A-A, A-B, B-B, High Density Overlay and Medium Density Overlay), A-A, A-B
Shelving	A-D, B-D, C-D (Plugged)	—
Signs	—	High Density Overlay, Medium Density Overlay, A-A, A-B
Tanks	—	High Density Overlay, A-A, A-B, A-C

(1) Produced in all standard grades in STRUCTURAL I only.
 (2) Decorative panels are described in paragraph 3.4.2.

- (b) Bonded with Intermediate glue (moisture resistance lower than Exterior but greater than Interior). Plywood of this quality is bonded with adhesives that possess high level bacteria, mold and moisture resistance. It is suitable for protected construction and industrial uses where moderate delays in providing protection may be expected or conditions of high humidity and water leakage may exist. Adhesive performance requirements are provided in paragraphs 3.6.2 and 4.4.
- (c) Bonded with Exterior glue. Plywood of this quality is produced with D grade veneer or better for inner plies and backs where specified and is bonded with a waterproof adhesive. It is intended for protected construction and industrial uses where maximum performance

is required for protection against moisture exposure from long construction delays, or other conditions of similar severity. Adhesive performance requirements are provided in paragraphs 3.6.3 and 4.5. (As amended 6/30/69.)

2.3.2 Exterior Type – Plywood of this type is produced with C grade veneers or better throughout and is bonded with a completely waterproof adhesive. It is a plywood that will retain its glue bond when repeatedly wetted and dried or otherwise subjected to the weather, and is, therefore, intended for permanent exterior exposure. Adhesive performance requirements are provided in paragraphs 3.6.4 and 4.5. (The grades of Exterior type plywood generally available are given in Table 4. Additional premium grades of Exterior plywood are described in paragraph 3.4.) (As amended 6/30/69.)

2.3.2.1 Overlaid Plywood—Overlaid plywood is Exterior type plywood covered by this Product Standard to which has been added a resin-treated fiber surfacing material on one or both sides. It is made in two standard categories, "High Density" and "Medium Density," and a "Special" category (see paragraph 3.5.3), all of which refer to the surfacing materials. The overlay surfaces are permanently fused to the base panel under heat and pressure. Although designed for all types of moisture exposure and service, all overlaid plywood is made only in the Exterior type. This refers to the base panel and to the overlay itself. (Table 4 lists the standard grades of overlaid plywood generally available.)

2.4 Standard Sizes—Plywood is generally available in panel widths of 36, 48 and 60 inches, and in panel lengths ranging from 60 inches to 144 inches in

12-inch increments. Other sizes are also available on special order. Panels 48 inches wide by 96 inches long (4' by 8'), and 48 inches wide by 120 inches long (4' by 10'), are most commonly available.

2.5 Thickness—Nominal thicknesses of sanded panels range from 1/4 inch to 1-1/4 inches and greater, generally in 1/8 inch increments. Unsanded panels are available in nominal thicknesses of 5/16 inch to 1-1/4 inches or greater, in increments of 1/8 inch for thicknesses over 3/8 inch. Under 3/8 inch, thicknesses are in 1/16 inch increments. Tolerances are as provided in paragraph 3.9.1.

2.6 Number of Plys (standard construction)—The minimum number of plys (veneer layers) used in panels of standard commercial construction are given in paragraph 3.10.

Table 2. Classification of Species (As amended 9/20/69, and 3/20/70.)

Group 1	Group 2	Group 3	Group 4	Group 5	
Birch Yellow Sweet Douglas Fir 1 Larch, Western Maple, Sugar Pine, Caribbean Pine, Southern Loblolly Longleaf Shortleaf Slash Tanoak	Cedar, Port Orford Douglas Fir 2 Fir California Red Grand Noble Pacific Silver White Hemlock, Western Lauan Red Tangile White Almon Bagtikan	Maple, Black Meranti Mengkulang Pine Pond Red Western white Spruce, Sitka Sweet Gum Tamarack	Alder, Red Cedar Alaska Pine Jack Lodgepole Ponderosa Spruce Redwood Spruce Black Red White	Aspen Bigtooth Quaking Birch, Paper Cedar Incense Western Red Fir, Subalpine Hemlock, Eastern Pine Sugar Eastern White *Poplar, Western Spruce, Engelmann	Fir, Balsam Poplar, Balsam

* Black Cottonwood

3. Requirements

3.1 General—All plywood panels represented as conforming to this Product Standard shall meet or exceed all applicable requirements set forth in this section. Required test methods are given in Section 4. All Product Standard terms are defined in Section 5. Requirements for grademarking and certification are given in Section 6.

3.2 Wood Species

3.2.1 Species for faces and backs—For purposes of this Product Standard, veneer species are classified into the five groups given in Table 2. The species of face and back plys may be from any group. However, when a face or back is made of more than one piece, the entire ply shall be of the same species. Panels, other than sheathing, which are produced with face and back veneers of the same species group shall be classified as being of that species group. Sanded, touch-sanded and decorative panels manufactured with face and back plys of different species groups shall be classified and identified by the higher

numbered species group (e.g., Group 4 is higher numbered than Group 1). The species classification group (except for sheathing) shall be set forth in the grademark on each panel. See paragraph 3.7.5 for sheathing identification requirements. Where intermixing between species groups occurs in the faces and backs of sheathing panels, the Identification Index corresponding to the higher numbered species group shall be used to identify the panels. Douglas fir, for the purpose of this Product Standard, shall be classed as Douglas fir No. 1 and Douglas fir No. 2. Douglas fir from trees grown in the states of Washington, Oregon, California, Idaho, Montana, Wyoming, and the Canadian Provinces of Alberta and British Columbia shall be classed as Douglas fir No. 1. Douglas fir from trees grown in the states of Nevada, Utah, Colorado, Arizona and New Mexico shall be classed as Douglas fir No. 2. Southern pine is defined, for the purpose of this Product Standard, as slash (*Pinus elliotii*), longleaf (*Pinus palustris*), shortleaf (*Pinus echinata*), and loblolly (*Pinus taeda*) pines.

Because black, white, and Engelmann spruce cannot be separated in veneer form by gross structure or minute anatomy, these species shall be classed as Engelmann spruce unless procedures are established for identification prior to peeling. (As amended 9/20/69, and 5/10/70.)

3.2.2 Species for Inner Plys—Inner plys of Groups 1, 2, 3, and 4 panels may be of any species listed in Groups 1, 2, 3, or 4 in Table 2, or of any softwood species or any hardwood species having a published² average specific gravity value of 0.41 or more based on green volume and oven dry weight except as required for premium panels in paragraph 3.4.

(As amended 9/20/69.)

3.3 Grade description of veneers—All veneers used in the construction of the plywood panels shall conform to one of the below listed grade requirements of which N grade is the highest classification. The standard combination of these veneers into the various panel grades shall be as provided in Tables 3 and 4 and in the premium grades as described in paragraph 3.4. The terms used shall be interpreted as described in Section 5, Nomenclature and Definitions.

3.3.1 Grade N Veneer (Intended for natural finish)

General

Shall be—smoothly cut 100% heartwood or 100% sapwood, free from knots, knotholes, pitch pockets, open splits, other open defects, and stain.

—of not more than two pieces in 48" width; not more than three pieces in wider panels.

—well matched for color and grain with joint parallel to edges when of more than one piece.

Permits—suitable synthetic fillers to fill:

- (a) Small cracks or checks not more than 1/32" wide.
- (b) Small splits or openings up to 1/16" wide if not exceeding 2" in length.
- (c) Small chipped areas or openings not more than 1/8" wide by 1/4" long.

Growth Characteristics

Permits—pitch streaks averaging not more than 3/8" in width and blending with color of wood.

Repairs

Shall be—neatly made and parallel to grain.

—limited to a total of six in number in any 4-foot by 8-foot face, with proportionate limits for other

(2) The Forest Products Laboratory will be considered as final evaluator of data.

sizes.

—well matched for color and grain.

Permits—patches limited to three "router" patches not exceeding 3/4" in width and 3-1/2" in length.

—no overlapping.

—wood shims not exceeding 12" in length that occur only at the ends of the panel.

3.3.2 Grade A Veneer (Suitable for painting)

General

Shall be—firm, smoothly cut and free from knots, pitch pockets, open splits, and other open defects.

—well joined when of more than one piece.

Permits—suitable synthetic fillers to fill:

- (a) small cracks or checks not more than 1/32" wide.
- (b) small splits or openings up to 1/16" wide, if not exceeding 2" in length.
- (c) small chipped areas or openings not more than 1/8" wide by 1/4" long.

Growth Characteristics

Permits—pitch streaks averaging not more than 3/8" in width, blending with color of wood.

—sapwood.

—discolorations.

Repairs

Shall be—neatly made and parallel to grain, limited to a total of 18 in number, excluding shims, in any 4-foot by 8-foot face; proportionate limit on other sizes.

Permits—patches:

- (a) which are "boat," "router" and "sled" type only, including die-cut patches if edges are cut clean and sharp. Radius of ends of boat patches shall not exceed 1/8".
 - (b) not exceeding 2-1/4" in width singly.
 - (c) multiple, consisting of not more than two patches, neither of which may exceed 7" in length if either is wider than 1".
- shims, except over or around patches or as multiple repairs.³

3.3.3 Grade B Veneer

General

Shall be—solid and free from open defects and torn grain except as noted.

(3) Only wood shims shall be admitted in Interior type panels. Synthetic shims shall completely fill kerfs or voids; shall present a smooth, level surface; and shall not crack, shrink or lose their bond under Exterior type plywood test exposures described in paragraphs 4.5.2 and 4.5.3. Performance of synthetic shims under normal conditions of service shall be comparable to that of wood shims.

Permits—slightly rough grain.

—minor sanding and patching defects, including sander skips not exceeding 5% of panel area.

—suitable synthetic fillers to fill:

(a) small splits or openings up to 1/16" wide if not exceeding 2" in length.

(b) small chipped areas or openings not more than 1/8" wide by 1/4" long.

Growth Characteristics

Permits—knots up to 1" measured across the grain if both sound and tight.

—pitch streaks averaging not more than 1" in width.

—discolorations.

Open Defects

Permits—splits not wider than 1/32".

—vertical holes not exceeding 1/16" in diameter if not exceeding an average of one per square foot in number.

—horizontal or surface tunnels limited to 1/16" across, 1" in length, and to 12 in number in a 4-foot by 8-foot panel, or proportionately in panels of other dimensions.

Repairs

Shall be—neatly made.

Permits—patches ("boat," "router," and "sled") not exceeding 3" in width individually where occurring in multiple repairs, or 4" in width where occurring singly.

—plugs (circular, "dog bone" and leaf shaped) not exceeding 3" in width individually where occurring in multiple repairs, or 4" in width where occurring singly.

—shims.⁴

—synthetic plugs not exceeding above dimensions which present solid, level, hard surface. Performance under normal conditions of service shall be comparable to that of wood plugs.

3.3.4 Grade C Veneer

General

Permits—sanding defects that will not impair the strength or serviceability of the panel.

See also paragraphs 3.7.2, 3.7.3 and 3.7.4.

(4) Synthetic shims shall completely fill kerfs or voids; shall present a smooth, level surface; and shall not crack, shrink or lose their bond under Exterior type plywood test exposures described in paragraphs 4.5.2 and 4.5.3. Performance of synthetic shims under normal conditions of service shall be comparable to that of wood shims.

Growth Characteristics

Permits—knots if tight and not more than 1-1/2" across grain.

—discolorations.

Open Defects

Permits—knotholes up to 1" measured across the grain; an occasional knothole more than 1" but not more than 1-1/2" measured across the grain, occurring in any section 12" along the grain in which the aggregate width of all knots and knot-holes occurring wholly within the section does not exceed 6" in a 48" width, and proportionately for other widths.

—open pitch pockets not wider than 1".

—splits, required to taper to a point:

1/2" by one-half panel length.

3/8" by any panel length.

1/4" maximum width where located within 1" of parallel panel edge.

—borer holes not more than 5/8" wide and 1-1/2" long.

Repairs

Shall be—neatly made.

Permits—patches (boat, including die cut) not exceeding 3" in width individually where occurring in multiple repairs, or 4" in width where occurring singly.

—plugs (circular, "dog bone" and leaf shaped) not exceeding 3" in width individually where occurring in multiple repairs or 4" in width where occurring singly.

—shims including synthetic as provided for in B grade.

—synthetic plugs not exceeding above dimensions which present solid, level, hard surface. Performance under normal conditions of service shall be comparable to that of wood plugs.

3.3.4.1 C-Plugged Veneer—(Veneer used for faces of Underlayment, C-D (Plugged) and C-C (Plugged) grades, and inner plies of overlaid panels and other products if specified). This veneer may contain knot-holes, worm and borer holes, and other open defects not larger than 1/4" by 1/2", sound and tight knots up to 1-1/2" measured across the grain, splits up to 1/8" wide, ruptured and torn grain, pitch pockets, if solid and tight, plugs, patches, and shims. Where grades having C-Plugged face veneer are specified as fully sanded, sanding defects shall be the same as admitted under B grade.

3.3.5 Grade D Veneer

General

Permits—except as otherwise specified, any number of plugs, patches, shims, worm or borer holes, sanding defects, and other characteristics, provided they do not seriously impair the strength or serviceability of the panels.

See also paragraphs 3.7.2, 3.7.3. and 3.7.4.

Growth Characteristics

Permits—tight knots in inner plys.

—in D grade backs, tight knots not larger than 2-1/2" measured across the grain.

—in D grade backs, an occasional tight knot larger than 2-1/2" but not larger than 3" measured across the grain, occurring in any section 12" along the grain in which the aggregate width of all knots and knotholes occurring wholly within the section does not exceed 10" in a 48" width and proportionately for other widths.

Open Defects

Permits—knotholes up to 2-1/2" in maximum dimension; an occasional knothole larger than 2-1/2" but not larger than 3" maximum dimension occurring in any section 12" along the grain in which the aggregate width of all knots and knotholes occurring wholly within the section does not exceed 10" in a 48" width, and proportionately for other widths.

—in sanded panels, knotholes shall not exceed 2-1/2" in maximum dimension in veneer thicker than 1/8".

—knotholes not exceeding 3-1/2" in maximum dimension in center ply only of 5-ply STANDARD and C-D (Plugged) grades.

—pitch pockets not exceeding 2-1/2" measured across the grain.

—splits, required to taper to a point:

—Up to 1".

—In backs only, not more than one exceeding 1/2".

—Not exceeding 1/4" maximum width where located within 1" of parallel panel edge.

White Pocket

Any area 24" wide across the grain and 12" long, in which light or heavy white pocket occurs, shall not contain more than three of the following characteristics, in any combination:

(a) 6" width of heavy white pocket.

(b) 12" width of light white pocket.

(c) One knot or knothole, 1-1/2" to 2-1/2", or two knots or knotholes, 1" to 1-1/2"; knots or knotholes less than 1" shall not be considered. Sizes of any knot or knothole shall be measured in greatest dimension. Any repair in white pocket area shall be treated for grading purposes as a knothole.

3.3.6 Veneer Thickness—Except as noted below, veneers shall be 1/10" or thicker in panels 3/8" rough (unsanded) thickness or over; 1/12" or thicker in panels of lesser thickness. Veneers 1/16" or thicker may be used in 5-ply, 3/8" Exterior type panels, and as centers only in other 5-ply panels. Veneers 1/12" or thicker may be used as core in 5-ply 1/2" panels. In no case, however, shall veneers be thicker than 1/4". The average veneer thickness shall conform to the limitations given in this Product Standard within a tolerance of 5% of the specified nominal thicknesses measured dry before layup.

3.3.7 Scarfed Veneers—Scarfed veneer may be used for any face, back, or inner ply except as provided in paragraph 3.8. Scarfed joints shall not have a slope steeper than 1 to 8, but may be specified at less than 1 to 8. Veneer in the scarf area shall not contain defects which reduce its effective cross section by more than 20%. Veneer scarfed joints shall be glued with a waterproof adhesive.

3.4 Premium Grades

3.4.1 Marine Exterior Plywood—Marine Exterior grade shall be of Exterior type meeting applicable requirements of this Product Standard, and of one of the following grades: A-A, A-B, B-B, High Density Overlay, or Medium Density Overlay, all as modified below for "Marine Exterior" plywood.

Only Douglas fir 1 and Western larch veneers shall be used.

veneers—"A" faces shall be limited to a total of 9 single repairs in a 4-foot by 8-foot sheet, or to a proportionate number in any other size as manufactured.

"B" faces or backs where specified, and all inner plys, shall conform to "B" quality veneer requirements and shall be full length and width.

All patches shall be glued with an adhesive meeting Exterior type performance requirements of this Product Standard and, in addition, shall be set in the panel using a technique involving both heat and pressure.

EDGE-GRAIN JOINTS—When the inner ply veneers consist of two or more pieces of veneer, the edges shall be straight and square without lapping.

CORE-GAPS AND EDGE-SPLITS—Neither edge of a panel shall have any core-gap or edge-split in excess of 1/8" wide. Core-gaps and edge-splits per 8 feet of crossband layer shall not exceed four in number. End splits and gaps on either end of a panel shall not exceed 1/8" in aggregate width.

Filling of core-gaps and edge-splits with materials that serve to conceal the gaps or splits is prohibited.

3.4.2 Decorative Panels—Specialty panels with decorative face veneer treatments in the form of striations, grooving, embossing, brushing, etc., which, except for the special face treatment, meet all of the requirements of this Product Standard, including veneer qualities, glue bond performance and workmanship, shall be considered as conforming to the Standard.

3.4.3 Exterior B-B (Concrete Form) Panels—A panel especially made for general concrete form use. Face veneers shall be not less than B grade and shall always be from the same species group. Inner plys shall be not less than C grade. (See Table 4 for veneer grade limitations of High Density overlaid concrete form panels.) This grade of plywood is produced in two classes and panels of each class shall be identified accordingly. Panels shall be sanded two sides, edge-sealed and, unless otherwise specified, mill-oiled. Species shall be limited as follows and are applicable also to High Density overlaid exterior concrete form panels: (See also paragraph 3.2.1.)

Class I—Faces of any Group 1 species, core of any Group 1 or Group 2 species, and centers of any Group 1, 2, 3 or 4 species.

Class II—Faces of any Group 1 or Group 2 species, and core and centers of any Group 1, 2, 3 or 4 species, or, faces of Group 3 species of 1/8" minimum thickness before sanding core of any Group 1, 2, or 3 species, and centers of any Group 1, 2, 3 or 4 species.

3.4.4 Structural Grade Panels—Panels especially designed for engineered applications such as structural components where design properties including tension, compression, shear, cross-panel flexural properties and nail bearing may be of significant importance. In addition to the special species, grade

(5) See Section 5, Nomenclature and Definitions.

and glue bond requirements set forth below, all other provisions of this Product Standard for the specific types and grades form a part of the specifications for Structural panels. (See also paragraph 3.2.1.)

Grade	Glue Bond	Species
STRUCTURAL I, C-D ¹	(See footnote 3)	Face, back and all inner plys limited to Group 1 species.
STRUCTURAL II, C-D ¹	(See footnote 3)	Face, back and all inner plys may be of any Group 1, 2 or 3 species.
STRUCTURAL I, A-C ²	Exterior	Face, back and all inner plys limited to Group 1 species.

- (1) Special limitations applying to STRUCTURAL C-D grade panels are:
- White pocket in any area larger than the size of the largest knothole, pitch pocket, or split specifically permitted in D grade shall not be permitted in any ply.
 - Sound, tight knots shall not exceed 2-1/2" measured across the grain, except as provided in Tables 5 and 6.
 - Plugs (circular, "dog bone," and leaf shaped), including multiple repairs shall not exceed 4" in width.
 - Panels 1/2" and greater in thickness shall consist of a minimum of 5 plys.
 - See also paragraph 3.7.2.

- (2) Produced also in all standard Exterior grades in STRUCTURAL I only.

- (3) STRUCTURAL C-D shall be bonded with an adhesive identical to those used for Exterior plywood and meet the performance requirements of paragraph 3.6.3 when tested in accordance with paragraph 4.5. Panels shall be clearly identified as "STRUCTURAL I" or "STRUCTURAL II."

3.4.5 Interior Type bonded with Exterior glue—Regular Interior plywood bonded to meet the requirements for STRUCTURAL C-D. See paragraph 3.6.3. (As amended 6/30/69.)

3.4.6 Special Exterior. A premium panel of Exterior type that may be produced of any specified species covered by this Product Standard. It shall otherwise meet all of the requirements for Marine Exterior (See paragraph 3.4.1) and be produced in one of the following grades: A-A, A-B, B-B, High Density Overlay, or Medium Density Overlay.

3.5 Overlays—The standard grades of overlaid plywood are listed in Table 4. The overlays shall conform to the following requirements:

3.5.1 High Density—The surfacing on the finished product shall be hard, smooth, and of such character that further finishing by paint or varnish is not necessary. It shall consist of a cellulose-fiber sheet or sheets, containing not less than 45% resin solids based on a volatile-free weight of fiber and resin. The resin shall be a thermo-setting phenol or melamine type. The total resin-impregnated materials

for each face shall be not less than 0.012 inch thick before pressing and shall weigh not less than 60 lbs. per 1,000 sq. ft., including both resin and fiber. The resin impregnation shall be sufficient to make a continuous bond without voids or blisters between the surfacing material and the plywood. The overlay face is usually produced in natural translucent color, but certain other colors may be used by manufacturers for identification.

3.5.2 Medium Density—The resin-treated facing on the finished product shall present a smooth, uniform surface intended for high-quality paint finishes. It shall consist of a cellulose-fiber sheet containing not less than 17% resin solids for a beater loaded sheet, or 22% for an impregnated sheet, both based on the volatile free weight of resin and fiber exclusive of glueline. The resin shall be a thermo-setting phenol or melamine type. The resin-treated material shall weigh not less than 58 lbs. per 1,000 sq. ft. of single face including both resin and fiber but exclusive of glueline. After application, the material shall measure not less than 0.012 inch thick. Some evidence of the underlying grain may appear. The overlay face is produced in a natural color and certain other colors.

3.5.3 Special Overlays—Surfacing materials having special characteristics which do not fit the exact description of High Density or Medium Density types as outlined in paragraphs 3.5.1 and 3.5.2. These must meet the test requirements of Section 4 for overlaid plywood, and paragraph 2.3.2.1 as to the durability of the surface material, and panels shall be identified as "Special Overlay."

3.6 Adhesive Bond Requirements

3.6.1 Interior Type Panels—When tested in accordance with paragraph 4.3, panels shall be evaluated for conformance with the Product Standard in the following manner:

Underlayment, C-D Plugged, and STANDARD:

A panel shall be classed as failing if more than two of the five test specimens fail. The material represented by the sampling shall be considered as meeting the requirements of this Product Standard if no more than two of the twenty panels are classed as failures.

All Other Grades:

Eighty-five per cent of all test specimens shall pass the test described in paragraph 4.3.

If these requirements are satisfied, the panels represented by the sampling shall be considered as meeting the requirements of the Product Standard.

3.6.1.1 Mold Resistance — Underlayment, C-D (Plugged), and STANDARD shall be made with an adhesive possessing a mold resistance equivalent to that created by adding, to plain protein glue, five pounds of pentachlorophenol or its sodium salt per 100 pounds of dry glue base. The equivalency shall be established by testing and evaluation in accordance with "Mold Testing Procedures and Approved Requirements" published by the American Plywood Association. This procedure is specifically designed for adhesive qualification approval and is not applicable to inspection and testing, as covered in Section 4.

3.6.1.2 Resistance to Elevated Temperature—Underlayment, C-D (Plugged) and STANDARD shall be made with an adhesive possessing resistance to temperatures up to 160°F at least equal to that of plain protein glue. Urea resin glue shall not be used in these grades unless evidence is submitted indicating performance equivalent to plain protein glues.

3.6.2 Interior Type bonded with Intermediate glue—When tested in accordance with paragraph 4.4, Interior plywood bonded with Intermediate glue shall be considered as meeting the requirements of this Product Standard if all of the following minimum conditions are met:

1. Test specimens average 45% wood failure.
2. At least 90% of the panels as represented by the test pieces show 30% wood failure or better.

Specimens cut through localized defects permitted in the grade shall be discarded. Test specimens showing delamination in excess of 1/8 inch deep and one inch long shall be rated as 0% wood failure. (As amended 6/30/69.)

3.6.2.1 Intermediate glue heat durability—Requirements shall be the same as for Exterior glue. See paragraph 3.6.4.1. (As amended 6/30/69.)

3.6.2.2 Bacteria-mold resistance — Plywood bonded with Intermediate glue shall be made with an adhesive possessing a high degree of resistance to attack by bacteria and mold organisms. Adhesives, in order to qualify as Intermediate glue, must meet the "Bacteria Test" requirements as published by

the American Plywood Association. This procedure is specifically designed for adhesive qualification and is not applicable to inspection and testing, as covered in Section 4. (As amended 6/30/69.)

3.6.3 STRUCTURAL C-D—When tested in accordance with paragraph 4.5, STRUCTURAL C-D plywood shall be considered as meeting the requirements of this Product Standard if all of the following minimum conditions are met:

1. Test specimens average 80% wood failure
2. At least 90% of the panels as represented by the test pieces show 60% wood failure or better
3. At least 95% of the panels as represented by the test pieces show 30% wood failure or better.

The above requirements are applicable separately and independently to the results obtained from the vacuum-pressure test and the boiling test. Specimens cut through localized defects permitted in the grade shall be discarded. Test specimens showing delamination in excess of 1/8 inch deep and 1 inch long shall be rated as 0% wood failure.

3.6.4 Exterior Type—When tested in accordance with paragraph 4.5, Exterior type plywood shall be considered as meeting the requirements of this Product Standard if all of the following minimum conditions are met:

1. Test specimens average 85% wood failure.
2. At least 75% of the panels as represented by the test pieces show 80% wood failure or better.
3. At least 90% of the panels as represented by the test pieces show 60% wood failure or better.
4. At least 95% of the panels as represented by the test pieces show 30% wood failure or better.

The above requirements are applicable separately and independently to the results obtained from the vacuum-pressure test and the boiling test. Specimens cut through localized defects permitted in the grade shall be discarded. Test specimens showing delamination in excess of 1/8 inch deep and 1 inch long shall be rated as 0% wood failure.

3.6.4.1 Exterior glue heat durability—Plywood shall be tested as described in 4.5.4. Any delamination due to combustion shall be considered as failure, except when occurring at a localized defect permitted in the grade. When testing overlaid plywood, blisters or bubbles in the surface caused by combustion shall not be considered delamination.

(As amended 6/30/69.)

3.6.4.2 Overlaid plywood—The bond between veneers of overlaid plywood as well as the bond between the overlay and the base panel shall meet the wood failure requirements described above for Exterior. In evaluating specimens for separation of resin-treated face from the plywood, fiber failure shall be considered the same as wood failure.

3.7 Panel construction and workmanship—Plywood shall be clean, well manufactured, and free from blisters, laps and other defects, except as expressly permitted herein. End butt joints are prohibited in any veneer. Panels shall have no continuous holes or through openings from face to back.

Plywood panels shall be constructed in the grades and veneer combinations as provided in Tables 3 and 4. All terms used herein shall be interpreted as described in Section 5. The grain of all plies shall be at right angles to the grain of adjacent plies and to the ends or edges of the panel. The entire area of each contacting surface of the adjacent veneer plies including repairs shall be bonded with an adhesive in a manner to assure satisfactory compliance with the performance requirements for its type as set forth in the tests described in Section 4. No tape shall occur in any glueline. Where face plies consist of more than one piece of veneer, gaps between adjacent pieces shall be graded as splits. Any adhesive or bonding system that causes degradation of the wood or latent failure of bond will not be permitted.

Shims or strips of veneer shall not be used to repair panel edge voids. However, filling with approved synthetic fillers neatly applied will be admitted. Staples are prohibited. Exposed veneer (faces) on both sides of panel shall have the bark or tight surface out. Plies directly under surfaces of overlaid panels are not considered exposed veneers.

3.7.1 Core gaps and center gaps—Core gaps or center gaps, except as noted for plugged core and jointed core shall not exceed 1 inch in width for a depth of 8 inches (measured from panel edge) and the average of all gaps occurring in a panel shall not exceed 1/2 inch. Every effort shall be made to produce closely-buttet core joints.

Unless otherwise specified, plugged core (also referred to as solid core) shall be core and center construction of C(Plugged) veneer and gaps between adjacent pieces of core shall not exceed 1/2 inch. When jointed core is specified, gaps between pieces of core shall not exceed 3/8 inch, and the average of all gaps occurring in a panel shall not exceed 3/16 inch.

Table 3. Interior Type Grades

Panel Grade Designations	Face	Minimum Veneer Quality Back	Inner Plys	Surface
N-N ¹	N	N	C	Sanded 2 sides
N-A ¹	N	A	C	Sanded 2 sides
N-B ¹	N	B	C	Sanded 2 sides
N-D ²	N	D	D	Sanded 2 sides
A-A	A	A	D	Sanded 2 sides
A-B	A	B	D	Sanded 2 sides
A-D	A	D	D	Sanded 2 sides
B-B	B	B	D	Sanded 2 sides
B-D	B	D	D	Sanded 2 sides
Underlayment	C (Plugged)	D	C ³ & D	Sanded or touch-sanded as specified
C-D (Plugged)	C (Plugged)	D	D	Unsanded or touch-sanded as specified
STRUCTURAL STANDARD	C	See Paragraph 3.4.4	D	Unsanded grade ⁴
STANDARD WITH EXTERIOR GLUE (See para. 3.4.5)	C	D	D	Unsanded grade ⁴

(1) Natural finish items intended primarily for cabinet work. Available generally only in 3/4" thickness and only from certain mills.

(2) Natural finish item, intended primarily for paneling and wainscoting. Available generally only in 1/4" thickness and only from certain mills.

(3) Veneer immediately adjacent to face shall be C or better.

(4) Panels shall not be sanded, touch-sanded, or thickness sized by any mechanical means.

Table 4. Exterior Type Grades¹

Panel Grade Designations	Face ²	Minimum Veneer Quality Back ²	Inner Plys	Surface
Marine Special Exterior		See paragraph 3.4.1 See paragraph 3.4.6		
A-A	A	A	C	Sanded 2 sides
A-B	A	B	C	Sanded 2 sides
A-C	A	C	C	Sanded 2 sides
B-B (Concrete Form)		See paragraph 3.4.3		
B-B	B	B	C	Sanded 2 sides
B-C	B	C	C	Sanded 2 sides
C-C (Plugged)	C (Plugged)	C	C	Sanded or touch-sanded as specified
C-C	C	C	C	Unsanded grade ³
A-A High Density Overlay	A	A	C (Plugged)	---
B-B High Density Overlay	B	B	C (Plugged)	---
B-B High Density Concrete Form Overlay (See para. 3.4.3)	B	B	C (Plugged)	---
B-B Medium Density Overlay	B	B	C or C (Plugged) as specified	---
Special Overlays	C	C	C	---

(1) Available also in STRUCTURAL I classification as provided in paragraph 3.4.4.

(2) For overlaid plywood, the grade designation for face and back refers to the veneer directly underlying the surface. All overlaid

plywood is overlaid on two sides unless otherwise specified. When only one side is surfaced, the exposed back shall be C or better.

(3) Panels shall not be sanded, touch-sanded or thickness sized by any mechanical means.

3.7.2 Veneer requirements—The veneers used in each ply of each panel and the completed panel shall conform with the applicable veneer grade and with the construction and workmanship requirements given herein. Additionally, in recognition of the requirements of selected end uses, the type and frequency of the characteristics listed in Table

5 shall be further limited as provided in Table 6 for the grades listed.

3.7.3 Sanded Panels — Unless otherwise specified, sanded plywood shall be surfaced on two sides. Faces and backs of panels shall be full width and full length except that C grade and D grade backs

may be narrow on one edge or short on one end only, but by not more than 1/8 inch for half the panel length or width, respectively. Inner plies shall be full width and length except that one edge or end void not exceeding 1/8 inch in depth or 8 inches in length per panel will be acceptable. Core veneers not exceeding 1/8 inch in thickness may be lapped but by not more than 3/16 inch when adjacent to faces, or 1/2 inch when adjacent to backs, and provided such laps create no adjacent visible opening. Sanding defects resulting from core laps shall not be permitted in panel faces.

3.7.4 Unsanded Panels — When specified rough or unsanded, plywood may have paper tape on either face or back or both, except that in C-C Exterior no

tape used for veneer splicing shall be permitted. Core veneers may be lapped by not more than 1/2 inch providing such laps create no adjacent visible opening. All plies of STANDARD panels only shall be full length and full width except that no more than half the length of one edge nor half the width of one end may contain short or narrow plies, provided:

- (a) Such plies shall not be short or narrow by more than 3/16 inch.
- (b) The aggregate area in the plane of the plies of such edge characteristics does not exceed 6 sq. in. in the entire panel.
- (c) Such edge characteristics do not occur in more than one ply at any panel cross section.

Table 5. Classification of Panel Characteristics

Designation	Characteristic	Description	Notes
(a)	C Veneer (3.3.4) Knotholes	Over 1" but not over 1-1/2"	{ Not applicable to } { C(Plugged) veneer }
(b)		Over 1/4" (not over 3/8" by any length, nor over 1/2" by half panel length)	
	D Veneer (3.3.5)		
(c)	Knots	Over 2-1/2" but not over 3"	D backs only
(d)	Knotholes	Over 2-1/2" but not over 3"	---
(e)	Splits	Over 1/2" (not over 1")	---
(f)	Core laps (3.7.3, 3.7.4)	Laps adjacent to face	---
(g)	Core laps (3.7.3, 3.7.4)	Laps adjacent to backs	---

Table 6. Number of Characteristics Permitted for Certain Panel Grades

Panel Grade Designation	Characteristic (See Table 5)	Total number of characteristics permitted per panel ¹
N-N, N-A	(f), (g)	0
N-B	(f)	0
	(g)	2
N-D	(f)	0
	(d), (e), (g)	2
Underlayment, and C-C (Plugged)	(a), (f)	0—Applies to core veneer next to face only
STRUCTURAL I, C-D STRUCTURAL II, C-D	(b), (e)	0—Applies to faces and backs only
	(a), (c), (d), (f), (g)	2

(1) Limitation applies only to those characteristics listed in center column.

**Table 7. Identification Index¹
Table for Sheathing Panels**

Species of face and back		Grade			
Group 1	C-C Structural I Structural II ³ Standard] ²			
		Group 2	C-C Structural II Standard	C-C Structural II Standard] ²
Group 3	C-C Structural II Standard				
		Group 4	C-C Standard] ⁴	C-C Standard
Nominal Thickness	5/16				
	3/8	24/0	20/0	16/0	
	1/2	32/16	24/0	24/0	
	5/8	42/20	32/16	30/12	
	3/4	48/24	42/20	36/16	
	7/8	---	48/24	42/20	

(1) Identification Index refers to the numbers in the lower portion of the table which are used in the marking of sheathing grades of plywood. The numbers are related to the species of panel face and back veneers and panel thickness in a manner to describe the bending properties of a panel. They are particularly applicable where panels are used for subflooring and roof sheathing to describe recommended maximum spans in inches under normal use conditions and to correspond with commonly accepted criteria. The left hand number refers to spacing of roof framing with the right hand number relating to spacing of floor framing. Actual maximum spans are established by local building codes. See reference sources listed in Appendix A for complete description and product use information.

(2) Panels of standard nominal thickness and construction.

(3) Panels manufactured with Group 1 faces but classified as STRUCTURAL II by reason of Group 2 or Group 3 inner plys.

(4) Panels conforming to the special thickness and panel construction provisions of 3.7.6.

In grades other than STANDARD, backs may be narrow on one edge or short on one end only, but by not more than 1/8 inch for half the panel length or width, respectively; inner plys shall be full width and length, except that one edge or end void not exceeding 1/8 inch in depth or 8 inches in length per panel will be acceptable.

3.7.5 Identification Index for Sheathing – Grade-marking or trademarking of C-C, STRUCTURAL C-D, and STANDARD shall include an "Identification Index" for the thicknesses shown in Table 7.

3.7.6 Thickness and construction of Group 2 and Group 4 sheathing panels – C-C Exterior, STANDARD, and STRUCTURAL panels of Group 2 woods may be marked with the same Identification Index as Group 1 woods, if the 5/16, 3/8, 1/2, 5/8, and 3/4 inch thick panels are manufactured 1/32 inch thicker than the standard nominal thickness, and the 5/8 inch and 3/4 inch panels have 1/8 inch

minimum thick faces and backs. Otherwise they shall be marked with the Identification Index for Group 2 woods of standard nominal thickness. (See paragraphs 3.7.5 and Table 7.)

C-C Exterior and STANDARD panels of Group 4 woods may be marked with the same Identification Index as Group 3 woods if the 5/16, 3/8, 5/8, 3/4, and 7/8 inch thick panels are manufactured 1/32 inch thicker than standard nominal thickness, and the 3/4 and 7/8 inch constructions have 1/8 inch minimum thick faces and backs. Otherwise they shall be marked with the Identification Index for Group 4 woods of standard nominal thickness. (See paragraph 3.7.5 and Table 7.)

3.8 Scarf Jointed Panels – Neither panels with N faces, nor the faces of such panels, unless longer than 10 feet shall be scarf jointed except when specifically so ordered. Panels of other grades may be scarfed, and panels longer than 12 feet are necessarily scarfed. Scarf joints shall not have a slope greater than 1 to 8, but may be specified as less than 1 to 8. Joints shall be glued with a waterproof adhesive and meet the test requirements set forth in paragraph 3.8.1, 3.8.2 and 3.8.3 as applicable. In addition, the adhesive shall not show creep or flow characteristics greater than unjointed wood when subject to load under any conditions of temperature and moisture.

3.8.1 Strength requirements (Interior and Exterior) scarfed panels – Panels shall be tested in accordance with paragraph 4.5.1. If the average ultimate stress of the three test specimens of any one panel is less than 4,000 psi for panels of Group 1 species, or less than 2,800 psi for panels of Group 2 or Group 3 species, or 2,400 psi for panels of Group 4 species, or less than 2,000 psi for panels of Group 5 species, then that panel fails. The scarfed panels represented by the sampling are acceptable if not more than one of the panels fails. (As amended 9/20/69.)

3.8.2 Scarf joint durability for Interior panels – Panels shall be tested as outlined in paragraph 4.5.2. Test specimens showing continuous delamination in excess of 1/16 inch deep and 1/2 inch long at the joint glueline shall be considered as failing. More than one failing specimen in a panel shall constitute failure of that panel. The scarfed panels represented by the sampling are acceptable if not more than one of the panels fails.

3.8.3 Scarf joint durability for Exterior Type plywood and Interior Type bonded with Exterior and Intermediate glue – Panels shall be tested in accordance with paragraph 4.6.3. The material represented by the sampling shall be evaluated in accordance with paragraph 3.6.2, 3.6.3 and 3.6.4. (As amended 6/30/69.)

3.9 Dimensions, tolerances and squareness of panels

—Tolerances that will be permitted for the specified length, width, and thickness of panels represented as complying with this Product Standard are as follows:

3.9.1 Tolerances — A tolerance of 1/32 inch (0.0312) over and under the specified width and/or length will be allowed. Sanded panels shall have a thickness tolerance of 1/64 inch (0.0156) of the specified panel thickness. Unsanded, touch-sanded, and overlaid panels shall fall within a plus or minus tolerance of 1/32 inch (0.0312) of the specified panel thickness for all thicknesses through 13/16 inch, and such panels greater than 13/16 inch shall have a thickness tolerance of 5% over or under the specified thickness.

3.9.2 Squareness and straightness — Panels shall be square within 1/64 inch per lineal foot for panels of 4 feet by 4 feet size or larger. Panels less than four feet in length or width shall be square within 1/16 inch measured along the short dimension. All panels shall be sawn so that a straight line drawn from one corner to the adjacent corner shall fall within 1/16 inch of panel edge.

3.10 Number of Plys — For a given thickness, the number of plys used in the panel makeup shall not be less than as provided in the following table:

Table 8. Minimum Number of Plys for Panel Thicknesses

Panel Characteristics	Finished Thickness Range	Minimum Number of Plys
Sanded and overlaid	inch	
	1/4 — 3/8	3
	7/16 — 3/4	5
	13/16 — or greater	7
Unsanded	5/16 — 7/16	3
	1/2 — 13/16	5*
	7/8 — or greater	7

*1/2" or 5/8" thick panels of STANDARD sheathing and C-D (Plugged) may have minimum of three plys. (As amended 5/10/70.)

3.11 Moisture Content — Moisture content of panels at time of shipment shall not exceed 18% of oven-dry weight as determined by oven-dry test specified in paragraph 4.7.

3.12 Loading or Packing — The plywood shall be securely loaded or packed to insure delivery to destination in a clean and serviceable condition.

4. Inspection and Testing

4.1 General — The tests set forth in this section shall be used to determine the glue bond quality of plywood produced under this Product Standard. The sampling procedures are used with the applicable tests to determine the glue bond quality only in reinspections. (See Appendix for information on reinspection.)

4.1.1 Inspections — All plywood designated as complying with this Product Standard shall be subject to inspection in the white only, except that concrete form material may have a priming coat of oil or other clear preparation before inspection.

4.2 Sampling for Reinspection — For test purposes, a minimum of twenty panels shall be selected at random from the shipment or lot being sampled. These panels shall be selected to represent as many variations in grades and thicknesses as possible, and shall be selected from locations distributed as widely as is practicable throughout the shipment being sampled. Where shipments or lots involve panels with different adhesive bond requirements as covered under paragraph 3.6, testing and evaluation shall apply separately to each category. In such cases, sampling shall include no less than twenty panels of Interior type construction grades (see paragraph 3.6.1). Sampling of Interior type (including the different adhesive qualities) or Exterior type grades shall be prorated on the basis of ratio of their volume to total shipment volume (i.e., for shipment containing 50% Exterior, ten Exterior panels shall be selected), but in no case shall less than ten panels of each type or adhesive quality be selected. Shipments of overlaid and

STRUCTURAL plywood shall be sampled in the same manner as for Exterior plywood.

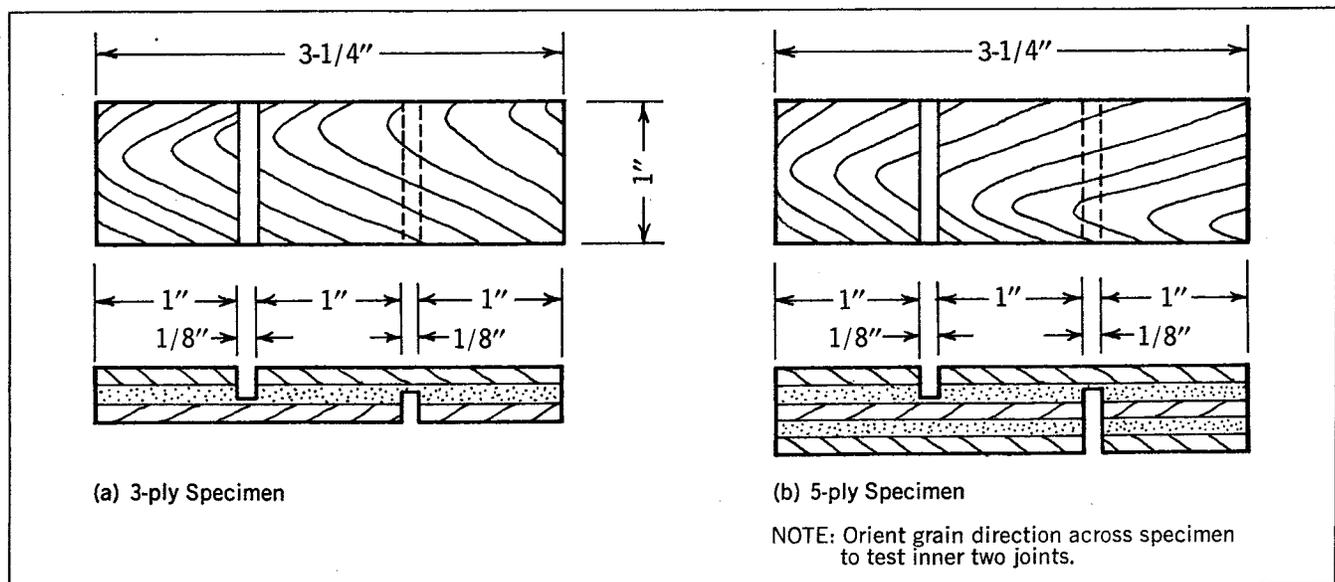
(As amended 6/30/69.)

4.2.1 Specimen Preparation—One piece shall be cut from each Interior panel selected and from that piece five test specimens shall be cut. Each specimen shall be 2 in. wide by 5 in. along the grain. From each Exterior panel selected, one piece shall be cut from the panel and from that piece ten test specimens shall be cut as described in paragraph 4.5.1. Of the ten specimens cut from each test piece, five shall be for vacuum pressure test, and five shall be for the boil test. From each overlaid panel selected, ten specimens shall be cut as described for Exterior plywood. These shall be for testing the bond between veneers. A second set of ten specimens shall be cut to test the bond between the overlay and the base panel as described in paragraph 4.5.1.

From five of the Exterior test panels and five of the overlaid test panels, a 5-1/2 inch by 8 inch specimen shall be cut and tested as described in paragraph 4.5.4.

4.3 Test for Interior Type Plywood — The test specimens prepared as described in paragraph 4.2 shall be placed in a pressure vessel and completely submerged in 110°F water. A vacuum of 15 inches of mercury shall be drawn, maintained for 30 minutes and released. Specimens shall then be allowed to soak in the same water at atmospheric pressure for 4-1/2 hours with no additional heating. They shall be removed and dried for 15 hours at 150°F in an oven with fan forced air circulation of 45 to 50 air changes per minute. Specimens shall then be examined for delamination and evaluated in accordance with requirements given in paragraph 3.6.1.

Figure 1. Shear Test Specimens



Total continuous visible delamination of 1/4" or more in depth and 2" in length along the edges of a 2" by 5" test specimen shall be considered as failure. Where required, this shall be determined by probing with a suitable feeler gauge not greater than 0.013 inch in thickness. When delamination occurs by reason of a localized defect permitted in the grade, other than white pocket, that test specimen shall be discarded.

4.4 Tests for Interior Type plywood bonded with Intermediate glue. (As amended 6/30/69.)

4.4.1 Preparation of test specimens — Test specimens, taken as described in paragraph 4.2 shall be cut 3-1/4 inches long and 1 inch wide, and kerfed one-third of the length of the specimen from each end as illustrated in Figure 1, so that a one-inch square test area in the center results. Specimens shall be oriented so that the grain direction of the ply under test runs at a 90° angle to the length of the specimen. Kerfing shall extend two-thirds of the way through the ply under test, and shall not penetrate the next glueline.

If the number of plies exceeds three, the cuts shall be made so as to test any two of the joints, but the additional plies need not be stripped except as demanded by the limitations of the width of the retaining jaws on the testing device. When desired, special jaws may be constructed to accommodate the thicker plywood. If the number of plies exceeds three, the choice of joints to be tested shall be left to the discretion of the inspector, but at least one-half of the tests shall include the innermost joints. (As amended 6/30/69.)

4.4.2 Vacuum-soak test — The test specimens shall be placed in a pressure vessel and submerged in water at 120° F. A vacuum of 15 inches of mercury shall be drawn and maintained for 30 minutes. Following release of vacuum, specimens shall continue soaking for 15 hours at atmospheric pressure. Temperature of water shall not drop below 75° F at any time during the 15-hour soaking period. Specimens shall then be removed from the vessel and tested while wet by tension loading to failure in a shear testing machine operated at a maximum head travel of 16 inches per minute. Jaws of the machine shall securely grip the specimen so there is no slippage. The percentage of wood failure of the specimens shall be determined with specimens in a dry condition and shall be evaluated as described in paragraph 3.6.2. (As amended 6/30/69.)

4.5 Tests for Exterior Type, STRUCTURAL C-D and Interior Type bonded with Exterior Glue.

(As amended 6/30/69)

4.5.1 Preparation of Test Specimens — Test specimens, taken as described in paragraph 4.2 shall be cut 3-1/4 inches long and 1 inch wide, and kerfed one-third of the length of the specimen from each end, as illustrated in Figure 1, so that a one-inch square test area in the center results. Specimens shall be oriented so that the grain direction of the ply under test runs at a 90° angle to the length of the specimen. Kerfing shall extend two-thirds of the way through the ply under test, and shall not penetrate the next glueline. Overlaid plywood specimens, taken as described in paragraph 4.2 for testing of bond between veneers, shall be cut as described above for Exterior specimens. Overlaid specimens for testing the bond between the overlay and the base panel, shall be cut 1 inch wide and long enough for handling (3 inches is a convenient length) and kerfed just through the overlay 1 inch from the end, on each overlay face.

If the number of plies exceeds three, the cuts shall be made so as to test any two of the joints, but the additional plies need not be stripped except as demanded by the limitations of the width of the retaining jaws on the testing device. When desired, special jaws may be constructed to accommodate the thicker plywood. If the number of plies exceeds three, the choice of joints to be tested shall be left to the discretion of the inspector, but at least one-half of the tests shall include the innermost joints.

4.5.2 Vacuum-Pressure Test — The test specimen shall be placed in a pressure vessel and submerged in cold tap water. A vacuum of 25 inches of mercury shall be drawn and maintained for 30 minutes, followed immediately with application of 65-70 psi of pressure for 30 minutes duration. Specimens shall then be removed from the vessel and tested while wet by tension loading to failure in a shear testing machine operated at a maximum head travel of 16 inches per minute. Jaws of the machine shall securely grip the specimens so there is no slippage. The percentage of wood failure of the specimens shall be determined with specimens in a dry condition and evaluated as described in paragraph 3.6.4.

The bond between veneers in overlaid plywood shall be tested in an identical manner and evaluated as described in paragraph 3.6.4. Specimens for testing the bond between the overlay and the base panel shall be subjected to the same test cycle described above. The bond between the overlay and the base panel shall be tested by inserting a sharp, thin blade of adequate stiffness into the corner of the one inch test area at the overlay-veneer interface, taking care not to cut into the overlay, and attempting to peel the overlay off. It may be neces-

sary to reinsert the blade several times in order to remove the overlay from the one square inch area. The percentage of wood and/or fiber failure shall then be estimated with specimens in a dry condition and evaluated as described in paragraph 3.6.4. The value for each specimen shall be the average of the test areas on each face.

4.5.3 Boiling Test – Test specimens shall be boiled in water for four hours and then dried for 20 hours

at a temperature of $145 \pm 5^\circ\text{F}$ with sufficient air circulation to lower moisture content of the specimens to a maximum of 8%, based on oven-dry weight. The specimens shall be boiled again for a period of four hours, cooled in water, and tested while wet by tension loading for failure in a shear testing machine operated at a maximum head travel of 16 inches per minute. Jaws of the machine shall securely grip the specimens so there is no slippage. The percentage of wood failure of the specimens shall be determined

Figure 2. Apparatus for heat durability test

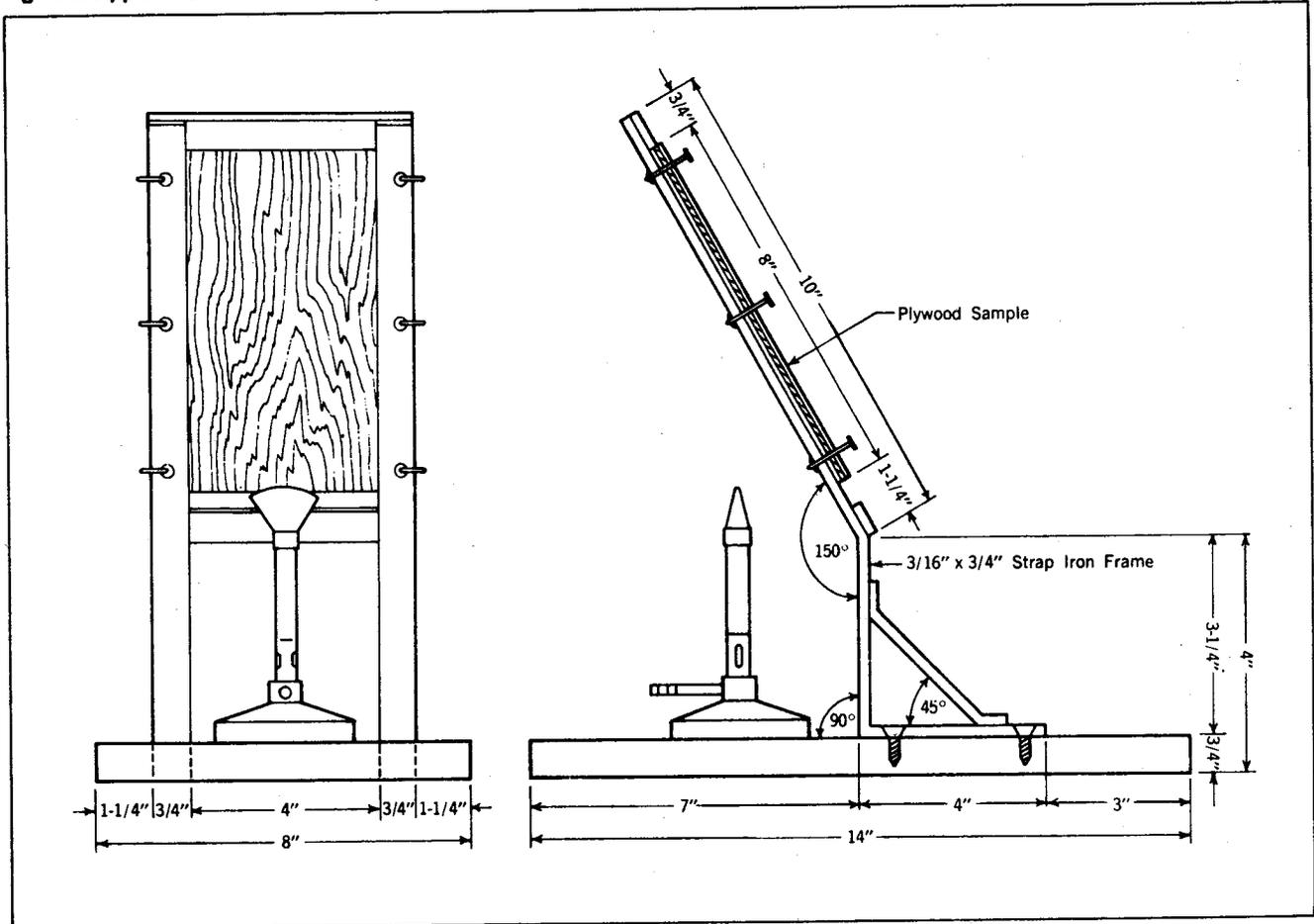
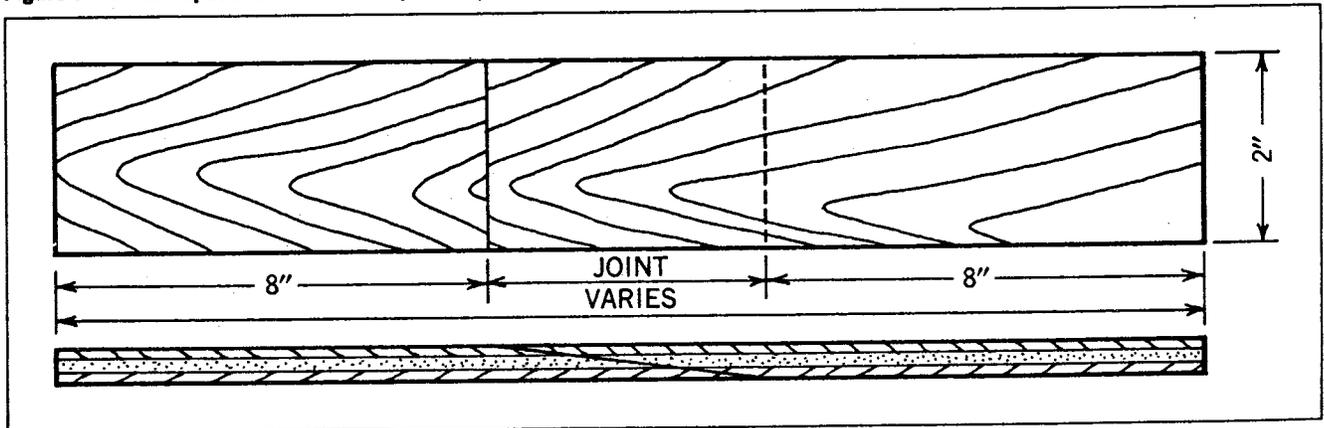


Figure 3. Tension specimen for scarfed jointed panels



with specimens in a dry condition and evaluated as described in paragraph 3.6.4. The bond between veneers in overlaid plywood shall be tested in an identical manner and evaluated as described in paragraph 3.6.4. Specimens to test the bond between the overlay and the base panels shall be subjected to the same test cycle described above. The bond between the overlay and the base panel shall be tested by inserting a sharp, thin blade of adequate stiffness into the corner of the 1 inch test area at the overlay-veneer interface, taking care not to cut into the overlay, and attempting to peel the overlay off. It may be necessary to reinsert the blade several times in order to remove the overlay from the 1 square inch area. The percentage of wood and/or fiber failure shall then be estimated with specimens in a dry condition and evaluated as described in paragraph 3.6.4. The value for each specimen shall be the average of the test areas on each face.

4.5.4 Heat Durability Test – Specimens cut as described in paragraph 4.2.1 shall be placed on a stand as illustrated in Figure 2. It shall then be subjected to a 1,472° to 1,652°F (800° to 900°C) flame from a Bunsen-type burner for a period of 10 minutes or, in the case of a thin specimen, until a brown char area appears on the back side. The burner shall be equipped with a wing top to envelop the entire width of the specimen in flame. The top of the burner shall be 1 inch from the specimen face and the flame 1-1/2 inches high. The flame shall impinge on the face of the specimen 2 inches from the bottom

end. After the test, the sample shall be removed from the stand and the gluelines examined for lamination by separating the charred plys with sharp, chisel-like instrument. Specimens shall be evaluated in accordance with the requirements paragraph 3.6.4.1.

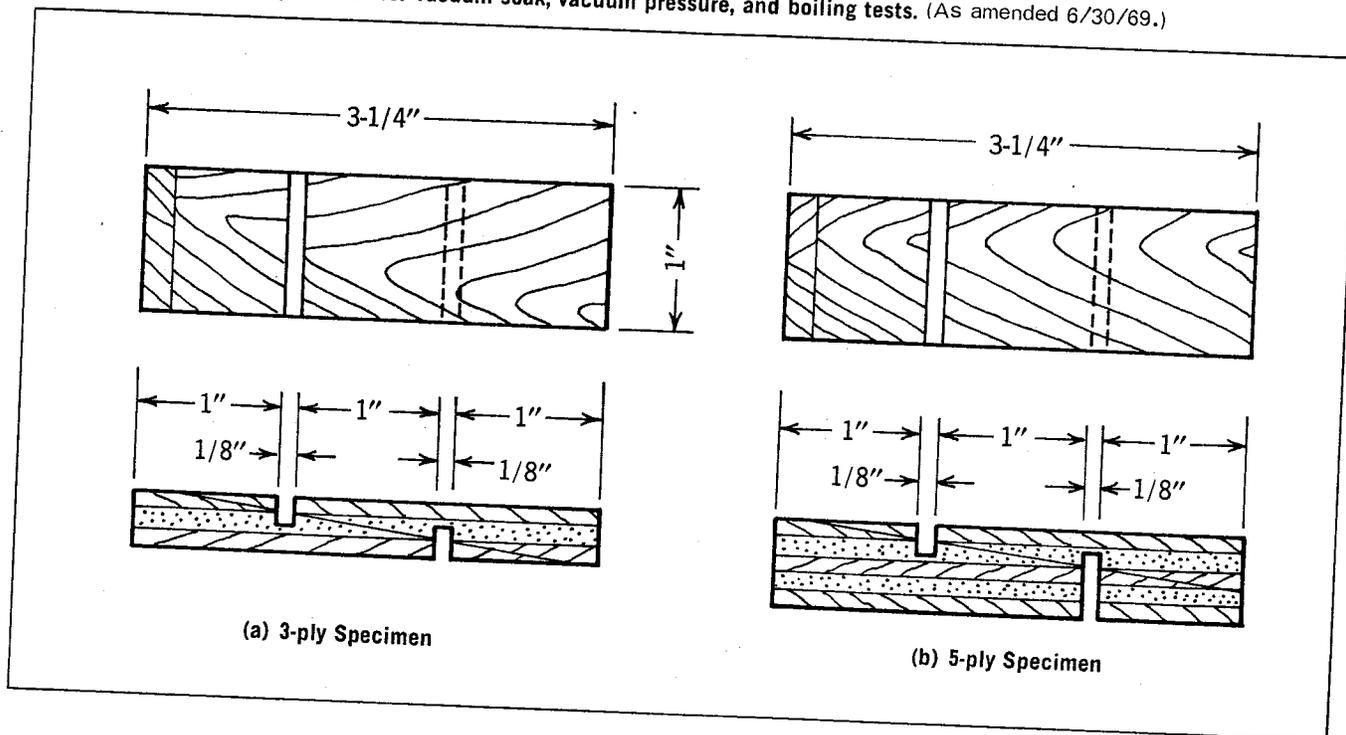
4.6 Scarf Joint Tests –

4.6.1 Strength – Three test specimens shall be cut at random along each joint from panels selected directed in paragraph 4.2. Type, grade and species of the panels shall be recorded. The specimens shall be cut so as to include the joint and shall be prepared as illustrated in Figure 3.

Insofar as possible, the joint test area shall contain no localized natural defects permitted within the grade. At the joint, the maximum thickness at width of plys parallel with the load shall be recorded. Each specimen shall then be placed in the tensile grips of a testing machine and loaded continuously at a rate of cross-head travel of from 0.030 to 0.04 inches per minute until failure, and the ultimate load recorded. The ultimate stress in lbs. per sq. in. shall be computed using the ultimate load and area of those plys whose grain is parallel with direction of load. Moisture content of specimens at the time of testing shall not exceed 16%. (As amended 6/30/68)

4.6.2 Scarf Joint Durability of Interior Type Panels - Ten test specimens shall be cut at random along

Figure 4. Scarf jointed specimens for vacuum soak, vacuum pressure, and boiling tests. (As amended 6/30/69.)



each scarf joint from panels selected as directed in paragraph 4.2, and shall be prepared following the general procedure in paragraph 4.2, but shall be cut so that the scarf joint occurring on one surface of the panel runs across the middle of five specimens and the joint occurring on the opposite surface runs across the middle of the other five specimens. The specimens shall be subjected to the same test procedure as outlined in paragraph 4.3.

4.6.3 Scarf Joint Durability of Exterior Type Panels and Interior Type Panels Bonded with Exterior and Intermediate glue—Ten test specimens shall be cut at random along each joint from panels selected as directed in paragraph 4.2. The specimens shall be prepared following the general procedure described in paragraphs 4.4.1 and 4.5.1 but, in addition, shall be cut so that the joint runs through the test specimens as shown in Figure 4.

For Exterior Type Panels and Interior Type Bonded with Exterior glue—five specimens shall be subjected to the vacuum pressure test described in paragraph 4.5.2, and five to the boiling test of paragraph 4.5.3. The panels shall be evaluated as described in paragraphs 3.6.3 and 3.6.4.

For Interior type panels bonded with Intermediate glue, the ten specimens shall be subjected to the vacuum soak test outlined in paragraph 4.4.2. The panels shall be evaluated as described in paragraph 3.6.2. (As amended 6/30/69.)

4.7 Test for Determination of Moisture Content (Oven-Drying Method) — The moisture content of the plywood shall be determined as follows: A small test specimen shall be cut from each sample panel; the test specimen shall measure not less than 9 sq. inches in area and shall weigh not less than 20 grams (approximately 3/4 ounce). All loose splinters shall be removed from the specimen. The specimen shall be immediately weighed on a scale that is accurate to 0.5 per cent, and the weight shall be recorded as original weight. The specimen shall then be dried in an oven at 212° to 221°F (100° to 105°C) until constant weight is attained. After drying, the specimen shall be reweighed immediately, and this weight shall be recorded as the oven-dry weight. The moisture content shall be calculated as follows:

$$\frac{\text{Original weight} - \text{Oven-dry weight}}{\text{Oven-dry weight}} \times 100 = \text{Moisture content (per cent).}$$

5. Nomenclature and Definitions

5.1 — For purposes of this Product Standard, the trade terms used herein are defined as follows:

Back — The side of a panel that is of lower veneer quality on any panel whose outer plys are of different veneer grades.

Borer Holes — Voids made by wood-boring insects, such as grubs or worms.

Centers — Inner plys whose grain direction runs parallel to that of the outer plys.

Check — A lengthwise separation of wood fibers, usually extending across the rings of annual growth caused chiefly by strains produced in seasoning.

Class I, II — Term used to identify different species group combinations of B-B Concrete form panels. The Product Standard provides for two classes, Class I and Class II, as described in paragraph 3.4.3. See references in Appendix A for detailed product use information.

Cores — Inner plys whose grain direction runs perpendicular to that of the outer plys.

Core Gap (Center Gap) — An open joint extending through or partially through a panel, which results when core or center veneers are not tightly butted.

Crossband — Same as core.

Defects, Open — Irregularities such as splits, open joints, knotholes, or loose knots, that interrupt the smooth continuity of the veneer.

Edge Splits — Wedge-shaped openings in the inner plys caused by splitting of the veneer before pressing.

Face — The better side of any panel whose outer plys are of different veneer grades; also either side of a panel where the grading rules draw no distinction between faces.

Group — Term used to classify species covered by this Product Standard in an order that provides a basis for simplified marketing and efficient utilization. Species covered by the Standard are classified as Groups 1, 2, 3, 4, and 5. See Table 2 for listing of species in individual groups and references in Appendix A for product use information.

(As amended 9/20/69.)

Heartwood — Non-active core of a log generally distinguishable from the outer portion (sapwood) by its darker color.

Identification Index — A set of numbers used in the marking of sheathing grades of plywood. The numbers are related to the species of panel face and back veneers and panel thickness in a manner to describe the bending properties of a panel. They are particularly applicable where panels are used for roof sheathing and subflooring to describe recommended maximum spans in inches, under normal use conditions. The left hand number refers to spacing of roof framing in inches and the right hand number refers to the spacing of floor framing in inches. Actual maximum spans are established by local building codes.

Jointed Core — Core veneer that has had edges machine-squared to permit tightest possible layup.

Knot — Natural characteristic of wood that occurs where a branch base is embedded in the trunk of a tree. Generally the size of a knot is distinguishable by (1) a difference in color of limbwood and surrounding trunkwood; (2) abrupt change in growth ring width between knot and bordering trunkwood; and (3) diameter of circular or oval shape described by points where checks on the face of a knot that extend radially from its center to its side experience abrupt change in direction.

Knotholes — Voids produced by the dropping of knots from the wood in which they are originally embedded.

Lap — A condition where the veneers are so placed that one piece overlaps the other.

Nominal Thickness — Full "designated" thickness. For example, 1/10 inch nominal veneer is 0.10 inch thick. Nominal 1/2 inch thick panel is 0.50 inch thick. Also, commercial size designation, subject to acceptable tolerances.

Patches — Insertions of sound wood in veneers or panels for replacing defects. "Boat" patches are oval-shaped with sides tapering in each direction to a point or to a small rounded end; "Router" patches have parallel sides and rounded ends. "Sled" patches are rectangular with feathered ends.

Pitch pocket — A well-defined opening between rings of annual growth, usually containing, or which has contained, pitch, either solid or liquid.

Pitch streak — A localized accumulation of resin in coniferous woods which permeates the cells forming resin soaks, patches, or streaks.

Plugs — Sound wood of various shapes, including, among others, circular, dog-bone, and leaf shapes, for replacing defective portions of veneer. Also synthetic plugs of fiber and resin aggregate used to fill openings and provide a smooth, level, durable surface. Plugs usually are held in veneer by friction until veneers are bonded into plywood.

Ply — One complete layer of veneer in plywood.

Repair — Any patch, plug, or shim.

Sapwood — The living wood of lighter color occurring in the outer portion of a log. Sometimes referred to as "sap."

Shim — A long, narrow repair of wood or suitable synthetic not more than 3/16 inch wide.

Shop cutting panel — Panels which have been rejected as not conforming to grade requirements of standard grades in this Product Standard. Identification of these panels shall be with a separate mark that makes no reference to this Standard and contains the notation, "Shop Cutting Panel—All Other Marks Void." Blistered panels are not considered as coming within the category covered by this stamp.

Split — Lengthwise separation of wood fibers completely through the veneer caused chiefly by manufacturing process or handling.

STANDARD — Name for unsanded interior type plywood commonly used for construction and industrial applications such as sheathing, subflooring, and limited exposure crates, containers, pallets and dunnage. Produced with C grade or better

face veneer and D grade or better back veneer and inner plys. See references in Appendix A for product use information.

Streaks — See "Pitch streak."

STRUCTURAL I, II — Name used to identify panels that provide for greatest refinement of engineering properties which may be important in the use of plywood for structural components and other sophisticated engineered applications. Manufacturing requirements include special provisions for species, panel construction, and veneer grade characteristics as described in paragraph 3.4.4. See references in Appendix A for detailed product use information.

Torn grain — A (leafing, shelling, grain separation) separation on veneer surface between annual rings.

Touch-sanding — A sizing operation consisting of a light surface sanding in a sander. Sander skips to any degree are admissible.

Veneer — Thin sheets or layers of wood of which plywood is made.

Waterproof Adhesive — For purposes of this Product Standard, glue capable of bonding plywood in a manner to satisfy the exterior performance requirements given herein.

White pocket — A form of decay (*Fomes pini*) that attacks most conifers but has never been known to develop in wood in service. In plywood manufacture, routine drying of veneer effectively removes any possibility of decay surviving. (Admissible amounts of white pocket permitted by this Product Standard were established through a two-year research project at the U. S. Forest Products Laboratory.)

Light white pocket — Advanced beyond incipient or stain stage to point where pockets are present and plainly visible, mostly small and filled with white cellulose; generally distributed with no heavy concentrations; pockets for the most part separate and distinct; few to no holes through the veneer.

Heavy white pocket — May contain a great number of pockets, in dense concentrations, running together and at times appearing continuous; holes may extend through the veneer but wood between pockets appears firm. At any cross section extending across the width of the affected area, sufficient wood fiber shall be present to develop not less than 40% of the strength of clear veneer. Brown cubicle and similar forms of decay which have caused the wood to crumble are prohibited.

Wood Failure (percent) — The area of wood fiber remaining at the glue line following completion of the specified shear test. Determination is by means of visual examination and expressed as a percent of the one square inch test area. (See paragraph 4.4 for test.)

6. Grademarking and Certification

6.1 Certification of Shipments — In order to assure the purchaser that he is getting plywood of the grade and quality specified, the producer shall include with each shipment a Certificate of Inspection which states that the plywood conforms with this Product Standard. Each panel certified as being in conformance with this Standard shall bear the stamp of a qualified inspection and testing agency which (1) either inspects the manufacture (with adequate sampling, testing of glueline, and examination for quality of all veneers) or which (2) has tested a randomized sampling of the finished panels in the shipment being certified for conformance with this Standard. All plywood that is trademarked or otherwise designated as being in conformity with this Standard shall be accompanied by such Certificates of Inspection and applicable trademarks or grademarks of such inspection and testing agency as outlined above.

6.1.1 Qualified Inspection and Testing Agency — A qualified inspection and testing agency is defined to be one that

- (a) has the facilities and trained technical personnel to verify that the grading, measuring, species, construction, sanding, bonding, workmanship, and other characteristics of the products as determined by inspection, sampling and testing complies with all applicable requirements specified herein;
- (b) has developed procedures to be followed by agency personnel in performance of the inspection and testing;
- (c) has no financial interest in, or is not financially dependent upon, any single company manufacturing the product being inspected or tested; and,

(d) is not owned, operated, or controlled by any such company. (As amended 5/10/70.)

6.2 Panel Marking — All plywood panels which are produced in conformance with this Product Standard and which are represented as conforming hereto shall be identified with the mark of a qualified inspection and testing agency that shall designate the species group⁶ classification, glue bond quality (Interior or Exterior), grade name or the grade of face and back veneers, and a symbol signifying conformance with this Standard. (As amended 6/30/69.)

6.2.1 — Panels originally marked as conforming to the Product Standard but subsequently rejected as not conforming thereto shall have any reference to the Standard voided or obliterated by the manufacturer as follows:

Such panels shall be plainly marked by means of a 4 inch by 5 inch minimum size rectangular stamp carrying the legend, "Shop-cutting panel— all other marks void."

No reference shall be made to the Product Standard in the certification or trademarking or grademarking of panels not conforming to all provisions of the Standard.

6.2.2.—Grademarks or trademarks which refer to this Product Standard shall denote panels as "Exterior" or "Interior." Panels not fully satisfying Exterior veneer requirements shall be identified as "Interior." However, the additional notation "Exterior glue" or "Intermediate (IMG)" may be used where applicable to supplement the designation of Interior grades bonded with Exterior glue or Intermediate glue. Any further reference to adhesive bond, including those which imply premium performance or special warranty by the manufacturer, as well as manufacturer's proprietary designations, shall be separated from the grademarks or trademarks of the testing agency by not less than 6 inches. (As amended 6/30/69.)

(6) An Identification Index as provided in paragraph 3.7.5 shall be used in lieu of species group designation to identify C-C, STRUCTURAL C-D and STANDARD.

A class number as provided in paragraph 3.4.3 shall be used in lieu of species group designation to identify concrete form panels.

Appendix

A1. Product Use Information—Publications to provide purchasers of plywood with product end-use information are available from the American Plywood Association, 1119 A St., Tacoma, Wash. 98401.

A2. Shipment Reinspection Practices — Based on industry practices, the following information on reinspection of plywood shipments is offered purchasers of plywood:

All complaints regarding the quality of any shipment must be made within 15 days from receipt.

(a) If the grade of any plywood shipment is in dispute and a reinspection is demanded, the cost of such reinspection shall be borne by the seller if the shipment is more than 5% below grade, and the shipment shall be settled on the basis of the reinspection report.

The buyer need not accept those panels established as below grade, but shall accept the balance of the shipment as invoiced.

(b) If reinspection establishes the shipment to be 5% or less below grade, the buyer pays the cost of reinspection and pays for the shipment as invoiced.

(c) In addition to the above 5% grade tolerance, a 5% tolerance shall apply separately to the core gap limitations set forth in paragraph 3.7.1, as well as those for plugged core and jointed core both as set forth in paragraph 3.7.1.

A3. Method of Ordering — (Based on industry practice the following information is offered plywood purchasers):

(a) The regular method of specifying sanded grades of plywood is to designate the species group, number of pieces, width, length, number of plies, type, grade, and finished thickness. Width always refers to the distance across the grain of the face plies; length refers to the distance along the grain. Width should always be specified first. If, for example, the requirement is 100 pieces of Group 2 plywood 1/4 inch thick, 48 inches wide, and 96 inches long, for interior conditions, one side of which is to be nailed against a wall where it will not show, but the other side is to be exposed to view and painted, this material should be ordered as follows:

Group 2 plywood: 100 pcs. 48 in. by 96 in., 3-ply Interior type, A-D grade, sanded two sides to 1/4 in. thickness.

(b) Surface finish — For most uses, except for sheathing, sanded panels are desirable, but there are occasional uses where unsanded panels, of an A-D or other grade, are satisfactory. Such panels should be specified "unsanded," with notation made of any special patching requirements and the unsanded thickness specified.

(c) Special types of service — Special feature may be desirable in plywood panels, such as extra thick faces for certain architectural treatments, etc. In such cases, the special treatment or feature should be stated after the standard specification. For example, if special features are desired in Group 3 Exterior type A-A grade panels of 3/8 inch thickness, the order should read:

"Group 3 plywood: 100 pcs., 48 in. by 96 in. 3-ply, Exterior type, A-A grade, sanded sides to 3/8 in. thickness, (add further special requirements)."

(d) Overlaid plywood — When ordering overlaid plywood, the basic description should be specified such as "High Density Overlay" (HDO), "Medium Density Overlay" (MDO), or "High Density Concrete Form." The number of pieces, size, and thickness should be noted the same way as for other kinds of plywood. Special requirements, such as "High Density A-A," "Medium Density B Inner Plies," "one faced one side only," or special weights of surfacing material should be stated after the standard specification. Weights of surfacing material include "High Density 60-60" (standard weight), and other variations such as 90-90, 120-60, 120-120.

(e) Unsanded plywood sheathing—The method of specifying plywood sheathing (STANDARD, and STRUCTURAL C-D) is to designate grade, identification index (see paragraph and Appendix, paragraph A1), number of pieces, width, length, number of plies and thickness.

If, for example, the requirement is 100 pieces of STANDARD, 48 inches wide by 96 inches long to be used for roof sheathing over rafters spaced 24 inches on center, this may be ordered as follows:

"STANDARD, 24/0, 100 pcs., 48 in. by 96 in. (3 or 5-ply), 3/8 in. thickness." (If Exterior glue bond is desired, note "Exterior G")

(f) Concrete Form plywood – The method of specifying concrete form plywood is to designate the Class (I or II, see paragraph 3.4.3 and Appendix, paragraph A1), number of pieces, width, length, thickness and grade. Concrete form panels are edge-sealed and, unless otherwise specified, mill-oiled. It is nevertheless good practice to indicate oiling and edge sealing requirements when ordering.

If the requirement is 100 pieces of Class I Concrete Form plywood, 48 inches wide by 96 inches long by 5/8 inches thick, this may be ordered as follows:

“Concrete Form, Class I, 100 pcs. 48 in. by 96 in. by 5/8 in. thickness, B-B Exterior type, O. & E.S..”

EFFECTIVE DATE

The effective date of this Voluntary Product Standard is the date upon which reference to the Standard may be made by producers, distributors, users and consumers, and other interested parties. Compliance by producers with all of the requirements of this Product Standard may not actually occur until some time after its effective date. Products shall not be represented as conforming to this Product Standard until such time as all requirements established in the Standard are met. The effective date of this Standard is November 1, 1966.

HISTORY OF PROJECT

On October 1, 1965, the American Plywood Association submitted to the National Bureau of Standards a draft of a proposed Commercial Standard for softwood plywood together with a request that it be processed through the Commodity Standards Procedures as a revision and consolidation of Commercial Standards CS 45-60, Douglas Fir Plywood, CS 122-60, Western Softwood Plywood, and CS 259-63, Southern Pine Plywood. On December 16, 1965, new procedures for the development of Voluntary Product Standards were published and this became the first Product Standard to be processed under the new procedures by the newly designated Product Standards Section (formerly Office of Commodity Standards). The proposal was reviewed by the National Bureau of Standards, the Forest Products Laboratory in Madison, Wisconsin, and by other Federal agencies with a prime interest in the product. Adjustments were made and a new draft, TS 101, was submitted on April 20, 1966, to the standing committees for the three existing standards, to Federal agencies, and to a newly appointed Standard Review Committee which embraced organizations representative of most major interests in softwood plywood.

A summary of all comment received was prepared and the APA submitted a new draft, TS 101b, which reflected their responses to the suggestions made. TS 101b was unanimously approved by the Standard Review Committee. A recommended Product Standard, TS 101d, was circulated to the public for consideration and acceptance on September 1, 1966. A general press notice was released to related trade publications. Acceptances were received from producers of 85 percent of the production of softwood plywood, from many distributors, spec-

ifiers, architects, home builders, contractors, component and container manufacturers, as well as from State and Federal governmental agencies. (A list will be furnished upon request.) The acceptances were considered representative of a satisfactory consensus, and there were no outstanding substantial objections deemed valid by the Bureau. Accordingly, the successful establishment of Product Standard PS 1-66, Softwood Plywood, Construction Industrial, was announced on October 18, 1966, to become effective for new production on November 1, 1966. Commercial Standards CS 45-60, 122-60, and CS 259-63 were superseded by PS 1-66 on December 1, 1966.

Some of the principal features of this consolidation of three standards are as follows: (1) a simplified basis for producing, marketing, and specifying softwood plywood which was developed by APA after 27 months of study and research by industry committees, (2) the 30 species commercially available are classified into four relative strength and stiffness groups which are based in part on new Forest Service density studies, (3) uniform grading rules apply to all species, (4) a ready-reference end-guide for all types and grades of plywood available, (5) "critical section" grading concept, (6) new vacuum pressure procedure for moisture saturation test specimens, (7) new structural grade for engineered applications, and (8) new span-identification index guide for proper use of roof and floor sheathing. CS 157-56, Pine Plywood, was not included because it covers the more decorative or appearance grades of Western pine species. Several construction grades of hardwood species are included.

Synopsis of amendments in July 1970 reprint

Amendment No. 1, effective June 30, 1969, added provisions for a new "intermediate" glue quality that has greater mold and moisture resistance than "interior" glue but less than the fully waterproof qualities of "exterior" glue. The provisions include adhesive performance requirements and quality evaluation test methods.

Amendment No. 2, effective September 20, 1969, added 23 new species to the Standard that have become of economic importance for construction and industrial plywood since publication of the Standard.

Amendment No. 3, effective March 20, 1970, added three additional new species to the Standard. Caribbean Pine to Group 1, Spruce Pine to Group 3 and Bigtooth Aspen to Group 4.

Amendment No. 4, effective May 10, 1970, allows intermixing of species between group classifications on panel faces and backs. Where intermixing occurs, identification is with the group number or Identification Index of the higher numbered species (i.e., Group 4 is higher numbered than Group 1).

Amendment No. 5, effective May 10, 1970, provided for the conformance of a 5/8 inch thick panel made with a minimum of 3 plies but limited conformance to STANDARD sheathing and C-D (Plugged) grades.

Amendment No. 6, effective June 8, 1970, was an editorial change which clarified the definition of a qualified inspection and testing agency.

Technical Standards Coordinator: William H. Furcolow, Product Standards Section, Office of Engineering Standards Services, National Bureau of Standards, U.S. Department of Commerce.

STANDING COMMITTEE

The individuals whose names are listed below constitute the membership of the Standing Committee for this Standard. The function of the committee is to review all proposed revisions and amendments in order to keep this Standard up to date. Comments concerning this Standard and suggestions for its revision may be addressed to any member of the committee or to the Office of Engineering Standards Services, National Bureau of Standards, Washington, D.C. 20234, which acts as secretary for the committee. (As amended July 1970.)

Representing Manufacturers

- T. L. Bentley, General Manager, Dwyer Lumber & Plywood Company, Division of Publisher's Paper Company, 6637 SE. 100th Avenue, Portland, Oregon 97266
- Thomas O'Melia, Jr., Scotch Plywood Company, Fulton, Alabama 36446
- Henry A. Dotter, Jr., Manager, Douglas Fir Plywood Company, P.O. Box 218, Coquille, Oregon 97423
- Burl Brown, Plywood Division, Ellingson Timber Company, Box 744, Baker, Oregon 97814
- Thomas M. Orth, President, Kirby Lumber Corporation, P.O. Box 53029, Houston, Texas 77052
- H. G. Reents, Manager, International Paper Company, Long-Bell Division, P.O. Box 579, Longview, Washington 98632

Representing Distributors

- William P. Ames, Jr., Murphy & Ames, Inc., 6908 Fairfax Drive, Arlington, Virginia 22213 (Representing the National Lumber and Building Material Dealers Association).
- John R. Mercier, Assistant Manager, Ray Hill Lumber Co., 2510 Hyde Park Boulevard, Los Angeles, California 90043 (Representing the Southern California Plywood Association).
- Louis G. Riecke, Sr., President, Tulane Hardwood Lumber Company, Inc., 415 Edwards Avenue, New Orleans, Louisiana 70123 (Representing the National Sash and Door Jobbers Association).
- John E. Walker, President, Walker Plywoods, Inc., 1139 First Avenue, South, Birmingham, Alabama 35202 (Representing the Building Materials Distributors Association).

Representing Users

- R. E. Jordan, President, Jordan Construction Company, 600 W. Monument Street, Jackson, Mississippi 39205 (Representing the Associated General Contractors of America).
- W. James Schumaker, Quality Control Supervisor, The Champlin Company, 45 Bartholomew Avenue, Hartford, Connecticut 06106
- Robert C. Binning, Marshfield Homes, Inc., 2301 E. Fourth Street, Marshfield, Wisconsin 54449 (Representing the Mobile Homes Manufacturers Association).
- Milton W. Smithman, Assistant Staff Vice President of Builder Services (Homes and Apartments), National Association of Home Builders, 1625 L Street, NW., Washington, D.C. 20036

Representing General Interest

- Richard L. Sanderson, Building Officials Conference of America, Inc., 1313 East 60th Street, Chicago, Illinois 60636
- George S. Sowden, AIA, 6813 Brants Lane, Fort Worth, Texas 76116 (Representing the American Institute of Architects)
- Karl T. Lehmann, Chief, Technical Support Division, Wood Products Office, Defense Construction Supply Center, P.O. Box 2926, Portland, Oregon 97208
- Paul V. Douglas, Architectural Division, Federal Housing Administration, Department of Housing and Urban Development, Washington, D.C. 20411
- Russell W. Smith, Jr., Building Research Division, National Bureau of Standards, Washington, D.C. 20234

ACCEPTORS

The trade associations, producers, and Federal, State, and local government agencies listed below have individually indicated in writing their acceptance of this product standard prior to its publication. (The names of the distributors, users, and testing agencies who also accepted the standard were not published herein because the large number would have increased the cost of the printed standard. However, a list will be furnished upon request.) The acceptors indicated an intention to utilize the standard as far as practicable, but reserved the right to depart from it as may be deemed desirable. The list is published to show the extent to recorded public support for the standard, and should not be construed as indicating that all products made by the acceptors actually comply with its requirements.

Products that meet all requirements of the standard may be identified as such by a certificate, grade mark, or label. Purchasers are encouraged to require such specific representations of compliance, which may be given by the manufacturer whether or not he is listed as an acceptor.

TRADE ASSOCIATIONS (General Support)

American Institute of Architects, Montana Chapter, Billings, Mont.
American Institute of Timber Construction, Washington, D.C.
American Plywood Association, Tacoma, Wash.
American Wood Preservers Institute, Washington, D.C.
California Redwood Association, San Francisco, Calif.
Carolina Lumber & Building Material Dealers Association, Charlotte, N.C.
Construction Inspectors Association of Southern California, Inglewood, Calif.
Fine Hardwoods Association, Chicago, Ill.
Louisiana Building Materials Dealers Association, Baton Rouge, La.
Michigan Association of Traveling Lumber, Sash & Door Salesmen, Detroit, Mich.
Mississippi Retail Lumber Dealers Association, Inc., Jackson, Miss.
Mobile Home Manufacturers Association, Chicago, Ill.
National-American Wholesale Lumber Association, New York, N.Y.
National Association of Home Builders, Washington, D.C.
National Building Material Distributors Association, Chicago, Ill.
National Forest Products Association, Washington, D.C.
National Lumber and Building Material Dealers Association, Washington, D.C.
National Sash & Door Jobbers Association, Chicago, Ill.
National Wooden Pallet Manufacturers Association, Washington, D.C.
National Woodwork Manufacturers Association, Inc., Chicago, Ill.
Northwestern Lumbermen's Association, Minneapolis, Minn.
Placerville Fruit Growers Association, Placerville, Calif.
Plywood Research Foundation, Tacoma, Wash.
Red Cedar Shingle & Handsplit Shake Bureau, Seattle, Wash.
Southern California Plywood Association, Los Angeles, Calif.
Southern Pine Association, New Orleans, La.
Southern Pine Inspection Bureau, New Orleans, La.
Southwest Forest Industries, Phoenix, Ariz.
Trailer Coach Association, Los Angeles, Calif.
Western Wood Products Association, Portland, Ore.
Wood Products Association of Hawaii, Honolulu, Hawaii.
Woodwork Institute of California, Fresno, Calif.

PRODUCERS

Agnew Plywood, Grants Pass, Ore.
American Forest Products Corp., San Francisco, Calif.
Anacortes Veneer, Inc., Anacortes, Wash.
Angelina Plywood Co., Keltys, Tex.
Astoria Plywood Corp., Astoria, Ore.
Bate Plywood Co., Inc., Merlin, Ore.
Bohemia Lumber Co., Culp Creek, Ore.

Boise Cascade Corp., Yakima, Wash.
Brand-S Corp., Corvallis, Ore.
Brookings Plywood Corp., Brookings, Ore.
Brooks-Williamette Corp., Portland, Ore.
Buffelen Woodworking Co., Tacoma, Wash.
C&C Plywood Corp., Kalispell, Mont.
Centralia Plywood Inc., Centralia, Wash.
Chattahoochee Plywood Corp., Cedar Springs, Ga.
Chesapeake Bay Plywood Corp., Pocomoke City, Md.
Cloverdale Plywood Co., Cloverdale, Calif.
Columbia Southern Plywood Corp., Minden, La., Portia Ore.
Commercial Plywood Co., Creswell, Ore.
Coos Head Timber Co., Coos Bay, Ore.
Crown Zellerbach Corp., San Francisco, Calif., St. Helens, Ore.
D. L. Veneer Co., McMinnville, Ore.
DeWeese, A., Lumber Co., Philadelphia, Miss.
Diamond National Corp., Red Bluff, Calif.
Drain Plywood, Drain, Ore.
Elk Lumber Co., Medford, Ore.
Elma Plywood Corp., Elma, Wash.
Eugene Plywood Co., Eugene, Ore.
Evans Products Co., Portland, Ore.
Everett Plywood Corp., Everett, Wash.
Farwest Plywood Co., Tacoma, Wash.
Forest Laminates, Inc., Tacoma, Wash.
Forrest Industries, Inc., Dillard, Ore.
Georgia-Pacific Corp., Portland and Coquille, Ore.
Giustina Bros. Lumber & Plywood Co., Eugene, Ore.
Glendale Plywood Co., Glendale, Ore.
Hardel Mutual Plywood Corp., Olympia, Wash.
Hines, Edward, Lumber Co., Chicago, Ill., and Westfir, Ore.
Hult Lumber & Plywood Co., Junction City, Ore.
Idaho Veneer Co., Post Falls, Idaho
International Paper Co., Longview, Wash.
Jefferson Plywood Co., Madras, Ore.
Kirby Lumber Corp., Houston, Tex.
Klamath Plywood Corp., Klamath, Ore.
Lacey Plywood Co., Inc., Lacey, Wash.
Lane Plywood, Inc., Eugene, Ore.
Linnton Plywood Association, Portland, Ore.
Louisiana Plywood Corp., Ruston, La.
Lowell Plywood Co., Everett, Wash.
Martin Bros. Container & Timber Products Corp., Oakland, Ore.
MacMillan Bloedel Products, Inc., Thomasville, Ala.
McKenzie River Plywood Corp., Springfield, Ore.
Medford Corp., Medford, Ore.
Medford Veneer & Plywood Corp., White City, Ore.
Menasha Corp., North Bend, Ore.
Milwaukee Plywood Corp., Milwaukee, Ore.
Mt. Baker Plywood, Inc., Bellingham, Wash.
Montezuma Plywood Co., Cortez, Colo.
Multnomah Plywood Corp., Portland, Ore.

Nordic Plywood, Inc., Sutherlin, Oreg.
North Pacific Plywood, Inc., Tacoma, Wash.
North Santiam Plywood, Co., Mill City, Oreg.
Northern California Plywood, Inc., Crescent City, Calif.
Olin Mathieson Chemical Corp., West Monroe, La.
Oregon-Washington Plywood Co., Garibaldi, Oreg.
Pacific Lumber Co., San Francisco, Calif.
Peninsula Plywood Corp., Port Angeles, Wash.
Plum Creek Lumber Co., Columbia Falls, Mont.
Pope & Talbot, Inc., Portland, Oreg., and Kalama, Wash.
Pickering Lumber Corp., Standard, Calif.
Potlatch Forests, San Francisco, Calif., and Lewiston, Idaho

Publishers' Paper Co., Dwyer Division, Portland and Oregon City, Oreg.

Rosboro Lumber Co., Springfield, Oreg.
St. Maries Plywood Co., St. Maries, Idaho
St. Regis Paper Co., Tacoma, Wash.
Santiam Lumber Co., Portland, Oreg.
Scotch Plywood Co., Fulton, Ala.
Simpson Timber Co., Seattle, Wash.
South Ply, Inc., Natchitoches, La.
Southern Oregon Plywood, Inc., Grants Pass, Oreg.
Southern Pine Plywood Co., Diboll, Tex.
Standard Veneer & Timber Co., Crescent City, Calif.
Stevenson Co-Ply, Inc., Stevenson, Wash.
Temple Industries, Inc., Diboll, Tex.
Tidewater Plywood, Inc., Everett, Wash.
Tillamook Veneer Co., Tillamook, Oreg.
Timber Products Co., Medford, Oreg.
Tri-State Plywood Co., Santa Clara, Calif.
Union Lumber Co., Fort Bragg, Calif.
United States Plywood Corp., Eugene, Oreg. and Algoma, Wis.
Vancouver Plywood Co., Vancouver, Wash. and Florian, La.
Van-Evan Co., Missoula, Mont.
Western States Plywood Cooperative, Port Orford, Oreg.
Western Veneer & Plywood Co., Lebanon, Oreg.
Weyerhaeuser Co., Tacoma, Wash.
Willamette National Lumber Co., Portland, Oreg.
Willamette Plywood Corp., Aumsville, Oreg.
Willamette Valley Lumber Co., Portland, Oreg.
Winnsboro Plywood Co., Winnsboro, S.C.

U.S. GOVERNMENT AGENCIES

Agriculture, U.S. Department of, U.S. Forest Service, Albuquerque, N. Mex.
Agriculture, U.S. Department of, Agricultural Engineering Research Division, Beltsville, Md.
Air Force, Department of, Deputy for Civil Engineering (SWCP) Planning Section, Albuquerque, N. Mex.
Air Force, Department of, MOAMA (MONEB), Brookley, Ala.
Air Force Packaging Evaluation Agency, Mobile, Ala.
Army, Department of, Office of the Chief of Engineers, Washington, D.C.
Army, Department of, Corps of Engineers, Albuquerque District, Albuquerque, N. Mex.
Army, Department of, Mobility Equipment Command, RD&ED, Fort Belvoir, Va.
Defense Construction Supply Center, Defense Supply Agency, Columbus, Ohio
District of Columbia, Highways and Traffic Department, Washington, D.C.
General Services Administration, Federal Supply Service, Washington, D.C.

General Services Administration, Public Buildings Service, Washington, D.C.
Health, Education, and Welfare, Department of, Procurement Management Branch, OA-GS, Washington, D.C.
Housing Assistance Administration, Washington, D.C.
Housing and Urban Development, Department of, Federal Housing Administration, Regional Office, Des Moines, Iowa and Phoenix, Ariz.
Interior, Department of, Bureau of Indian Affairs, Albuquerque, N. Mex.
U.S. Navy Marine Engineering Laboratory, Industrial Equipment Division, Annapolis, Md.

STATE AND LOCAL GOVERNMENTS

Albany, city of, Albany, Ga.
Albuquerque, city of, Albuquerque, N. Mex.
Anne Arundel County, Inspection and Permits, Department of, Annapolis, Md.
Baltimore, city of, Baltimore, Md.
Baltimore County Buildings Department, Towson, Md.
Birmingham, city of, Birmingham, Ala.
Bloomington, city of, Bloomington, Minn.
Brooklyn Park, village of, Brooklyn Park, Minn.
Charlotte Building Inspection Department, city of, Charlotte, N.C.
Chula Vista, city of, Chula Vista, Calif.
Cincinnati, city of, Cincinnati, Ohio
Clayton County, Jonesboro, Ga.
Colorado Springs, Regional Building Department, Colorado Springs, Colo.
Dade County Building and Zoning Department, Miami, Fla.
Des Moines, city of, Department of Building Inspections, Des Moines, Iowa
Dougherty County Health Department, Albany, Ga.
Dover Township, Toms River, N.J.
Downers Grove, village of, Downers Grove, Ill.
Durham, city of, Inspection Division, Durham, N.C.
Fort Myers, city of, Fort Myers, Fla.
Fresno, city of, Planning and Inspection Department, Fresno, Calif.
Greensboro, city of, Greensboro, N.C.
Hazelwood, village of, Hazelwood, Mo.
Hickory, city of, Building Inspection Department, Hickory, N.C.
Hillsborough County Building and Zoning Department, Tampa, Fla.
Jacksonville Beach, city of, Jacksonville Beach, Fla.
Los Angeles, city of, Los Angeles, Calif.
Lynchburg, city of, Bureau of Inspections, Lynchburg, Va.
Mesa, city of, Building Inspection Department, Mesa, Ariz.
New Hampshire, State of, Division of Purchase and Property, Concord, N.H.
New Jersey, State of, Trenton, N.J.
Oregon, State of, Procurement Section, Salem, Oreg.
Pine Bluff, city of, Pine Bluff, Ark.
Sacramento, city of, Sacramento, Calif.
San Diego, city of, Engineering Department, San Diego, Calif.
St. Louis County, Office of Public Works, Clayton, Mo.
Torrance, city of, Department of Building and Safety, Torrance, Calif.
Scottsdale, city of, Scottsdale, Ariz.
South Bend, city of, South Bend, Ind.
West Palm Beach, city of, Building and Zoning Department, West Palm Beach, Fla.

TO THE ACCEPTOR

The following statements answer the usual questions arising in connection with the acceptance and its significance:

1. *Enforcement.*—Product standards contain requirements which are voluntarily established by mutual consent of those concerned. They present a common basis of understanding among the producers, distributors, and consumers and should not be confused with any plan of governmental regulation or control. The National Bureau of Standards has no regulatory power in the enforcement of their provisions, but since they represent the will of the interested groups as a whole, their provisions soon become established as trade customs, and are made effective through incorporation into sales contracts, labels, invoices, and the like.

2. *The acceptor's responsibility.*—The purpose of product standards is to establish nationally recognized grades or consumer criteria for specific items, and the benefits therefrom will be measurable in direct proportion to their general recognition and actual use. Instances will occur when it may be necessary to deviate from the standard and the signing of an acceptance does not preclude such departures; however, such signature indicates an intention to follow the standard, where practicable, in the production, distribution, or consumption of the article in question.

3. *The Department's responsibility.*—The major function, performed by the National Bureau of Standards in the voluntary establishment of product standards on a nationwide basis is fourfold: First, to act as an unbiased coordinator to bring all interested parties together for the mutually satisfactory development of voluntary standards; second, to supply such assistance and advice as past experience with similar programs may suggest; third, to canvass and record the extent of acceptance of the standard on the part of producers, distributors, and users; and fourth, after acceptance, to publish the standard for the information and guidance of buyers and sellers of the product.

4. *Announcement.*—When a recommended standard has been endorsed by a substantial majority of production and by a satisfactory number of distributors and users or consumers, in the absence of active, valid opposition, the success of the project is announced. If however, in the opinion of the standing committee or of the National Bureau of Standards, the support of any standard is inadequate, the right is reserved to withhold publication.

ACCEPTANCE OF PRODUCT STANDARD

PS1-66 SOFTWOOD PLYWOOD, CONSTRUCTION AND INDUSTRIAL

If acceptance has not previously been filed, this sheet properly filled in, signed, and returned will provide for the recording of your organization as an acceptor of this product standard.

Date _____

Office of Engineering Standards Services
National Bureau of Standards
U. S. Department of Commerce
Washington, D.C. 20234

Gentlemen:

We believe that this product standard constitutes a useful standard of practice, and we individually plan to utilize it as far as practicable in the
production¹ distribution¹ purchase¹ testing¹
of this commodity.

We reserve the right to depart from the standard as we deem advisable.

We understand, of course, that only those articles which actually comply with the standard in all respects can be identified or labeled as conforming thereto.

Signature of authorized officer _____
(In ink)

(Kindly typewrite or print the following lines)

Name and title of above officer _____

Organization _____
(Fill in exactly as it should be listed)

Street address _____

City, State, and ZIP code _____

¹ Underscore the applicable words. Please see that separate acceptances are filed for all subsidiary companies and affiliates which should be listed separately as acceptors. In the case of related interests, trade associations, trade papers, etc., desiring to record their general support, the words "General support" should be added after the signature.

(Cut on this line)

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