U. S. DEPARTMENT OF COMMERCE
DANIEL C. ROPER, Secretary
NATIONAL BUREAU OF STANDARDS
LYMAN J. BRIGGS, Director

HARDWOOD DIMENSION LUMBER

COMMERCIAL STANDARD CS60–36

Effective Date, October 1, 1936

A RECORDED STANDARD OF THE INDUSTRY

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PROMULGATION

of

COMMERCIAL STANDARD CS60-36

for

HARDWOOD DIMENSION LUMBER

On June 26, 1936, at the instance of the Hardwood Dimension Manufacturers Association, a general conference, to which were invited representative manufacturers, distributors, and users of hardwood dimension lumber, adopted a recommended commercial standard for this commodity. The industry has since accepted and approved for promulgation by the U. S. Department of Commerce, through the National Bureau of Standards, the standard as shown herein.

The standard became effective on October 1, 1936.

Promulgation recommended:

I. J. Fairchild,
Chief, Division of Trade Standards.

Promulgated:

Lyman J. Briggs,
Director, National Bureau of Standards.

Promulgation approved:

Daniel C. Roper,
Secretary of Commerce.

HARDWOOD DIMENSION LUMBER

COMMERCIAL STANDARD CS60–36

PURPOSE

1. The commercial standard grading rules for hardwood dimension lumber are established as a basis of common understanding between the manufacturer, distributor, and user. It is recognized that these grading specifications may not be applicable to every transaction involving the sale of hardwood dimension lumber, but they will in most cases provide basic specifications to which other requirements may be added in order that the purchaser may purchase, by grade, the type of material best suited to his needs.

DEFINITION OF PRODUCT

2. Hardwood dimension lumber, as covered by this standard, is defined as kiln-dried hardwoods processed to a point where the maximum waste is left at the dimension mill, and the maximum utility delivered to the user. It is manufactured from rough boards and flitches to the specific requirements of a particular plant or industry. It is in specified thicknesses, widths, and lengths, or multiples thereof. It may be glued or not glued, as specified. It may be considered in three classes, namely, rough, semi-machined, or completely machined to specifications.

GENERAL REQUIREMENTS

3. All hardwood dimension lumber sold as conforming to commercial standard grades shall meet the following general requirements:

4. *Seasoning.*—Material shall be properly kiln-dried according to accepted methods for the thickness and species in question within the range of moisture content agreed upon. Because of the tendency of wood to change in moisture content with changes in atmospheric conditions, no specific percentage of moisture content can be guaranteed when the hardwood dimension lumber reaches its destination. Shippers shall exercise all possible care in the seasoning and handling of their products to assure delivery in suitable condition. The purchaser shall be responsible for the proper storing and handling of the material after it is received.

5. *Gluing.*—Glued hardwood dimension lumber shall be made with high grade glue and in such manner as to provide strong joints. Type of glue used and kind of joint shall be a matter of contract between buyer and seller.

6. *Workmanship.*—All hardwood dimension lumber sold as of commercial standard quality shall be well manufactured, of good work-

manship, and shall conform to the various grades as hereinafter defined.

DETAIL REQUIREMENTS—GRADES

FLAT STOCK

7. In rough dimension lumber of any grade, those blemishes that will be removed in planing or dressing to finished thickness shall not be regarded as defects.

8. The standard grades of flat stock hardwood dimension lumber are as follows:

9. *Clear.*—This grade shall be clear on both faces, the edges, and the ends except that sapwood, slight streaks, and slight stain shall not be considered defects. Irregularities of the wood fibers producing a slight configuration such as a swirl, blister, or burl effect shall not be considered as defects unless accompanied by a knot or encased bark. (NOTE.—In glued hardwood dimension lumber, matching for grain, figure, and color shall be a matter of contract between buyer and seller.)

10. *Clear, one face.*—This grade shall be clear on one face, both edges, and both ends and otherwise comply with the clear grade, except that the reverse face may contain defects of a sound nature, including patches and slight imperfections in surfacing. (NOTE.—In glued hardwood dimension lumber, matching for grain, figure, and color shall be a matter of contract between buyer and seller.)

11. *Paint.*—This grade may contain smooth defects on the best face such as burls, smooth knots, or their equivalent which, when properly filled, will be concealed when finished with nontransparent material. The reverse face or back may contain defects of a sound nature, patches, and slight imperfections in surfacing.

12. *Core.*—This grade shall be sound on both faces, admitting tight sound knots, pin, shot or spot worm holes, slight surface checks, or their equivalent. Pieces making up the core may be joined for length, using glued joints, lock, lap, tongue and grooved, or butt joints, providing no such joint is within 2 inches from the edges or the ends. Patches or plugs in reasonable amount may also be used, providing they are not within 2 inches from the edges or the ends. Wedge patches will be permitted in the ends provided no such patch is witnin 2 inches of the edge of the piece. Stock shall be surfaced smoothly on both faces.

13. *Sound.*—This grade is a utility grade that may contain any defects that will not materially impair the strength of the individual piece. It will admit slight skips in dressing on either face not exceeding the tolerances provided in paragraphs 23 to 30, inclusive.

SQUARES

14. Dimension squares are generally considered as dimension rectangular in cross section but may include stock not more than twice as wide as the thickness. The grades of squares are as follows:

15. *Clear squares.*—This grade shall be clear on all faces, edges, and ends, and shall otherwise conform to the clear grade of flat stock.

16. *Select squares.*—This grade shall be clear on two adjacent sides as specified in the clear grade described above. The other two sides shall be clear one-third the length of the piece from one end while the

other two-thirds may contain sound knots not larger in diameter than one-fourth the width of the face, pin, shot or spot worm holes, bird pecks, slight surface checks, skips in dressing, and wane if it does not extend farther inward from the corner than one-fifth the thickness of either side.

17. *Paint squares.*—This grade may contain smooth defects on all faces such as burls, pin, shot or spot worm holes, smooth knots or their equivalent, which when properly filled, will be concealed when finished with non-transparent material.

18. *Sound squares.*—This grade may contain on any face, small knots situated so as to cause no material impairment of the strength of the piece, pin, shot or spot worm holes, bird pecks, twig knots, and slight surface checks. Skips in dressing and other machining defects shall be admitted on two adjacent sides of any piece.

STANDARD MEASUREMENT METHODS

19. *Thickness.*—In computing the footage of hardwood dimension lumber the rough thickness is to be used. Surface measurement is to apply on rough 1 inch and thinner lumber and board measurement is to apply on lumber over 1 inch rough thickness.

20. *Width.*—Hardwood dimension lumber, when the edges are surfaced, moulded, or sawed to exact width, shall be measured as ¼ inch wider than the net finished width if under 6 inches wide and under 50 inches long. If 6 inches or wider and 50 inches or longer, ½ inch shall be added. If widths are in fractions of less than ⅛ inch, assume the next higher ⅛ inch and add the ¼ or ½ for dressing as above. No pieces shall be counted as less than 1 inch wide.

21. *Length.*—Hardwood dimension lumber when equalized to exact length shall be measured 1 inch longer than the net finished length. If lengths are in fractions of ⅛ inch or less, assume tne next lower ¼ inch, or if in fractions greater than ⅛ inch, assume the next higher ¼ inch, then add the 1 inch for equalizing as above.

EXAMPLES OF MEASUREMENT

If S4S and equalized to $\frac{5}{16}\times7\times16\frac{1}{2}$ in., measure as $1\times7\frac{1}{2}\times17\frac{1}{2}$ in.
If S4S and equalized to $\frac{7}{16}\times5\frac{1}{8}\times17\frac{1}{8}$ in., measure as $1\times5\frac{3}{8}\times18$ in.
If S4S and equalized to $\frac{3}{4}\times11\frac{1}{16}\times20$ in., measure as $1\times11\frac{5}{8}\times21$ in.
If S4S and equalized to $\frac{3}{4}\times6\frac{1}{4}\times74$ in., measure as $1\times6\frac{3}{4}\times75$ in.
If S4S and equalized to $1\frac{1}{32}\times3\frac{15}{16}\times18\frac{3}{16}$ in., measure as $1\frac{1}{4}\times4\frac{1}{4}\times19\frac{1}{4}$ in.
If S4S and equalized to $1\frac{1}{16}\times1\frac{1}{16}\times29\frac{1}{8}$ in., measure as $2\times2\times30$ in.

LAMINATED STOCK

22. When flat stock or squares are laminated for thickness regardless of the number of plies used, the thickness measurement is to be determined from the table of standard thicknesses as to the rough thickness of lumber required for solid stock.

EXAMPLES OF MEASUREMENT

If S4S and equalized to $2\frac{1}{4}\times2\frac{1}{4}\times30$ in., measure as $2\frac{1}{2}\times2\frac{1}{2}\times31$ in.
If S4S and equalized to $2\frac{1}{2}\times2\frac{1}{2}\times42$ in., measure as $3\times2\frac{3}{4}\times43$ in.

TOLERANCES

23. In the manufacture of hardwood dimension lumber utmost care shall be exercised in machining to specified sizes. A tolerance of 1/64 inch plus or minus will be allowed in any measurement of semimachined or completely machined dimension and in the length of rough dimension except as otherwise provided. Since lumber is a product of nature, the fact must be recognized that atmospheric conditions cause variations in thickness and width.

24. *Rough dimension.*—Thickness may be 1/8 inch over thickness specified. Not more than 10 percent of the pieces of any one size in any one shipment may be 1/16 inch scant of thickness specified.

25. Width may be 1/8 inch over width specified. Not more than 10 percent of the pieces of any one size in any one shipment may be 1/16 inch scant of width specified.

26. Length may be up to 1 inch over, but not under the length specified.

27. *Semimachined dimension.*—Thickness shall be as specified.

28. Width, if surfaced two sides, may be 1/8 inch over width specified. Not more than 10 percent of the pieces in any one size in any one shipment may be 1/16 inch under width specified. If surfaced or moulded on the edges, the width shall be as specified.

29. Length may be 1 inch over but not under the length specified. If equalized, the length must be as specified.

30. *Completely machined dimension.*—Shall be machined to all dimensions as specified.

TABLE 1.—*Standard S2S thicknesses*

Rough lumber	Surfaced two sides to—			Rough lumber	Surfaced two sides to—		
	Less than 6 inches wide	6 inches, and less than 18 inches wide	18 inches and wider		Less than 6 inches wide	6 inches, and less than 18 inches wide	18 inches and wider
in.	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*	*in.*
3/8	3/16	5/32	1/8	5/4	1 1/16	1 1/32	1
1/2	5/16	9/32	1/4	6/4	1 5/16	1 9/32	1 1/4
5/8	7/16	13/32	3/8	8/4	1 3/4	1 11/16	1 5/8
3/4	9/16	17/32	1/2	10/4	2 1/4	2 3/16	2 1/8
4/4	1 3/16	2 5/32	3/4	12/4	2 3/4	2 11/16	2 5/8

INSPECTION

31. All hardwood dimension lumber sold as conforming to the commercial standard grading rules is subject to inspection in the form and condition as received and complaints regarding any shipment shall be made within five (5) days after receipt thereof. Any rejected material shall be held intact in its original form for a period up to three (3) weeks after notice of rejection and pending adjustment.

QUANTITY

32. Hardwood dimension lumber shall be ordered in specific quantities in terms of number of pieces, sets of pieces, and/or number of feet. The buyer shall accept up to 5 percent overrun in pieces, sets of pieces, or feet in any or all items ordered.

CERTIFICATION

In an effort to acquaint the hardwood dimension lumber purchaser with the origin of the material he is buying and to extend assurance of its quality, the Hardwood Dimension Manufacturers Association has developed a guarantee certificate, copy of which appears below.

GENERAL INFORMATION

The following information is not, strictly speaking, a part of the commercial standard grading specifications but is furnished for the guidance of producers, distributors, and users of hardwood dimension lumber.

ESSENTIAL INFORMATION FOR PRICE INQUIRIES

To avoid confusion and delay the following data should be included in any inquiry for prices on hardwood dimension lumber. (See pages 6 and 7 for appropriate symbols.)

Number of pieces.
Part name.
Kind of lumber.
Grade.
Finished dimensions:
  Length.
  Width.
  Thickness.
How worked.

RECOMMENDED USES OF VARIOUS GRADES

Clear.—This grade is recommended for use where both faces, both edges, and both ends are exposed and where strength and appearance are necessary.

Clear one face.—This grade is recommended for use where only one face, one or both edges, and one or both ends are exposed.

Paint.—This grade is recommended for use where one face, one or both edges, and one or both ends are smoothly finished and covered with nontransparent material.

Core.—This grade is recommended as a base for plywood or large surfaces requiring a sound lumber base or backing of good appearance and strength.

Sound.—This grade is recommended for purposes where the requirements are such that strength rather than appearance is a characteristic of its use.

Clear squares.—This grade is recommended for turnings or other purposes in which the entire surface area is exposed.

Select squares.—This grade is recommended for use where a considerable portion of two faces is not exposed, as in case goods, cabinets, etc.

Paint squares.—This grade is recommended for application where one or more faces are finished and covered with nontransparent material.

Sound squares.—Sound squares are recommended for use as interior framing or fillers where no part of the piece is exposed and requirements for strength are unimportant.

SYMBOLS

The following standard lumber abbreviations are in common use in contracts and other documents arising in the transactions of purchase and sale of lumber:

Abbreviation	Expression	Abbreviation	Expression
AD	Air dried.	FAS	Firsts and seconds—a combined grade of the two upper grades of hardwoods.
a. l	All lengths.	f. bk	Flat back.
av	Average.	fcty	Factory (lumber).
av. w	Average width.	F. G	Flat grain.
av. l	Average length.	f. o. k	Free of knots.
a. w	All widths.	ft	Foot or feet. Also one accent (′).
B1S	Beaded 1 side.	feet b. m	Feet board measure.
B2S	Beaded 2 sides.	feet s. m	Feet surface measure.
bd	Board.	H. bk	Hollow back.
bd. ft	Board foot; that is, an area of 1 square foot by 1 inch thick.	hdwd	Hardwood.
bdl	Bundle.	Hrt	Heart.
Bev	Beveled.	Hrtwd	Heartwood.
b. m	Board (foot) measure.	1s&2s	Ones and twos—a combined grade of the hardwood grades of firsts and seconds.
Btr	Better.	in.	Inch or inches. Also two accent marks (″).
Clg	Ceiling.	KD	Kiln-dried.
Clr	Clear.	k. d	Knocked down.
CM	Center matched; that is, the tongue-and-groove joints are worked along the center of the edges of the piece.	lbr	Lumber.
Com	Common.	lgth	Length.
cu. ft	Cubic foot.	lgr	Longer.
Dim	Dimension.	lin. ft	Lineal foot; that is, 12 inches.
DS1S	Drum sanded 1 side.	LR	Log run.
DS2S	Drum sanded 2 sides.	M	Thousand.
DS4S	Drum sanded 4 sides.	M. b. m	Thousand (feet) board measure.
E	Edge.	m. l	Mixed lengths.
Eq	Equalized.	Mldg	Moulding.
E. G	Edge grain.	M. s. m	Thousand (feet) surface measure.
EM	End matched—either center or standard.	m. w	Mixed widths.
		N. Eq	Not equalized.

Abbreviation	Expression	Abbreviation	Expression
No.	Number.	Sap	Sapwood.
Ord	Order.	Sd	Seasoned.
P	Planed.		
Pat	Pattern.	Sel	Select.
Pln	Plain, as plain sawed.	s. f	Surface foot; that is, an area of 1 square foot.
Qtd	Quartered—when referring to hardwoods.	Sftwd	Softwood.
		Sh. D	Shipping dry.
R	Rough.	s. m	Surface measure.
rdm	Random.		
res	Resawed.	s. n. d	Sap no defect.
rip	Ripped.	snd	Sound.
		sq	Square.
r. l	Random lengths.	sqrs	Squares.
rnd	Round.	Std	Standard.
r. w	Random widths.		
S&E	Surfaced 1 side and 1 edge.	stnd	Stained.
S1E	Surfaced one edge.	stk	Stock.
		S. W	Sound wormy.
S1S	Surfaced 1 side.	Te	Tennon.
S2S	Surfaced 2 sides.	T&G	Tongued and grooved.
S1S1E	Surfaced 1 side and 1 edge.		
S2S1E	Surfaced 2 sides and 1 edge.	TB&S	Top, bottom, and sides.
S1S2E	Surfaced 1 side and 2 edges.	Tbrs	Timbers.
S4S	Surfaced 4 sides.	V. G	Vertical grain.
S&CM	Surfaced 1 or 2 sides and center matched.	Wth	Width.
		Wdr	Wider.
S2S&CM	Surfaced 2 sides and center matched.	wt	Weight.

STRENGTH VALUES OF CLEAR WOOD AND RELATED FACTORS [1]

Truly representative strength values for any species are preferably obtained from tests on small, clear pieces of wood because the effect of defects is then eliminated. Table 2 [2] gives the strength properties of the more commercially important species; information on additional species is given in United States Department of Agriculture Bulletin 556 and Technical Bulletin 158. The data are based on tests of specimens 2 by 2 inches in cross section and of different lengths, depending upon the test. The standard testing procedure of the American Society for Testing Materials was followed.

Since there is a considerable difference in the strength of small clear pieces of wood when green and when air-dry, strength values are given for both conditions. The normal increase in strength with seasoning shown in table 2, however, does not hold for large pieces because the development of checks in and around knots and of shakes and checks along the neutral axis during seasoning usually largely offset the increase in strength caused by drying.

[1] Reprinted from Wood Handbook, by permission of the Forest Products Laboratory, Madison, Wis.
[2] See page 49 of Wood Handbook for a detailed explanation of table 2.

TABLE 2.—*Strength properties of some commercially important woods grown in the United States*

[Results of tests on small, [1] clear specimens in the green and air-dry condition [2]]

Commercial and botanical name of species	Moisture content	Specific [3] gravity	Static bending					Impact bending		Compression parallel to grain		Compression perpendicular to grain—fiber stress at proportional limit	Shear parallel to grain—maximum shearing strength	Hardness	
			Fiber stress at proportional limit	Modulus of—		Work to—		Fiber stress at proportional limit	Height of drop causing complete failure (50-pound hammer)	Fiber stress at proportional limit	Maximum crushing strength			Load required to embed a 0.444-inch ball to ½ its diameter	
				Rupture	Elasticity	Proportional limit	Maximum load							End	Side
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Percent		*Lb. per sq. in.*	*Lb. per sq. in.*	*1,000 lb. per sq. in.*	*In.-lb. per cu. in.*	*In.-lb. per cu. in.*	*Lb. per sq. in.*	*Inches*	*Lb. per sq. in.*	*Lb. per sq. in.*	*Lb. per sq. in.*	*Lb. per sq. in.*	*Lb.*	*Lb.*
Alder, red (*Alnus rubra*)	98	0.37	3,800	6,500	1,170	0.70	8.0	8,000	22	2,620	2,960	310	770	550	440
	12	.41	6,900	9,800	1,380	1.85	8.4	11,600	20	4,530	5,820	540	1,080	980	590
Ash, black (*Fraxinus nigra*)	85	.45	2,600	6,000	1,040	.41	12.1	----------	33	1,690	2,300	430	860	590	------
	12	.49	7,200	12,600	1,600	1.57	14.9	----------	35	4,520	5,970	940	1,570	1,150	------
Ash, commercial white [4] (*Fraxinus* sp.)	43	.54	5,300	9,500	1,400	1.14	14.7	12,800	37	3,360	4,060	860	1,350	1,010	940
	12	.58	8,900	14,600	1,680	2.68	15.6	17,000	40	5,580	7,280	1,510	1,920	1,680	1,260
Ash, Oregon (*Fraxinus oregona*)	48	.50	4,200	7,600	1,130	.92	12.2	8,900	39	2,760	3,510	650	1,190	850	790
	12	.55	7,000	12,700	1,360	2.08	14.4	13,300	33	4,100	6,040	1,540	1,790	1,430	1,160
Aspen (*Populus tremuloides*)	94	.35	3,200	5,100	860	.69	6.4	7,000	22	1,670	2,140	220	660	280	300
	12	.38	5,600	8,400	1,180	1.53	7.6	9,000	21	3,040	4,250	460	850	510	350
Basswood (*Tilia glabra*)	105	.32	2,700	5,000	1,040	.40	5.3	6,300	16	1,690	2,220	210	600	290	250
	12	.37	5,900	8,700	1,450	1.37	7.2	9,800	16	3,800	4,730	450	990	520	410
Beech (*Fagus grandifolia*)	54	.56	4,300	8,600	1,380	.85	11.9	11,500	43	2,550	3,550	670	1,290	970	850
	12	.64	8,700	14,900	1,729	2.63	15.1	16,000	41	4,880	7,300	1,250	2,010	1,590	1,300
Birch [5] (*Betula* sp.)	62	.57	4,400	8,700	1,560	.79	15.9	11,100	48	2,640	3,510	550	1,160	910	850
	12	.63	10,100	16,700	2,070	2.83	19.8	20,000	52	6,200	8,310	1,250	2,020	1,660	1,340
Birch, paper (*Betula papyrifera*)	65	.48	3,000	6,400	1,170	.45	16.2	8,000	49	1,640	2,360	340	840	470	560
	12	.55	6,900	12,300	1,590	1.80	16.0	12,400	34	3,610	5,690	740	1,210	890	910
Butternut (*Juglans cinerea*)	104	.36	2,900	5,400	970	.52	8.2	7,300	24	2,020	2,420	270	760	410	390
	12	.38	5,700	8,100	1,180	1.59	8.2	11,200	24	4,200	5,110	570	1,170	570	490
Cedar, Alaska (*Chamaecyparis nootkatensis*)	38	.42	3,800	6,400	1,140	.77	9.2	9,100	27	2,500	3,050	430	840	540	440
	12	.44	7,100	11,100	1,420	2.06	10.4	12,200	29	5,210	6,310	770	1,130	790	580
Cedar, eastern red (*Juniperus virginiana*)	35	.44	3,400	7,000	650	1.08	15.0	7,000	35	2,540	3,570	860	1,010	760	650
	12	.47	3,800	8,800	880	1.01	8.3	8,500	22	----------	6,020	1,140	----------	900	------

Cedar, incense (*Libocedrus decurrens*)	108	.35	3,900	6,200	840	.94	6.4	7,300	17	2,940	3,150	460	830	570	390
	12	------	5,900	8,000	1,040	1.67	5.4	9,600	17	4,760	5,200	730	880	830	470
Cedar, northern white (*Thuja occidentalis*)	55	.29	2,600	4,200	640	.60	5.7	5,300	15	1,490	1,990	290	620	320	230
	12	.31	4,900	6,500	800	1.72	4.8	7,100	12	2,630	3,960	380	850	450	320
Cedar Port Orford (*Chamaecyparis lawsoniana*)	43	.40	4,000	6,200	1,420	.65	7.4	9,200	22	2,770	3,130	350	830	460	400
	12	.42	7,700	11,300	1,730	1.97	9.1	13,500	28	5,890	6,470	760	1,080	730	560
Cedar, southern white (*Chamaecyparis thyoides*)	35	.31	2,500	4,700	750	.51	5.9	6,000	18	1,660	2,390	300	690	400	290
	12	.32	4,800	6,800	930	1.46	4.1	7,600	13	2,740	4,700	500	800	520	350
Cedar, western red (*Thuja plicata*)	37	.31	3,200	5,100	920	.63	5.0	6,900	17	2,470	2,750	340	710	430	270
	12	.33	5,300	7,700	1,120	1.44	5.8	8,600	17	4,360	5,020	610	860	660	350
Cherry, black (*Prunus serotina*)	55	.47	4,200	8,000	1,310	.80	12.8	10,200	33	2,940	3,540	440	1,130	750	660
	12	.50	9,000	12,300	1,490	3.11	11.4	13,600	29	5,960	7,110	850	1,700	1,470	950
Chestnut (*Castanea dentata*)	122	.40	3,100	5,600	930	.59	7.0	7,900	24	2,080	2,470	380	800	530	420
	12	.43	6,100	8,600	1,230	1.78	6.5	10,700	19	3,780	5,320	760	1,080	720	540
Cottonwood, eastern (*Populus deltoides*)	111	.37	2,900	5,300	1,010	.49	7.3	7,200	21	1,740	2,280	240	680	380	340
	12	.40	5,700	8,500	1,370	1.39	7.4	7,300	20	3,490	4,910	470	930	580	430
Cottonwood, northern black (*Populus trichocarpa hastata*)	132	.32	2,900	4,800	1,070	.44	5.0	6,800	20	1,760	2,160	200	600	280	250
	12	.35	5,300	8,300	1,260	1.25	6.7	9,800	22	3,270	4,420	370	1,020	540	350
Cypress, southern (*Taxodium distichum*)	91	.42	4,200	6,600	1,180	.91	6.6	8,800	25	3,100	3,580	500	810	440	390
	12	.46	7,200	10,600	1,440	2.15	8.2	10,400	24	4,740	6,360	900	1,000	660	510
Douglas fir (coast region) (*Pseudotsuga taxifolia*)	36	.45	4,800	7,600	1,550	.85	6.8	9,800	24	3,410	3,890	510	930	510	480
	12	.48	8,100	11,700	1,920	1.96	8.6	12,700	30	6,450	7,420	910	1,140	760	670
Douglas fir ("Inland Empire" region) (*Pseudotsuga taxifolia*)	42	.41	3,600	6,800	1,340	.55	6.9	8,700	22	2,460	3,240	500	870	530	470
	12	.44	7,400	11,300	1,610	1.91	8.6	11,800	27	5,520	6,700	950	1,190	720	630
Douglas fir (Rocky Mountain region) (*Pseudotsuga taxifolia*)	38	.40	3,600	6,400	1,180	.65	6.8	9,100	20	2,540	3,000	450	880	450	400
	12	.43	6,300	9,600	1,400	1.60	6.4	12,100	26	4,660	6,060	820	1,070	740	630
Elm, American (*Ulmus americana*)	89	.46	3,900	7,200	1,110	.81	11.8	---------	38	1,920	2,910	440	1,000	680	------
	12	.50	7,600	11,800	1,340	2.53	13.0	---------	39	4,030	5,520	850	1,510	1,110	------
Elm, rock (*Ulmus racemosa*)	48	.57	4,600	9,500	1,190	1.05	19.8	---------	54	2,970	3,780	750	1,270	980	------
	12	.63	8,000	14,800	1,540	2.45	19.2	---------	56	4,700	7,050	1,520	1,920	1,510	------
Elm, slippery (*Ulmus fulva*)	85	.48	4,000	8,000	1,230	.82	15.4	9,200	47	2,790	3,320	510	1,110	750	660
	12	.53	7,700	13,000	1,490	2.35	16.9	15,300	45	4,760	6,360	1,010	1,630	1,120	860
Fir, balsam (*Abies balsamea*)	117	.34	3,000	4,900	960	.52	4.7	6,900	16	2,080	2,400	210	610	290	290
	12	.36	5,200	7,600	1,230	1.23	5.1	7,800	20	3,970	4,530	380	710	510	400
Fir, commercial white [6] (*Abies* sp.)	108	.36	3,800	5,800	1,120	.75	5.3	8,300	22	2,470	2,810	360	750	390	340
	12	.38	6,300	9,300	1,470	1.55	7.0	11,200	20	3,870	5,380	610	930	710	460
Gum, black (*Nyssa sylvatica*)	55	.46	4,000	7,000	1,030	.91	8.0	9,800	30	2,490	3,040	600	1,100	790	640
	12	.50	7,300	9,600	1,200	2.54	6.2	14,500	22	3,470	5,520	1,150	1,340	1,240	810
Gum, red (*Liquidambar styraciflua*)	81	.44	3,700	6,800	1,150	.81	9.4	10,000	33	2,230	2,840	460	1,070	630	520
	12	.49	8,100	11,900	1,490	2.57	11.3	16,800	32	4,700	5,800	860	1,610	950	690
Gum, tupelo (*Nyssa aquatica*)	97	.46	4,200	7,300	1,050	.98	8.3	9,000	30	2,690	3,370	590	1,190	800	710
	12	.50	7,200	9,600	1,260	2.41	6.9	12,500	23	4,280	5,920	1,070	1,590	1,200	880
Hackberry (*Celtis occidentalis*)	65	.49	2,900	6,500	950	.58	14.5	7,900	48	2,070	2,650	490	1,070	760	700
	12	.53	5,900	11,000	1,190	1.72	12.8	13,700	43	3,710	5,440	1,100	1,590	1,110	880

[1] Test specimens 2 by 2 inches in section. Bending specimens 30 inches long; others shorter depending on kind of test.

[2] The values in the first line for each species are from tests of green material; those in the second line are from tests of seasoned material adjusted to an average air dry condition of 12 percent moisture.

[3] Based on weight when oven dry and volume when green or at 12-percent moisture content.

[4] Average of Biltmore white ash (*Fraxinus biltmoreana*), blue ash (*F. quadrangulata*), green ash (*F. pennsylvanica lanceolata*), and white ash (*F. americana*).

[5] Average of sweet birch (*Betula lenta*) and yellow birch (*B. lutea*).

[6] Average of lowland white fir (*Abies grandis*) and white fir (*A. concolor*).

TABLE 2.—*Strength properties of some commercially important woods grown in the United States*—Continued

Commercial and botanical name of species	Moisture content	Specific[3] gravity	Static bending					Impact bending		Compression parallel to grain		Compression perpendicular to grain—fiber stress at proportional limit	Shear parallel to grain—maximum shearing strength	Hardness	
			Fiber stress at proportional limit	Modulus of—		Work to—		Fiber stress at proportional limit	Height of drop causing complete failure (50-pound hammer)	Fiber stress at proportional limit	Maximum crushing strength			Load required to embed a 0.444-inch ball to ½ its diameter	
				Rupture	Elasticity	Proportional limit	Maximum load							End	Side
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Percent		*Lb. per sq. in.*	*Lb. per sq. in.*	*1,000 lb. per sq. in.*	*In.-lb. per cu. in.*	*In.-lb. per cu. in.*	*Lb. per sq. in.*	*Inches*	*Lb. per sq. in.*	*Lb. per sq. in.*	*Lb. per sq. in.*	*Lb. per sq. in.*	*Lb.*	*Lb.*
Hemlock, eastern (*Tsuga canadensis*)	111	.38	3,800	6,400	1,070	.76	6.7	7,900	21	2,600	3,080	440	850	500	400
	12	.40	6,100	8,900	1,200	1.79	6.8	10,700	21	4,020	5,410	800	1,060	810	500
Hemlock, western (*Tsuga heterophylla*)	74	.38	3,400	6,100	1,220	.57	6.8	8,100	22	2,480	2,990	390	810	520	430
	12	.42	6,800	10,100	1,490	1.82	7.5	12,400	26	5,340	6,210	680	1,170	940	580
Hickory, pecan[7] (*Hicoria* sp.)	68	.59	5,300	9,900	1,380	1.18	19.3	14,200	60	3,810	4,320	980	1,260	1,274	1,308
	12	.65	9,100	16,300	1,780	2.61	18.8	20,900	57	6,360	8,280	2,040	1,770	1,930	1,820
Hickory, true[8] (*Hicoria* sp.)	57	.65	6,100	11,300	1,570	1.34	28.9	15,700	88	3,650	4,570	1,080	1,360	------	------
	12	.73	10,900	19,700	2,180	3.07	27.2	22,900	75	------	8,970	2,310	2,140	------	------
Honey locust (*Gleditsia triacanthos*)	63	.60	5,600	10,200	1,290	1.40	12.6	11,800	47	3,320	4,420	1,420	1,660	1,440	1,390
	12	------	8,800	14,700	1,630	2.74	13.3	15,400	47	5,250	7,500	2,280	2,250	1,860	1,580
Larch, western (*Larix occidentalis*)	58	.48	4,600	7,500	1,350	1.01	7.1	9,400	24	3,250	3,800	560	920	470	450
	12	.52	7,900	11,900	1,710	2.46	8.0	15,100	32	5,950	7,490	1,080	1,360	1,110	760
Locust, black (*Robinia pseudoacacia*)	40	.66	8,800	13,800	1,850	2.36	15.4	18,300	44	6,120	6,800	1,530	1,760	1,640	1,570
	12	.69	12,800	19,400	2,050	4.62	18.4	21,100	57	6,800	10,180	2,260	2,480	1,580	1,700
Magnolia, cucumber (*Magnolia acuminata*)	80	.44	4,200	7,400	1,560	.66	10.0	9,300	30	2,810	3,140	410	990	600	520
	12	.48	8,000	12,300	1,820	1.98	12.2	14,700	35	4,840	6,310	710	1,340	950	700
Magnolia, evergreen (*Magnolia grandiflora*)	105	.46	3,600	6,800	1,110	.67	15.4	8,800	54	2,160	2,700	570	1,040	780	740
	12	.50	6,800	11,200	1,400	1.90	12.8	13,600	29	3,420	5,460	1,060	1,530	1,280	1,020
Maple, bigleaf (*Acer macrophyllum*)	72	.44	4,400	7,400	1,100	1.02	8.7	8,500	23	2,510	3,240	550	1,110	760	620
	12	.48	6,600	10,700	1,450	1.66	7.8	------	28	4,790	5,950	930	1,730	1,330	850
Maple, black (*Acer nigrum*)	65	.52	4,100	7,900	1,330	.70	12.8	10,200	48	2,800	3,270	740	1,130	940	840
	12	.57	8,300	13,300	1,620	2.39	12.5	13,500	40	4,600	6,680	1,250	1,820	1,700	1,180
Maple, red (*Acer rubrum*)	63	.49	3,800	7,700	1,390	.71	11.4	------	32	2,360	3,280	500	1,150	780	------
	12	.54	8,700	13,400	1,640	2.84	12.5	------	32	4,650	6,540	1,240	1,850	1,430	------
Maple, silver (*Acer saccharinum*)	66	.44	3,100	5,800	940	.61	11.0	6,800	29	1,930	2,490	460	1,050	670	590
	12	.47	6,200	8,900	1,140	1.90	8.3	12,400	25	4,360	5,220	910	1,480	1,140	700

Maple, sugar (*Acer saccharum*)	58	.56	5,100	9,400	1,550	1.03	13.3	12,200	40	2,850	4,020	800	1,460	1,070	970
	12	.63	9,500	15,800	1,830	2.76	16.5	20,600	39	5,390	7,830	1,810	2,330	1,840	1,450
Oak, red [9] (*Quercus* p.)	80	.57	4,400	8,500	1,360	.85	12.6	10,800	43	2,590	3,520	800	1,220	1,050	1,030
	12	.63	8,400	14,400	1,810	2.30	15.0	17,000	43	4,610	6,920	1,260	1,830	1,490	1,300
Oak, white [10] (*Quercus* sp.)	70	.59	4,700	8,100	1,200	1.08	11.3	10,900	42	2,940	3,520	850	1,270	1,110	1,070
	12	.67	7,900	13,900	1,620	2.31	13.3	17,400	39	4,350	7,040	1,410	1,890	1,420	1,330
Pine, lodgepole (*Pinus contorta*)	65	.38	3,000	5,500	1,080	.49	5.6	7,200	20	2,110	2,610	310	680	320	330
	12	.41	6,700	9,400	1,340	1.97	6.8	9,600	20	4,310	5,370	750	880	530	480
Pine, northern white (*Pinus strobus*)	68	.34	3,100	5,000	1,020	.54	5.2	6,700	17	2,060	2,490	290	660	310	310
	12	.36	6,000	8,800	1,280	1.59	6.7	9,500	19	3,680	4,840	550	860	500	400
Pine, Norway (*Pinus resinosa*)	54	.44	3,700	6,400	1,380	.59	5.8	7,500	28	2,410	3,080	360	780	360	340
	12	.48	9,400	12,500	1,800	2.78	10.0	15,900	25	5,330	7,340	830	1,230	670	580
Pine, ponderosa (*Pinus ponderosa*)	91	.38	3,100	5,000	970	.59	5.1	6,800	20	2,070	2,400	360	680	300	310
	12	.40	6,300	9,200	1,260	1.85	6.6	9,800	17	4,060	5,270	740	1,160	550	450
Pines, southern yellow:															
Loblolly (*Pinus taeda*)	81	.47	4,100	7,300	1,410	.68	8.2	8,900	30	2,550	3,490	480	850	420	450
	12	.51	7,800	12,800	1,800	1.92	10.4	12,100	30	4,820	7,080	980	1,370	750	690
Longleaf (*Pinus palustris*)	63	.54	5,200	8,700	1,600	.95	8.9	10,100	35	3,430	4,300	590	1,040	550	590
	12	.58	9,300	14,700	1,990	2.44	11.8	15,400	34	6,150	8,440	1,190	1,500	920	870
Shortleaf (*Pinus echinata*)	81	.46	3,900	7,300	1,390	.63	8.2	8,600	30	2,500	3,430	440	850	410	440
	12	.51	7,700	12,800	1,760	1.93	11.0	13,600	33	5,090	7,070	1,000	1,310	750	690
Pine, sugar (*Pinus lambertiana*)	137	.35	3,400	5,100	940	.70	5.4	7,400	17	2,330	2,530	350	680	320	310
	12	.36	5,700	8,000	1,200	1.53	5.5	10,700	18	4,140	4,770	590	1,050	530	380
Pine, western white (*Pinus monticola*)	54	.36	3,400	5,200	1,170	.56	5.0	7,600	19	2,430	2,650	290	640	310	310
	12	.38	6,200	9,500	1,510	1.47	8.8	11,900	23	4,480	5,620	540	----------	440	370
Poplar, yellow (*Liriodendron tulipifera*)	64	.38	3,400	5,400	1,090	.62	5.4	8,600	18	1,930	2,420	330	740	390	340
	12	.40	6,100	9,200	1,500	1.43	6.8	13,500	20	3,550	5,290	580	1,100	560	450
Redwood (virgin) (*Sequoia sempervirens*)	112	.38	4,800	7,500	1,180	1.18	7.4	8,900	21	3,700	4,200	520	800	570	410
	12	.40	6,900	10,000	1,340	2.04	6.9	10,200	19	4,560	6,150	860	940	790	480
Spruce, eastern [11] (*Picea* sp.)	46	.38	3,300	5,600	1,110	.57	6.5	7,000	21	2,120	2,600	290	710	390	340
	12	.40	6,500	10,100	1,440	1.68	8.4	11,400	22	4,160	5,590	590	1,070	630	490
Spruce Engelmann (*Picea engelmannii*)	100	.31	2,500	4,200	830	.43	4.9	5,800	14	1,680	1,980	290	590	250	240
	12	.33	6,000	8,500	1,160	1.64	5.6	9,000	15	3,580	4,580	640	1,010	450	310
Spruce, Sitka (*Picea sitchensis*)	42	.37	3,300	5,700	1,230	.53	6.3	8,400	24	2,240	2,670	340	760	430	350
	12	.40	6,700	10,200	1,570	1.62	9.4	11,400	25	4,780	5,610	710	1,150	660	510
Sugarberry (*Celtis laevigata*)	62	.47	3,200	6,600	810	.78	12.0	8,200	33	1,990	2,800	580	1,050	840	740
	12	.51	6,200	9,900	1,140	2.18	11.2	11,600	36	3,970	5,620	1,240	1,280	1,280	960
Sycamore (*Platanus occidentalis*)	83	.46	3,300	6,500	1,060	.60	7.5	8,800	26	2,400	2,920	450	1,000	700	610
	12	.49	6,400	10,000	1,420	1.66	8.5	10,500	26	3,710	5,380	860	1,470	920	770
Tamarack (*Larix laricina*)	52	.49	4,200	7,200	1,240	.84	7.2	7,800	28	2,930	3,480	480	860	400	380
	12	.53	8,000	11,600	1,640	2.19	7.1	12,500	23	4,780	7,160	990	1,280	670	590
Walnut, black (*Juglans nigra*)	81	.51	5,400	9,500	1,420	1.16	14.6	11,900	37	3,520	4,300	600	1,220	960	900
	12	.55	10,500	14,600	1,680	3.70	10.7	16,400	34	5,780	7,580	1,250	1,370	1,050	1,010

[7] Average of bitternut hickory (*Hicoria cordiformis*), nutmeg hickory (*H. myristicaeformis*), water hickory (*H. aquatica*), and pecan (*H. pecan*).
[8] Average of bigleaf shagbark hickory (*Hicoria laciniosa*), mockernut hickory (*H. alba*), pignut hickory (*H. glabra*), and shagbark hickory (*H. ovata*).
[9] Average of black oak (*Quercus velutina*), laurel oak (*Q. laurifolia*), pin oak (*Q. palustris*), red oak (*Q. borealis*), scarlet oak (*Q. coccinea*), southern red oak (*Q. rubra*), swamp red oak (*Q. rubra pagodaefolia*), water oak (*Q. nigra*), and willow oak (*Q. phellos*).
[10] Average of bur oak (*Quercus macrocarpa*), chestnut oak (*Q. montana*), post oak (*Q. stellata*), swamp chestnut oak (*Q. prinus*), swamp white oak (*Q. bicolor*), and white oak (*Q. alba*).
[11] Average of black spruce (*Picea mariana*), red spruce (*P. rubra*), and white spruce (*P. glauca*).

CONTROL OF MOISTURE CONTENT AND SHRINKAGE OF WOOD [3]

EQUILIBRIUM MOISTURE CONTENT

Any piece of wood will give off or take on moisture from the surrounding atmosphere until the moisture in the wood has come to a balance with that in the atmosphere. The moisture in the wood at the point of balance is called the equilibrium moisture content.

Assuming constant temperature, the ultimate moisture content that a given piece of wood will attain depends entirely upon the relative humidity of the atmosphere surrounding it, which is the amount of vapor in the air expressed as a percentage of the amount it would hold at saturation. This relationship is illustrated by figure 1, which shows, for example, that wood kept in an atmosphere constantly at 70° F and 60-percent relative humidity will eventually come to a moisture content of about 11 percent.

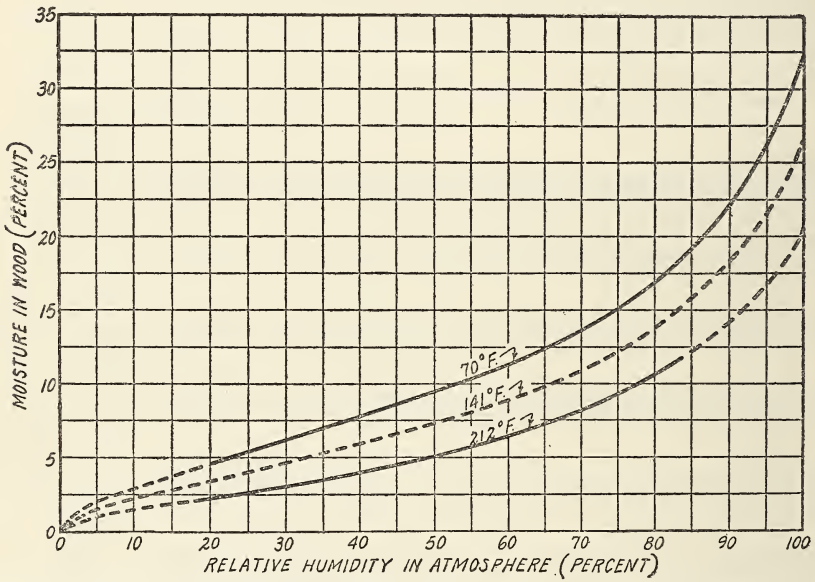

FIGURE 1.—Relation of the equilibrium moisture content of wood to the relative humidity of the surrounding atmosphere at three temperatures.

Changes in the relative humidity of the atmosphere range from the usual daily fluctuations to marked seasonal variations. Thus wood, when exposed to ordinary atmospheric conditions, is virtually always undergoing at least slight changes in moisture content because of its tendency to come to a balance with the surrounding air. The change, however, is a very gradual one and is further retarded by protective coatings such as varnish or paint. The practical objective of all correct seasoning and handling methods is to minimize moisture variations in wood by simple means of control that will adapt the material most fully to average atmospheric conditions in service. * * *

It is the general commercial practice to dry some wood products, such as flooring (Teesdale, Leaflet 56) and furniture wood to a lower moisture content than service conditions demand, counting on a moderate increase in moisture content during the storage and manufacturing period. This practice is intended to assure a uniform distribution of moisture among the individual pieces. Other wood products, such as finish and millwork lumber, are not seasoned to so low a moisture content. * * *

[3] Reprinted from Wood Handbook, by permission of the Forest Products Laboratory, Madison, Wis

SHRINKAGE OF WOOD

Wood, like many other materials, shrinks as it loses moisture and swells as it absorbs moisture.

While wood in its green condition as it comes from the tree may contain from 30 to 250 percent water (Mathewson, and Thelen), based on the weight of the oven-dry wood, the removal of only the last 25 or 30 percent of this moisture content has the effect of shrinking the wood on drying out; and since wood in service is never totally dry, the possible shrinkage effect falls within a relatively narrow range. Water is held in the wood in two distinct ways—imbibed water in the walls of the wood cells, and free water in the cell cavities. When the wood begins to dry the free water leaves first, followed by the imbibed water. The fiber-saturation point is that condition in which all the free water has been removed but all the imbibed water remains; for most woods this point is between 25- and 30-percent moisture content.

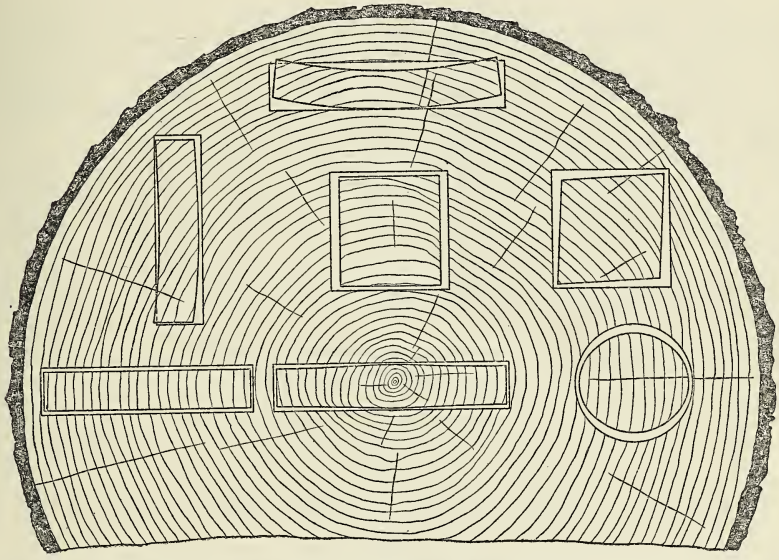

FIGURE 2.—Characteristic shrinkage and distortion of flats, squares, and rounds as affected by the direction of the annual rings. Tangential shrinkage is about twice as great as radial.

Wood changes size with moisture content only below the fiber-saturation point. Since in seasoning green wood the surface dries more rapidly than the interior and reaches the fiber-saturation point first, shrinkage may start while the average moisture content is considerably above the fiber-saturation point. Wood shrinks most in the direction of the annual growth rings (tangentially), about one-half to two-thirds as much across these rings (radially), and very little, as a rule, along the grain (longitudinally). The joint effects of radial and tangential shrinkage on the shape of various sections in drying from the green condition are illustrated in figure 2. When a board is excessively cross-grained the lengthwise shrinkage is a combination of crosswise and longitudinal shrinkage, resulting in a greater shortening than would occur in a straight-grained piece. Shrinkage is usually expressed as a percentage of the green dimensions, which represent the natural size of the piece. Table 3 gives the range in shrinkage in different directions for most of the commercially important native species.

TABLE 3.—*Range in average shrinkage of a number of native species of wood*

Direction of shrinkage	From green to oven-dry condition	From green to air-dry condition (12- to 15-percent moisture content)
	Percent of green size	*Percent of green size*
Tangential	4.3–14	2.1 –7
Radial	2 – 8.5	1 – 4.2
Longitudinal	.1– .2	.05– .1
Volumetric	7 –21	3.5 –10.5

Shrinkage in drying is proportional to the moisture lost below the fiber-saturation point. Approximately one-half the total shrinkage possible has occurred in wood seasoned to an air-dry condition (12- to 15-percent moisture content) and about three-fourths in lumber kiln dried to a moisture content of about 7 percent. Hence, if wood is properly seasoned, manufactured, and installed at a moisture content in accord with its service conditions, there is every prospect of satisfactory performance without serious changes in size or distortion of section.

In general, the heavier species of wood shrink more across the grain than the lighter ones. Heavier pieces also shrink more than lighter pieces of the same species. When shrinkage is more of a factor than hardness or strength a lightweight species should be chosen. When both hardness or strength and low shrinkage are very important then an exceptional species, such as black locust, should be chosen.

The average tangential, radial, and volumetric shrinkages for individual species dried to an air-dry, kiln-dry, or oven-dry condition are given in table 4.

TABLE 4.—*Shrinkage values for commercially important woods grown in the United States*

Species	Shrinkage (percent of dimension when green) from green to—								
	Air dried to 12- to 15-percent moisture (estimated values)			Kiln dried to 6- to 7-percent moisture (estimated values)			Oven dried to 0-percent moisture (test values)		
	Radial	Tangential	Volumetric	Radial	Tangential	Volumetric	Radial	Tangential	Volumetric
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Alder, red	2.2	3.6	6.3	3.3	5.5	9.4	4.4	7.3	12.6
Ash:									
Black	2.5	3.9	7.6	3.8	5.8	11.4	5.0	7.8	15.2
Commercial white [3]	2.3	3.8	6.4	3.4	5.6	9.6	4.6	7.5	12.8
Oregon	2.0	4.0	6.6	3.1	6.1	9.9	4.1	8.1	13.2
Aspen	1.8	3.4	5.8	2.6	5.0	8.6	3.5	6.7	11.5
Basswood	3.3	4.6	7.9	5.0	7.0	11.8	6.6	9.3	15.8
Beech	2.6	5.5	8.2	3.8	8.2	12.2	5.1	11.0	16.3
Birch [4]	3.4	4.4	8.2	5.2	6.7	12.2	6.9	8.9	16.3
Birch, paper	3.2	4.3	8.1	4.7	6.4	12.2	6.3	8.6	16.2
Butternut	1.6	3.0	5.1	2.5	4.6	7.6	3.3	6.1	10.2
Cedar:									
Alaska	1.4	3.0	4.6	2.1	4.5	6.9	2.8	6.0	9.2
Eastern red	1.6	2.4	3.9	2.3	3.5	5.8	3.1	4.7	7.8
Incense	1.6	2.6	3.8	2.5	3.9	5.7	3.3	5.2	7.6
Northern white	1.0	2.4	3.5	1.6	3.5	5.2	2.1	4.7	7.0
Port Orford	2.3	3.4	5.0	3.4	5.2	7.6	4.6	6.9	10.1
Southern white	1.4	2.6	4.2	2.1	3.9	6.3	2.8	5.2	8.4
Western red	1.2	2.5	3.8	1.8	3.8	5.8	2.4	5.0	7.7
Cherry, black	1.8	3.6	5.8	2.8	5.3	8.6	3.7	7.1	11.5
Chestnut	1.7	3.4	5.8	2.6	5.0	8.7	3.4	6.7	11.6
Cottonwood:									
Eastern	2.0	4.6	7.0	2.9	6.9	10.6	3.9	9.2	14.1
Northern black	1.8	4.3	6.2	2.7	6.4	9.3	3.6	8.6	12.4
Cypress, southern	1.9	3.1	5.2	2.8	4.6	7.9	3.8	6.2	10.5

See footnotes at end of table.

TABLE 4.—*Shrinkage values for commercially important woods grown in the United States*—Continued

Species	Shrinkage (percent of dimension when green) from green to—								
	Air dried to 12- to 15-percent moisture (estimated values)			Kiln dried to 6- to 7-percent moisture (estimated values)			Oven dried to 0-percent moisture (test values)		
	Radial	Tangential	Volumetric	Radial	Tangentiall	Volumetric	Radial	Tangential	Volumetric
Douglas fir:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Coast region	2.5	3.9	5.9	3.8	5.8	8.8	5.0	7.8	11.8
"Inland Empire" region	2.0	3.8	5.4	3.1	5.7	8.2	4.1	7.6	10.9
Rocky Mountain region	1.8	3.1	5.3	2.7	4.6	8.0	3.6	6.2	10.6
Elm:									
American	2.1	4.8	7.3	3.2	7.1	11.0	4.2	9.5	14.6
Rock	2.4	4.0	7.0	3.6	6.1	10.6	4.8	8.1	14.1
Slippery	2.4	4.4	6.9	3.7	6.7	10.4	4.9	8.9	13.8
Fir:									
Balsam	1.4	3.3	5.4	2.1	5.0	8.1	2.8	6.6	10.8
Commercial white [5]	1.6	3.6	4.9	2.4	5.3	7.4	3.2	7.1	9.8
Gum:									
Black	2.2	3.8	7.0	3.3	5.8	10.4	4.4	7.7	13.9
Red	2.6	5.0	7.5	3.9	7.4	11.2	5.2	9.9	15.0
Tupelo	2.1	3.8	6.2	3.2	5.7	9.4	4.2	7.6	12.5
Hackberry	2.4	4.4	6.9	3.6	6.7	10.4	4.8	8.9	13.8
Hemlock:									
Eastern	1.5	3.4	4.8	2.2	5.1	7.3	3.0	6.8	9.7
Western	2.2	4.0	6.0	3.2	5.9	8.9	4.3	7.9	11.9
Hickory:									
Pecan [6]	2.4	4.4	6.8	3.7	6.7	10.2	4.9	8.9	13.6
True [7]	3.6	5.7	9.0	5.5	8.6	13.4	7.3	11.4	17.9
Honey locust	2.1	3.3	5.4	3.2	5.0	8.1	4.2	6.6	10.8
Larch, western	2.1	4.0	6.6	3.2	6.1	9.9	4.2	8.1	13.2
Locust, black	2.2	3.4	4.9	3.3	5.2	7.4	4.4	6.9	9.8
Magnolia:									
Cucumber	2.6	4.4	6.8	3.9	6.6	10.2	5.2	8.8	13.6
Evergreen	2.7	3.3	6.2	4.0	5.0	9.2	5.4	6.6	12.3
Maple:									
Bigleaf	1.8	3.6	5.8	2.8	5.3	8.7	3.7	7.1	11.6
Black	2.4	4.6	7.0	3.6	7.0	10.5	4.8	9.3	14.0
Red	2.0	4.1	6.6	3.0	6.2	9.8	4.0	8.2	13.1
Silver	1.5	3.6	6.0	2.2	5.4	9.0	3.0	7.2	12.0
Sugar	2.4	4.8	7.4	3.7	7.1	11.2	4.9	9.5	14.9
Oak:									
Red [8]	2.2	4.5	7.4	3.2	6.8	11.1	4.3	9.0	14.8
White [9]	2.7	4.6	8.0	4.0	7.0	12.0	5.4	9.3	16.0
Pine:									
Loblolly	2.4	3.7	6.2	3.6	5.6	9.2	4.8	7.4	12.3
Lodgepole	2.2	3.4	5.8	3.4	5.0	8.6	4.5	6.7	11.5
Longleaf	2.6	3.8	6.1	3.8	5.6	9.2	5.1	7.5	12.2
Northern white	1.2	3.0	4.1	1.7	4.5	6.2	2.3	6.0	8.2
Norway	2.3	3.6	5.8	3.4	5.4	8.6	4.6	7.2	11.5
Ponderosa	2.0	3.2	4.8	2.9	4.7	7.2	3.9	6.3	9.6
Shortleaf	2.2	3.8	6.2	3.3	5.8	9.2	4.4	7.7	12.3
Sugar	1.4	2.8	4.0	2.2	4.2	5.9	2.9	5.6	7.9
Western white	1.3	2.6	5.9	2.0	4.0	8.8	2.6	5.3	11.8
Poplar, yellow	2.0	3.6	6.2	3.0	5.3	9.2	4.0	7.1	12.3
Redwood	1.3	2.2	3.4	2.0	3.3	5.1	2.6	4.4	.86
Spruce:									
Eastern [10]	2.2	3.8	6.3	3.2	5.8	9.4	4.3	7.7	12.6
Engelmann	1.7	3.3	5.2	2.6	5.0	7.8	3.4	6.6	10.4
Sitka	2.2	3.8	5.8	3.2	5.6	8.6	4.3	7.5	11.5
Sugarberry	2.5	3.6	6.4	3.8	5.5	9.5	5.0	7.3	12.7
Sycamore	2.6	3.8	7.1	3.8	5.7	10.6	5.1	7.6	14.2
Tamarack	1.8	3.7	6.8	2.8	5.6	10.2	3.7	7.4	13.6
Walnut, black	2.6	3.6	5.6	3.9	5.3	8.5	5.2	7.1	11.3

[1] These shrinkage values have been taken as ½ the shrinkage to the oven-dry condition as given in the last 3 columns of this table.

[2] These shrinkage values have been taken as ¾ the shrinkage to the oven-dry condition as given in the last 3 columns of this table.

[3] Average of Biltmore white ash, blue ash, green ash, and white ash.

[4] Average of sweet birch and yellow birch.

[5] Average of lowland white fir and white fir.

[6] Average of bitternut hickory, nutmeg hickory, water hickory, and pecan.

[7] Average of bigleaf shagbark hickory, mockernut hickory, pignut hickory, and shagbark hickory.

[8] Average of black oak, laurel oak, pin oak, red oak, scarlet oak, southern red oak, swamp red oak, water oak, and willow oak.

[9] Average of bur oak, chestnut oak, post oak, swamp chestnut oak, swamp white oak, and white oak.

[10] Average of black spruce, red spruce, and white spruce.

Theoretically the normal moisture content-shrinkage relation may be considered a direct one, from zero shrinkage at the fiber-saturation point to maximum shrinkage at zero moisture content. Actually the relationship in lumber of commercial size is similar to the curves in figure 3, but for practical use a straight-line relation may be assumed without appreciable error. The curves represent average values, and the shrinkage of an individual board may, of course, be above or below the amount indicated.

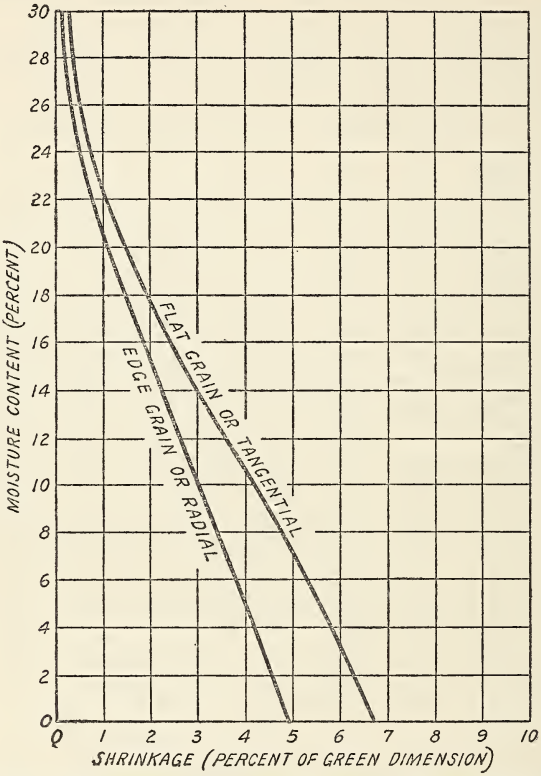

FIGURE 3.—Typical moisture-shrinkage curves. These curves are for Douglas fir and southern yellow pine and may be used for estimating the amount of change in dimension that will take place with change in the moisture content of the wood.

Changes in moisture content in seasoned wood, such as those caused by seasonal variation in relative humidity, produce changes in dimension proportional to the moisture-content changes. For example, assume that a piece of flat-sawed southern yellow pine sheathing at 12 percent moisture content loses 5 percent of moisture. The shrinkage curve (marked "tangential") indicates that from the green condition to 7 percent moisture content the shrinkage in width would be 5 percent and to 12-percent moisture content would be 3½ percent. The difference of 1½ percent indicates the shrinkage in width of the board because of the 5 percent loss in moisture. These curves represent average values, and the shrinkage of an individual board may be below or above the indicated amount.

GLOSSARY [4]

Air-dried. (See Seasoning.)
Annual growth ring. (See Ring, annual growth.)
Bastard sawn. Hardwood lumber in which the annual rings make angles of 30° to 60° with the surface of the piece.
Birdseye. A small central spot with the wood fibers arranged around it in the form of an ellipse so as to give the appearance of an eye.
Blemish. Anything, not necessarily a defect, marring the appearance of wood.
Blue stain. (See Stain, blue.)
Bow. That distortion of a board in which the face is convex or concave longitudinally.
Brashness. A condition of wood characterized by low resistance to shock and by an abrupt failure across the grain without splintering.
Broad-leaved trees. (See Hardwoods.)
Brown stain. (See Stain, brown.)
Burl. A large wartlike excrescence on a tree trunk. It contains the dark piths of a large number of buds which rarely develop. The formation of a burl apparently results from an injury to the tree.
Cell. A general term for the minute units of wood structure. It includes fibers, vessel segments, and other elements of diverse structure and functions.
Cellulose. The carbohydrate that is the principal constitutent of wood and forms the framework of the cells.
Check. A lengthwise separation of the wood, the greater part of which occurs across the rings of annual growth.
Chemical brown stain. (See Stain, chemical brown.)
Close-grained wood. (See Grain.)
Coarse-grained wood. (See Grain.)
Collapse.—The flattening of single cells or rows of cells in heartwood during the drying or pressure treatment of wood, characterized externally by a caved-in or corrugated appearance.
Compression wood. Abnormal wood that often forms on the lower side of branches and of leaning trunks of softwood trees. Compression wood is identified by its relatively wide annual rings, usually eccentric, and its relatively large amount of summer wood, usually more than 50 percent of the width of the annual rings in which it occurs. Compression wood shrinks excessively lengthwise as compared with normal wood.
Conifer. (See Softwoods.)
Crook. That distortion of a board in which the edge is convex or concave longitudinally.
Cross band. To place the grain of layers of wood at right angles in order to minimize shrinking and swelling and consequent warping; also the layer of veneer at right angles to the face plies.
Cross break. A separation of the wood cells across the grain. Such breaks may be due to internal strains resulting from unequal longitudinal shrinkage or to external forces.
Cross grain. (See Grain.)
Cup. The distortion of a board in which the face is convex or concave transversely.
Decay. Disintegration of wood substance through the action of wood-destroying fungi.
Incipient decay. The early stage of decay in which the disintegration has not proceeded far enough to soften or otherwise impair the hardness of the wood perceptibly.
Typical or advanced decay. The stage of decay in which the disintegration is readily recognized because the wood has become punky, soft and spongy, stringy, pitted, or crumbly.
Defect. Any irregularity occurring in or on wood that may lower its strength.
Density. The mass of a body per unit volume. When expressed in the metric system, it is numerically equal to the specific gravity of the same substance.
Diagonal grain. (See Grain.)
Diamond. A distortion in drying that causes a piece of wood originally rectangular in cross section to become diamond-shaped.

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Diffuse-porous woods. Hardwoods in which the pores are practically uniform in size throughout each annual ring, or decrease slightly toward the outer border of the ring.

Dote. "Dote", "doze", and "rot" are synonymous with "decay", and are any form of decay which may be evident as either a discoloration or a softening of the wood.

Dry rot. A term loosely applied to many types of decay but especially to that which, when in an advanced stage, permits the wood to be easily crushed to a dry powder. The term is actually a misnomer for any decay, since all fungi require considerable moisture for growth.

Durability. A general term for permanence or lastingness. Frequently used to refer to the degree of resistance of a species or of an individual piece of wood to attack by wood-destroying fungi under conditions that favor such attack. In this connection the term "resistance to decay" is more specific.

Edge grain. (See Grain.)

Encased knot. (See Knot.)

Extractives. Substances in wood, not an integral part of the cellular structure, that can be dissolved out with hot or cold water, ether, benzene, or other relatively inert solvents.

Equilibrium moisture content. The moisture content at which wood neither gains nor loses moisture when surrounded by air at a given relative humidity and temperature.

Fiber. A wood fiber is a comparatively long (one-twenty-fifth or less to one-third inch), narrow, tapering cell closed at both ends.

Fiber-saturation point. The stage in the drying or in the wetting of wood at which the cell walls are saturated and the cell cavities are free from water.

Figure. The pattern produced in a wood surface by irregular coloration and by annual growth rings, rays, knots, and such deviations from regular grain as interlocked and wavy grain.

Flakes. (See Rays, wood.)

Flat grain. (See Grain.)

Flitch. A thick piece of lumber with wane (bark) on one or more edges.

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

Close-grained wood. Wood with narrow and inconspicuous annual rings. The term is sometimes used to designate wood having small and closely-spaced pores, but in this sense the term "fine textured" is more often used.

Coarse-grained wood. Wood with wide and conspicuous annual rings; that is, rings in which there is considerable difference between spring wood and summer wood. The term is sometimes used to designate wood with large pores, such as oak, ash, chestnut, and walnut, but in this sense the term "coarse textured" is more often used.

Cross grain. Grain not parallel with the axis of a piece. It may be either diagonal or spiral grain or a combination of the two.

Diagonal grain. Annual rings at an angle with the axis of a piece as a result of sawing at an angle with the bark of the tree.

Edge grain. Edge-grain lumber has been sawed parallel with the pith of the log and approximately at right angles to the growth rings; that is, the rings form an angle of 45° or more with the surface of the piece.

Flat grain. Flat-grain lumber has been sawed parallel with the pith of the log and approximately tangent to the growth rings; that is, the rings form an angle of less than 45° with the surface of the piece.

Interlocked-grain wood. Wood in which the fibers are inclined in one direction in a number of rings of annual growth, then gradually reverse and are inclined in an opposite direction in succeeding growth rings, then reverse again.

Open-grained wood. Common classification of painters for woods with large pores, such as oak, ash, chestnut, and walnut. Also known as "coarse textured."

Plain-sawed. Another term for flat grain.

Quarter-sawed. Another term for edge grain.

Spiral grain. A type of growth in which the fibers take a spiral course about the bole of a tree instead of the normal vertical course. The spiral may extend right-handed or left-handed around the tree trunk.

Vertical grain. Another term for edge grain.

Wavy-grained wood. Wood in which the fibers collectively take the form of waves or undulations.

Green. Unseasoned, wet.

Growth ring. (See Ring, annual growth.)

Hardwoods. The botanical group of trees that are broadleaved. The term has no reference to the actual hardness of the wood. Angiosperms is the botanical name for hardwoods.

Heart, Heartwood. The wood, extending from the pith to the sapwood, the cells of which no longer participate in the life processes of the tree. Heartwood may be infiltrated with gums, resins, and other materials which usually make it darker and more decay-resistant than sapwood.

Honeycomb.—Checks, often not visible at the surface, that occur in the interior of a piece, usually along the wood rays.

Imperfect manufacture.—Includes all defects or blemishes which are produced in manufacturing, such as chipped grain, loosened grain, raised grain, torn grain, skips in dressing, hit and miss, variation in sawing, miscut lumber, machine burn, machine gouge, mismatching, and insufficient tongue or groove.

Interlocked grained wood. (See Grain.)

Kiln. A heated chamber for drying lumber.

Kiln brown stain. (See Stain, chemical brown.)

Kiln dried. (See Seasoning.)

Knot. That portion of a branch or limb that has become incorporated in the body of a tree.

Decayed knot. A knot which, due to advanced decay, is not so hard as the surrounding wood.

Encased knot. A knot whose rings of annual growth are not intergrown with those of the surrounding wood.

Intergrown knot. A knot whose rings of annual growth are completely intergrown with those of the surrounding wood.

Round knot. A knot whose sawn section is oval or circular.

Sound knot. A knot which is solid across its face and which is as hard as the surrounding wood.

Spike knot. A knot sawn in a lengthwise direction.

Laminated wood. A piece of wood built up of plies or laminations that have been joined either with glue or with mechanical fastenings. The term is most frequently applied where the plies are too thick to be classified as veneer and when the grain of all plies is parallel.

Lignin. A principal constituent of wood, second in quantity to cellulose. It incrusts the cell walls and cements the cells together.

Moisture content of wood. Weight of the water contained in the wood usually expressed in percentage of the weight of the oven-dry wood.

Moisture gradient. A condition of graduated moisture content between the successive layers of a material, such as wood, due to the losing or absorbing of moisture. During seasoning the gradations are between the moisture content of the relatively dry surface layers and the wet layers at the center of the piece.

Open grained wood. (See Grain.)

Peck. Pockets or areas of disintegrated wood caused by advanced stages of localized decay in the living tree. It is usually associated with cypress and incense cedar. There is no further development of peck once the lumber is seasoned.

Pitch pocket. An opening extending parallel to the annual rings of growth usually containing, or which has contained, pitch, either solid or liquid.

Pith. The small soft core occurring in the structural center of a log.

Plywood. A piece of wood made of three or more layers of veneer joined with glue and usually laid with he grain of adjoining plies at right angles. Almost always an odd number of plies are used to secure balanced construction.

Plain-sawed. (See Grain.)

Pore. (See Vessel.)

Quarter-sawed. (See Grain.)

Radial. Coincident with a radius from the axis of the tree or log to the circumference.

Rate of growth. The rate at which a tree has laid on wood, measured radially in the trunk or in lumber cut from the trunk. The unit of measure in use is number of annual growth rings per inch.

Rays, wood. Strips of cells extending radially within a tree and varying in height from a few cells in some species to 4 inches or more in oak. The rays serve primarily to store food and transport it horizontally in the tree.

Ring, annual growth. The growth layer put on in a single growth year.

Ring-porous woods. A group of hardwoods in which the pores are comparatively large at the beginning of each annual ring and decrease in size more or less abruptly toward the outer portion of the ring, thus forming a distinct inner zone of pores known as the spring wood and the outer zone with smaller pores known as the summer wood.

Rot. (See Decay.)

Sap. All the fluids in a tree, special secretions and excretions, such as gum, excepted.

Sapwood. The layers of wood next to the bark, usually lighter in color than the heartwood, one-half inch to 3 or more inches wide that are actively involved in the life processes of the tree. Under most conditions sapwood is more susceptible to decay than heartwood; as a rule, it is more permeable to liquids than heartwood. Sapwood is not essentially weaker or stronger than heartwood of the same species.

Seasoning. Removing moisture from green wood in order to improve its serviceability.

Air-dried or air seasoned. Dried by exposure to the air, usually in a yard, without artificial heat.

Kiln dried. Dried in a kiln with the use of artificial heat.

Second growth. Timber that has grown after the removal by any means of all or a large portion of the previous stand.

Shake. A separation along the grain, the greater part of which occurs between the rings of annual growth.

Softwoods. The botanical group of trees that have needle or scalelike leaves and are evergreen for the most part, cypress, larch, and tamarack being exceptions. The term has no reference to the actual hardness of the wood. Softwoods are often referred to as conifers, and botanically they are called gymnosperms.

Specific gravity. The ratio of the weight of a body to the weight of an equal volume of water at some standard temperature.

Spiral grain. (See Grain.)

Split. A lengthwise separation of the wood, due to the tearing apart of the wood cells.

Spring wood. The portion of the annual growth ring that is formed during the early part of the season's growth. It is usually less dense and weaker mechanically than summer wood.

Stain, blue. A bluish or grayish discoloration of the sapwood caused by the growth of certain moldlike fungi on the surface and in the interior of the piece; made possible by the same conditions that favor the growth of other fungi.

Stain, brown. A rich brown to deep chocolate-brown discoloration of the sapwood of some pines caused by a fungus that acts similarly to the blue-stain fungus.

Stain, chemical brown. A chemical discoloration of wood, which sometimes occurs during the air drying or the kiln drying of several species, apparently caused by the oxidation of extractives.

Stain, sap. (See Stain, blue.)

Strength.—The term in its broader sense embraces collectively all the properties of wood which enable it to resist different forces or loads. In its more restricted sense, strength may apply to any one of the mechanical properties, in which event the name of the property under consideration should be stated, thus strength in compression parallel to the grain, strength in bending, hardness, etc.

Summer wood. The portion of the annual growth ring that is formed during the latter part of the yearly growth period. It is usually more dense and stronger mechanically than spring wood.

Tangential. Strictly, coincident with a tangent at the circumference of a tree or log, or parallel to such a tangent. In practice, however, it often means roughly coincident with a growth ring.

Texture. A term often used interchangeably with grain. In the Wood Handbook it refers to the finer structure of the wood (see Grain) rather than the annual rings.

Tracheid. The elongated cells that constitute the greater part of the structure of the softwoods (frequently referred to as fibers). Also a portion of some hardwoods.

Twist. A distortion caused by the turning or winding of the edges of a board so that the four corners of any face are no longer in the same plane.

Vertical grain. (See Grain).

Vessels. Wood cells of comparatively large diameter which have open ends and are set one above the other forming continuous tubes. The openings of the vessels on the surface of a piece of wood are usually referred to as pores.

Virgin growth. The original growth of mature trees.

Wane. Bark, or lack of wood or bark, from any cause, on edge or corner of a piece.

Warp. Any variation from a true or plane surface. Warp includes bow, crook, cup, and twist, or any combination thereof.

Wavy-grained wood. (See Grain.)

EFFECTIVE DATE

The standard became effective on October 1, 1936.

STANDING COMMITTEE

The following comprise the membership of the standing committee, which is to review, prior to circulation for acceptance, revisions proposed to keep the standard abreast of progress. Comment concerning the standard and suggestions for revision may be addressed to any member of the committee or to the Division of Trade Standards, National Bureau of Standards, which acts as secretary for the committee.

A. F. Deneke (chairman), Himmelberger-Harrison Manufacturing Co., Cape Girardeau, Mo.
C. B. Castner, Gamble Bros., Inc., Louisville, Ky.
Guy P. Darsey, Woodward Manufacturing Corporation, Austin, Tex.
Max Haden, E. L. Bruce Co., Little Rock, Ark.
O. William Lowry, Charles R. Sligh Co., Holland, Mich.
Chas. M. Rasche, Pekin Wood Products Co. (Chrysler Motor Co.), Helena, Ark.
J. W. Runyan, Fisher Tennessee Division, General Motors Corporation, Memphis, Tenn.
William J. Wenz, Auburn Wood Products, Inc., 13 Osborne St., Auburn, N. Y.

HISTORY OF PROJECT

Members of the Hardwood Dimension Manufacturers Association, representing the more important manufacturers of hardwood dimension lumber, had long felt the need of uniform grading specifications and measuring practices and, after several years experience with the use of their own grading rules, they were carefully revised by a committee appointed for that purpose and on January 20, 1936, the cooperation of the National Bureau of Standards was requested in bringing about their general acceptance and use as a commercial standard for the industry.

After several preliminary meetings, a general conference was called at Louisville, Ky., on June 26, 1936, to which were invited all interested manufacturers, distributors, and users of hardwood dimension lumber, for the purpose of considering and adjusting the proposed commercial standard, as submitted by the Association. After some modifications, the proposed standard was approved at the conference and recommended for circulation to and acceptance by all interested parties.

Endorsement of the recommended standard was received from most of the producers and many distributors and users of dimension stock and announcement was made that the standard would become effective beginning October 1, 1936.

ACCEPTANCE OF COMMERCIAL STANDARD

This sheet properly filled in, signed, and returned will provide for the recording of your organization as an acceptor of this commercial standard.

Date_____

Division of Trade Standards,
National Bureau of Standards,
Washington, D. C.

GENTLEMEN:

Having considered the statements on the reverse side of this sheet, we accept the Commercial Standard CS60–36 as our standard of practice in the

Production [1] Distribution [1] Use [1]

of hardwood dimension lumber.

We will assist in securing its general recognition and use, and will cooperate with the standing committee to effect revisions of the standard when necessary.

Signature_____

(Kindly typewrite or print the following lines)

Title_____

Company_____

Street address_____

City and State_____

[1] Please designate which group you represent by drawing lines through the other two. In the case of related interests, trade papers, colleges, etc., desiring to record their general approval, the words "in principle" should be added after the signature.

TO THE ACCEPTOR

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

1. *Enforcement.*—Commercial standards are commodity specifications voluntarily established by mutual consent of the industry. They present a common basis of understanding between the producer, distributor, and consumer and should not be confused with any plan of governmental regulation or control. The United States Department of Commerce has no regulatory power in the enforcement of their provisions, but since they represent the will of the industry as a whole, their provisions through usage soon become established as trade customs, and are made effective through incorporation into sales contracts by means of labels, invoices and the like.

2. *The acceptor's responsibility.*—The purpose of commercial standards is to establish for specific commodities, nationally recognized grades or consumer criteria 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 commercial 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 Department of Commerce in the voluntary establishment of commercial standards on a Nation-wide basis is fourfold: first, to act as an unbiased coordinator to bring all branches of the industry together for the mutually satisfactory adjustment of trade standards; second, to supply such assistance and advice as past experience with similar programs may suggest; third, to convass and record the extent of acceptance and adherence to the standard on the part of producers, distributors, and users; and fourth, after acceptance, to publish and promulgate the standard for the information and guidance of buyers and sellers of the commodity.

4. *Announcement and promulgation.*—When the standard has been endorsed by companies representing a satisfactory majority of production, the success of the project is announced. If, however, in the opinion of the standing committee of the industry or the Department of Commerce, the support of any standard is inadequate, the right is reserved to withhold promulgation and publication.

ACCEPTORS

The organizations and individuals listed below have accepted these grading rules as their standard of practice in the production, distribution, and use of hardwood dimension lumber. Such endorsement does not signify that they may not find it necessary to deviate from the standard, nor that producers so listed guarantee all of their products to conform with the requirements of this standard. Therefore specific evidence of quality certification should be obtained where required.

ASSOCIATIONS

Central Committee on Lumber Standards, Washington, D. C.
Empire State Forest Products Association, Albany, N. Y.
Hardwood Dimension Manufacturers Association, Louisville, Ky.
Hickory Handle Association, Inc., Hope, Ark. (In principle.)
Middle Atlantic Lumbermens Association, Philadelphia, Pa.
National Hardwood Lumber Association, Chicago, Ill. (In principle.)
National Lumber Manufacturers Association, Washington, D. C.
National Oak Flooring Manufacturers Association, Memphis, Tenn. (In principle.)
Southern Cypress Manufacturers' Association, Jacksonville, Fla. (In principle.)
Southern Hardwood Producers, Inc., New Orleans, La. (In principle.)
Southwestern Hardwood Manufacturers Club, New Orleans, La. (In principle.)

FIRMS

Adler Manufacturing Co., Louisville, Ky.
Angelus Furniture Manufacturing Co., Los Angeles, Calif.
Arcade Manufacturing Co., Freeport, Ill.
Arkansas Oak Flooring Co., Pine Bluff, Ark.
Avery Power Machinery Co., Peoria, Ill.
Behrend, Jacob, Philadelphia, Pa.
Bellingham Furniture Manufacturers, Inc., Bellingham, Wash.
Belmar Manufacturing Co., The, Canton, Pa.
Bennett Manufacturing Co., The, Westerville, Ohio.
Berne Furniture Co., Berne, Ind.
Bloom Manufacturing Co., The, Nashua, Iowa.
Bobb Furniture Co., Kalamazoo, Mich.
Boggs Manufacturing Corporation, Atlanta, N. Y.
Bonnell Publications, Inc., New York, N. Y. (In principle.)
Bradley Lumber Co. of Arkansas, Warren, Ark.
Bradley Lumber Sales Co., Warren, Ark.
Brillion Pulverizer Co., Brillion, Wis.
Bristol Door and Lumber Co., Bristol, Tenn.
Brown Dimension Co., Manistique, Mich.
Brown & Sons Lumber Co., Inc., W. P., Louisville, Ky. (In principle.)
Brownlee Co., The, River Rouge, Mich.
Bruce Co., E. L., Memphis, Tenn., and Little Rock, Ark.
Bryan Handle Co., Bryan, Ohio.
Buckstaff Co., Oshkosh, Wis.
Burnham Manufacturing Co., Los Angeles, Calif.
Charak Furniture Co., Boston, Mass.
Charlotte Furniture Co., Charlotte, Mich.
Chattahoochee Furniture Co., Flowery Branch, Ga.
Cleveland Model and Supply Co., Inc., Cleveland ,Ohio.
Cleveland-Oconee Lumber Co., The, Gardners, Ga.
Clore & Hawkins, Brightwood, Va. (In principle.)

Commercial Furniture Co., Chicago, Ill.
Company of Mastercraftsmen, Inc., Flushing, N. Y.
Connor Lumber and Land Co., Laona, Wis.
Coolerator Corporation, The, Duluth, Minn.
Curtis Bros. & Co., Clinton, Iowa.
Davenport Cabinet Works, Inc., Davenport, Iowa.
Davis-Birely Table Co., Shelbyville, Ind.
DeMoulin Bros. & Co., Greenville, Ill.
DeSoto Hardwood Flooring Co., Memphis, Tenn.
Dierks Lumber and Coal Co., Kansas City, Mo.
Drew, Lyle S., Union, N. H.
Estey Manufacturing Co., Owosso, Mich.
Fancher Furniture Co., Salamanca, N. Y.
Farrin Lumber Co., The M. B., Cincinnati, Ohio.
Federal Equipment Co., Carlisle, Pa.
Ferguson Lumber Co., W. T., St. Louis, Mo.
Ferguson-Sherman, Inc., Evansville, Ind. (In principle.)
Fink & Schindler Co., The, San Francisco, Calif.
Fisher-Price Toys, Inc., East Aurora, N. Y.
Fisher Tennessee Division, General Motors Corporation, Memphis, Tenn. (In principle.);
Flach, Sanford A., Milwaukee, Wis.
Flint & Horner Co., New York, N. Y. (In principle.)
Fond du Lac Table Manufacturing Co., Fond du Lac, Wis.
Fort Smith Body Co., Fort Smith, Ark.
Frost Lumber Industries, Inc., Shreveport, La.
Galloway Co., Inc., The, Waterloo, Iowa.
Gamble Bros., Inc., Louisville, Ky.
Gardner Upholstered Furniture Co., Inc., Gardner, Mass.
Gem Manufacturing Corporation, Bascom, Ohio.
Gideon Anderson Lumber Co., St. Louis & Gideon, Mo.
Goodman Lumber Co., Goodman, Wis.
Graham Bros., Ruffin, S. C.
Great Southern Lumber Co., Bogalusa, La.
Hagemeyer Lumber Co., Cincinnati, Ohio.
Hale Manufacturing Co., F. E., Herkimer, N. Y.
Hallack & Howard Lumber Co., The, Denver, Colo.
Halsam Products Co., Chicago, Ill.
Henshaw Refrigeration and Fixture Co., San Francisco, Calif. (In principle.)
Hillerich-Bradsby Co., Louisville, Ky.
Hillyer Deutsch Edwards, Inc., Oakdale, La.
Himmelberger-Harrison Manufacturing Co., Cape Girardeau, Mo.
Hofstatter's Sons, Inc., Long Island City, N. Y.
Huntingburg Furniture Co., Huntingburg, Ind.
Huttig Sash and Door Co., St. Louis, Mo.
Hutton & Bourbonnais Co., Hickory, N. C.
Imperial Upholstering Co., Lowell, Mass.
Indianapolis Chair and Furniture Co., Aurora, Ind.
James Lumber Co., Boston, Mass.
James Manufacturing Co., Fort Atkinson, Wis.
Jamestown-Royal Upholstery Corporation, Jamestown, N. Y.
Jeffersonville Manufacturing Co., Jeffersonville, Ind.
Kalamazoo Tank and Silo Co., Kalamazoo, Mich.
Kaul Lumber Co., Birmingham, Ala.
Kemper Furniture Co., Cincinnati, Ohio.
Kent Coffey Manufacturing Co., Lenoir, N. C.
Kewaunee Manufacturing Co., Kewaunee, Wis.
Klopstock Bros., San Francisco, Calif.
Knauth Bros., New York, N. Y.
Kneeland-Bigelow Co., Bay City, Mich.
Kohn, J. & J., & Mundus, Inc., New York, N. Y.
Lamb, Ira, & Sons, Inc., Nashville, Tenn.
Levinson Manufacturing Co., Jersey City, N. J. (In principle.)
Lewittes & Sons, Inc., New York, N. Y.
Littlestown Hardware and Foundry Co., Inc., The, Littlestown, Pa.
Long-Bell Lumber Co., The, Kansas City, Mo.
Lynch Co., The D. W., Lancaster, Pa.
Manchester Furniture Co., The, Manchester, Ohio.
Marsh Furniture Co., High Point, N. C.
McLeod & Smith, Inc., Minneapolis, Minn.
Meadow River Lumber Co., The, Rainelle, W. Va.
Mell Lumber Co., Philadelphia, Pa.
Memphis Hardwood Flooring Co., Memphis, Tenn.
Mengel Body Co., Louisville, Ky.
Mersman Bros. Corporation, Celina, Ohio.
Meyer-Smith Co., Inc., Buffalo, N. Y.
Michelsen Furniture Co., George J., Rochester, N. Y.
Michigan Seating Co., Jackson, Mich.
Milwaukee Chair Co., Milwaukee, Wis.
Monteath Co., J. H., New York, N. Y.

Moosilauke Lumber & Robbin Co., Pike, N. H.
Morgan Manufacturing Co., Black Mountain, N. C.
Mowat Corporation, San Francisco, Calif. (In principle.)
Mutual Furniture Manufacturing Co., The, Miamisburg, Ohio.
N. L. N. Manufacturing Co., Greeley, Colo.
New York Wood Working Corporation, New York, N. Y.
Northwest Paper Co., The, Cloquet, Minn. (In principle.)
Paine Furniture Co., Boston, Mass.
Pattee Plow Co., Monmouth, Ill.
Patterson Lumber Co., Pensacola, Fla.
Peavy-Moore Lumber Co., Inc., Shreveport, La.
Peek & Sons, S. H., East Aurora, N. Y.
Peerless Built-In Fixture Co., Berkeley, Calif.
Peers & McGlone, Pine Bluff, Ark.
Pekin Wood Products Co., The, Helena, Ark.
Penn Furniture Co., Conneautville, Pa.
Perkins Lumber Co., J. R., St. Louis, Mo.
Pettibone Mulliken Co., Chicago, Ill.
Phenix Co., L. C., Los Angeles, Calif. (In principle.)
Pines Winterfront Co., Chicago, Ill.
Puffer-Hubbard Manufacturing Co., Minneapolis, Minn.
Randolph Furniture Works, Plant No. 3, Jamestown, N. Y.
Red Lion Furniture Co., Red Lion, Pa.
Reed Furniture Manufacturing Co., Miami, Fla.
Richmond Cabinet Co., Richmond, Ind.
Rock, William, Baltimore, Md.
Rockford Desk Co., Rockford, Ill.
Roddis Lumber and Veneer Co., Marshfield, Wis.
Rohmann Sons & Co., C. F., Brooklyn, N. Y. (In principle.)
Roos Co., of Forest Park, Ed., Forest Park, Ill.
Rose & Co., D. M., Knoxville, Tenn.
Sagman Lumber Co., Sagman, Mich.
Sanford Sash and Blind Co., Sanford, N. C.
Saxon Lumber Co., Rhinelander, Wis.
Schilling Furniture Co., Inc., F. J., Kingston, N. Y.
Seymour Manufacturing Co., Inc., Seymour, Ind.
Sheip Co., Inc., Jerome H., Apalachicola, Fla.
Shelbyville Desk Co., Shelbyville, Ind.
Showers Bros. Co., Bloomington, Ind.
Simmons Co., Kenosha, Wis. (In principle.)
Spencer-Cardinal Corporation, Marion, Ind.
Stark Co., James E., Memphis, Tenn.
Steul & Sons, Inc., Henry C., Buffalo, N. Y.
Sumter Wood Products Co., Sumter, S. C.
Temple Lumber Co., Pineland, Tex.
Tennessee Coffin and Casket Co., Chattanooga, Tenn.
Tennessee Furniture Corporation, Chattanooga, Tenn.
Thompson & Sons, O. E., Ypsilanti, Mich.
Thonet Bros., Inc., New York, N. Y.
Thornecraft, Inc., Chicago, Ill.
Thunder Lake Lumber Co., Rhinelander, Wis.
Tremont Lumber Co., Rochelle, La. (In principle.)
Trogdon Furniture Co., Toccoa, Ga.
Underwood Veneer Co., Wausau, Wis.
Vermont Furniture Manufacturing Co., Inc., Winooski, Vt.
Von Platen-Fox Co., Iron Mountain, Mich.
Ward Furniture Manufacturing Co., Fort Smith, Ark.
Wayne Agricultural Works, Inc., Goldsboro, N. C.
Weis Manufacturing Co., The, Monroe, Mich. (In principle.)
West Lumber and Box Co., Fayetteville, N. C.
West Virginia Lumber Co., Pittsburgh, Pa.
Whitaker Manufacturing Co., The, Chicago, Ill. (In principle.)
Wiard Plow Co., Batavia, N. Y.
Willett, Inc., Consider H., Louisville, Ky.
Williams-Kimp Furniture Co., Grand Rapids, Mich. (In principle.)
Wood Mosaic Co., Louisville, Ky. (In principle.)
Woodcraft Novelty Co., Inc., Boone, N. C.
Wurlitzer Co., The Rudolph, North Tonawanda, N. Y.

U. S. GOVERNMENT

Agriculture, U. S. Department of, Washington, D. C.
District of Columbia, Government of the, Washington, D. C. (In principle.)
Treasury Department, U. S., Washington, D. C.
Veterans' Administration, Washington, D. C.
War Department, Washington, D. C.

COMMERCIAL STANDARDS

CS no.	Item
0–30.	The commercial standards service and its value to business.
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2–30.	Mopsticks.
3–28.	Stoddard solvent.
4–29.	Staple porcelain (all-clay) plumbing fixtures.
5–29.	Steel pipe nipples.
6–31.	Wrought-iron pipe nipples (second edition).
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47–34.	Marking of gold-filled and rolled-gold-plate articles other than watch cases.
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49–34.	Chip board, laminated chip board, and miscellaneous boards for bookbinding purposes.
50–34.	Binders' board for bookbinding and other purposes.
51–35.	Marking articles made of silver in combination with gold.
52–35.	Mohair pile fabrics (100-percent mohair plain velvet, 100-percent mohair plain frieze, and 50-percent mohair plain frieze).
53–35.	Colors and finishes for cast stones.
54–35.	Mattresses for hospitals.
55–35.	Mattresses for institutions.
56–36.	Oak flooring.
57–36.	Book cloths, buckrams, and impregnated fabrics for bookbinding purposes except library bindings.
58–36.	Woven elastic fabrics for use in overalls (overall elastic webbing).
59–36.	Woven dress fabrics—testing and reporting.
60–36.	Hardwood dimension lumber.

NOTICE.—Those interested in commercial standards with a view toward accepting them as a basis of every-day practice in their industry, may secure copies of the above standards, while the supply lasts, by addressing the Division of Trade Standards, National Bureau of Standards, Washington, D. C.

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