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**STRENGTH AND RELATED PROPERTIES
OF WOODS GROWN IN CANADA**

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Sommaire en français

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SUMMARY

This publication lists the strength values and main physical properties of most of the woods grown in Canada. The data have been obtained by the systematic sampling and testing of tens of thousands of clear wood specimens using standard procedures. Statistics are provided to inform the reader of the average values and the degree of variability of the properties. Summary tables of the most frequently used averages are presented in both English and metric units.

SOMMAIRE

La présente publication traite des coefficients de solidité et des principales propriétés physiques de la plupart des bois canadiens. Les données ont été recueillies grâce à des échantillonnages et à des essais qui ont porté sur des dizaines de milliers de spécimens de bois clairs, selon les méthodes classiques. Les tableaux statistiques permettront au lecteur de se renseigner au sujet des coefficients moyens de solidité et du degré de variabilité des diverses propriétés physiques des bois canadiens. Les tables des moyennes d'usage le plus courant donnent les chiffres en mesures anglaises et en mesures métriques.

ACKNOWLEDGEMENT

The data presented herein are the results of a research program started in Canada a half century ago. This research to determine the strength and related properties of Canadian woods has been conducted in both the Ottawa and Vancouver Laboratories of the FPRB. The author has been responsible for preparing the test data and statistical values in a form designed to be of use to wood technologists and others who have need of this information. This has involved a careful study of the original test data with suitable rearrangements to permit presentation on a sound statistical basis.

The author acknowledges the valuable contribution made by the past and present employees of the Ottawa and Vancouver Laboratories in assembling the store of test data on which this publication is based. Special thanks are due to T. W. Littleford in particular for his computations of variability statistics for Western Canadian species, and to D. E. Kennedy and W. J. Smith, the officers in charge of timber engineering research in the two laboratories, for their assistance and encouragement.

Strength and Related Properties of Woods Grown in Canada

This publication is a revised and greatly expanded version of the former Forest Products Laboratories Technical Note No. 3 which was published in 1956 under the same title. The 1956 edition presented the data in the form of average values only, whereas this new publication has been expanded to include statistical values so essential to the conduct of present-day research and engineering studies. In addition, the data are presented in both English and metric units in recognition of the fact that systematic sampling and testing of timber is now carried out in most of the timber-producing countries of the world.

Wood in common with many materials is subject to considerable variability in its properties. It is intended that the statistics presented in this revision will make available to the public these measures of the variability so important to the efficient utilization of the material.

Four statistics are presented:

- the average value for material tested in green condition;
- the average value for material tested in the air-dry condition, and adjusted to a uniform moisture content of 12 per cent;
- the number of specimens tested;
- the coefficient of variation.

Average values presented are the means of tree means and are considered to represent the species average. For a few Eastern species where the sample size was small estimates were obtained from the specimen or shipment averages. The number of specimens given is an indication of the thoroughness of the sampling and hence the reliability of the estimates. The coefficient of variation is a measure of dispersion—the percentage above and below the mean which may be expected to contain about two-thirds of the species values. Thus the statistics reported describe the sample tested, and from these data predictions may be made.

The format of the publication has been changed to present the more complete detailed statistical data. Average strengths most frequently used have been selected and presented in tables at the beginning of the publication. Because the data are of international interest these tables of averages have been repeated at the end of the publication in metric units.

All data used in the preparation of the publication were derived from tests performed on small clear specimens of timber. Thus they indicate the inherent strength and physical properties of wood containing no defects such as knots, sloping grain, rot, checks, shakes, or wane. The effect of these defects on the strength of timbers in commercial sizes is a separate field of research. Each

of the values shown in the tables is based on tests of a particular property of a species. All Canadian-grown species of commercial importance are included.

The sampling of the timbers was planned so that test specimens would be fairly representative of each species. It is known that properties vary from tree to tree, and from location to location, even within the same species, but it is believed that the sample data reported here for each species give a fair estimate of the properties throughout the range of growth. The more important species have been sampled more thoroughly, but data from the smaller samples can be interpreted reliably with appropriate consideration to the number of tests performed and the origin of the sample.

The methods of test employed in arriving at these values have followed a standard procedure, which is used with minor variations in all English-speaking countries of the world. This facilitates the comparison of strength properties between timbers tested in other countries of the British Commonwealth and the United States of America. These methods are detailed in Specification D-143 of the American Society for Testing and Materials. In certain other countries where wood research is carried out, slightly different methods are employed which can result in a slight disparity between the strength values obtained for equivalent material.

While an attempt is made to bring air-seasoned specimens to a uniform moisture content of 12 per cent before testing, it is inevitable that each specimen tested may have a moisture content slightly higher or lower. Since most of the strength properties are influenced by moisture content in the range below fibre saturation point, an accurate comparison of the strengths of different species is made more difficult. In order to overcome this problem, most of the air-dry strength values have been adjusted by mathematical formulae to a strength equivalent to that of a moisture content of 12 per cent. An exception is made for some strength values, particularly those involving impact loading, which do not lend themselves to this mathematical adjustment.

It must be emphasized that the data presented are values from the small clear specimens tested and require some degree of interpretation in practical applications. It will be observed, for example, that average values in the tables are several times as great as the working stresses recommended for the various stress-grades of structural timber. The strength values reported are not intended to be safe working stresses for use in design. However, they are basic data used in the derivation of timber working stresses which are published in design specifications and building codes. It is not the purpose of this publication to explain the procedure used in arriving at safe working stresses, nor to explain the various other practical uses of the information.

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TABLE 1—1 AVERAGE VALUES (Green Condition)—CONIFERS

SPECIES	Specific Gravity		Static Bending					
	Basic	Oven-dry	Stress at Proportional Limit (psi)	Modulus of Rupture (psi)	Modulus of Elasticity (1,000 psi)	Work in Bending (in. lb/cu. in.)		
	Volume Green Weight Oven-dry	Volume Oven-dry Weight Oven-dry				To Proportional Limit	To Maximum Load	Total
Cedar, Eastern White <i>Thuja occidentalis</i>	0.30	0.31	2,000	3,900	520	0.46	8.5	13.1
Cedar, Western Red <i>Thuja plicata</i>	0.31	0.34	3,100	5,300	1,050	0.53	4.9	8.3
Cypress, Yellow <i>Chamaecyparis nootkatensis</i>	0.42	0.46	3,700	6,600	1,340	0.59	8.2	21.8
Douglas Fir <i>Pseudotsuga menziesii</i>	0.45	0.51	4,300	7,500	1,610	0.66	7.1	18.8
Fir, Amabilis <i>Abies amabilis</i>	0.36	0.41	3,000	5,500	1,350	0.38	5.6	12.6
Fir, Balsam <i>Abies balsamea</i>	0.34	0.37	2,800	5,300	1,130	0.40	7.2	13.2
Hemlock, Eastern <i>Tsuga canadensis</i>	0.40	0.45	3,900	6,800	1,270	0.70	6.9	21.1
Hemlock, Western <i>Tsuga heterophylla</i>	0.41	0.47	4,100	7,000	1,480	0.66	6.7	17.2
Tamarack <i>Larix laricina</i>	0.48	0.54	3,200	6,800	1,240	0.49	9.9	35.6
Larch, Western <i>Larix occidentalis</i>	0.55	0.64	5,000	8,700	1,650	0.86	7.9	25.0
Pine, Jack <i>Pinus banksiana</i>	0.42	0.45	3,400	6,300	1,170	0.60	7.1	24.6
Pine, Lodgepole <i>Pinus contorta</i> var. <i>latifolia</i>	0.40	0.46	3,000	5,700	1,270	0.40	5.3	15.0
Pine, Red <i>Pinus resinosa</i>	0.39	0.42	2,900	5,000	1,070	0.45	6.0	25.3
Pine, Western White <i>Pinus monticola</i>	0.36	0.40	2,900	4,800	1,190	0.40	5.2	12.2
Pine, Ponderosa <i>Pinus ponderosa</i>	0.44	0.49	3,300	5,700	1,130	0.55	5.4	20.0
Pine, Eastern White <i>Pinus strobus</i>	0.36	0.38	3,000	5,100	1,180	0.44	5.4	12.8
Spruce, Black <i>Picea mariana</i>	0.41	0.44	3,100	5,900	1,320	0.42	8.4	25.6
Spruce, Engelmann <i>Picea engelmannii</i>	0.38	0.43	3,100	5,700	1,250	0.47	5.4	19.4
Spruce, Red <i>Picea rubens</i>	0.38	0.42	3,000	5,900	1,320	0.38	8.0	18.5
Spruce, Sitka <i>Picea sitchensis</i>	0.35	0.39	3,100	5,400	1,370	0.40	4.8	16.8
Spruce, White <i>Picea glauca</i>	0.35	0.39	2,800	5,100	1,150	0.39	5.9	15.8

Compression Parallel to Grain			Compression Perpendicular to Grain	Hardness		Shear Parallel to Grain	Cleavage	Tension Perpendicular to Grain
Stress at Proportional Limit (psi)	Maximum Crushing Stress (psi)	Modulus of Elasticity (1,000 psi)	Stress at Proportional Limit (psi)	Load Required to Imbed 0.444 in. Sphere to Half Diameter (lb.)		Maximum Stress (psi)	Splitting Strength (lb. per in. width; length 3")	Maximum Stress (psi)
				Side	End			
1,230	1,890	550	200	270	360	660	160	330
2,310	2,780	1,170	280	270	430	700	140	240
2,510	3,240	1,280	350	440	520	880	200	390
2,810	3,610	1,670	460	480	590	920	220	410
2,140	2,770	1,460	230	320	410	710	170	270
1,690	2,440	1,240	240	290	330	680	150	290
2,430	3,430	1,410	400	450	540	910	190	340
2,980	3,580	1,620	370	470	560	750	200	390
2,000	3,130	1,290	410	420	490	920	210	400
3,440	4,420	1,880	520	580	640	920	240	420
2,010	2,950	1,190	340	390	410	820	190	350
2,220	2,860	1,420	280	360	340	720	190	330
1,600	2,370	1,140	280	340	320	710	180	350
2,030	2,520	1,300	240	280	290	650	150	230
2,140	2,840	1,260	350	420	400	720	210	390
1,950	2,590	1,260	240	280	300	640	170	320
1,840	2,760	1,470	300	380	410	800	180	340
2,190	2,810	1,260	270	340	340	700	180	320
1,940	2,810	1,480	270	360	450	810	180	350
2,070	2,560	1,510	290	330	410	630	160	310
1,820	2,470	1,310	240	280	320	670	160	310

TABLE 1—2 AVERAGE VALUES (Green Condition)—BROAD-LEAVED

SPECIES	Specific Gravity		Static Bending					
	Basic	Oven-dry	Stress at Proportional Limit (psi)	Modulus of Rupture (psi)	Modulus of Elasticity (1,000 psi)	Work in Bending (in. lb/cu. in.)		
	Volume Green Weight Oven-dry	Volume Oven-dry Weight Oven-dry				To Proportional Limit	To Maximum Load	Total
Alder, Red <i>Alnus rubra</i>	0.37	0.42	3,500	6,300	1,200	0.58	8.0	14.9
Ash, Black <i>Fraxinus nigra</i>	0.47	0.54	2,900	6,400	1,240	0.39	19.6	53.3
Ash, Green <i>Fraxinus pennsylvanica</i> var. <i>subintegerrima</i>	0.49	0.56	2,300	5,000	830	0.40	12.8	26.2
Ash, White <i>Fraxinus americana</i>	0.57	0.65	4,000	8,300	1,440	0.66	23.5	61.0
Basswood <i>Tilia americana</i>	0.36	0.42	2,600	4,900	1,050	0.38	6.2	20.4
Beech <i>Fagus grandifolia</i>	0.59	0.70	4,200	9,100	1,510	0.68	13.5	39.9
Birch, White <i>Betula papyrifera</i>	0.51	0.59	3,200	6,800	1,450	0.40	14.6	48.5
Birch, Western White <i>Betula papyrifera</i> var. <i>commutata</i>	0.51	0.60	3,400	7,300	1,590	0.42	10.7	37.3
Birch, Yellow <i>Betula alleghaniensis</i>	0.56	0.65	4,000	8,200	1,540	0.62	18.3	55.1
Butternut <i>Juglans cinerea</i>	0.37	0.40	2,500	5,000	940	0.38	8.8	19.4
Cherry, Black <i>Prunus serotina</i>	0.51	0.62	3,700	7,900	1,450	0.55	13.4	37.5
Chestnut <i>Castanea dentata</i>	0.42	0.47	3,700	7,300	1,130	0.72	12.8	26.4
Elm, Slippery <i>Ulmus rubra</i>	0.55	0.64	3,700	8,000	1,240	0.65	20.6	51.3
Elm, Rock <i>Ulmus thomasi</i>	0.62	0.73	4,700	9,500	1,370	0.92	22.0	62.9
Elm, White <i>Ulmus americana</i>	0.52	0.62	3,600	7,500	1,110	0.67	16.7	46.9
Hickory, Bitternut <i>Carya cordiformis</i>	0.63	0.76	4,000	10,000	1,750	0.52	23.7	70.1
Hickory, Shagbark <i>Carya ovata</i>	0.65	0.79	4,800	10,600	1,540	0.68	22.3	64.0
Ironwood <i>Ostrya virginiana</i>	0.65	0.79	5,000	10,100	1,730	0.83	24.4	79.8

Compression Parallel to Grain			Compression Perpendicular to Grain	Hardness		Shear Parallel to Grain	Cleavage	Tension Perpendicular to Grain
Stress at Proportional Limit (psi)	Maximum Crushing Stress (psi)	Modulus of Elasticity (1,000 psi)	Stress at Proportional Limit (psi)	Load Required to Imbed 0.444 in. Sphere to Half Diameter (lb.)		Maximum Stress (psi)	Splitting Strength (lb. per in. width; length 3")	Maximum Stress (psi)
				Side	End			
2,370	3,020	1,200	360	430	530	910	240	450
1,460	2,420	1,440	380	740	760	840	350	650
1,180	2,150	990	520	700	750	990	320	690
2,380	3,690	1,590	780	1,050	1,080	1,380	480	950
1,110	2,220	1,170	200	320	390	720	170	450
2,620	3,820	1,540	660	1,040	1,120	1,330	460	910
1,670	2,690	1,490	360	620	560	940	290	620
1,960	3,080	1,570	360	550	630	1,040	290	600
2,220	3,390	1,630	490	830	890	1,140	290	760
1,240	2,450	1,170	240	410	460	680	220	480
1,760	3,440	1,510	500	710	930	1,150	380	800
1,900	3,170	1,260	330	600	690	1,020	280	660
1,700	3,420	1,410	560	950	980	1,120	420	810
2,620	4,080	1,500	810	1,170	1,200	1,440	500	970
1,760	3,060	1,240	560	780	850	1,100	390	780
2,240	4,320	1,930	800	1,360	1,410	1,460	520	1,000
2,580	4,490	1,850	910	1,340	1,420	1,560	550	1,030
2,040	3,890	1,710	710	1,300	1,300	1,390	430	830

TABLE 1—3 AVERAGE VALUES (Green Condition)—BROAD-LEAVED

SPECIES	Specific Gravity		Static Bending					
	Basic	Oven-dry	Stress at Proportional Limit (psi)	Modulus of Rupture (psi)	Modulus of Elasticity (1,000 psi)	Work in Bending (in. lb/cu. in.)		
	Volume Green Weight Oven-dry	Volume Oven-dry Weight Oven-dry				To Proportional Limit	To Maximum Load	Total
Maple, Broadleaf <i>Acer macrophyllum</i>	0.47	0.53	4,300	8,100	1,300	0.81	12.4	28.7
Maple, Manitoba <i>Acer negundo</i>	0.42	0.50	2,800	5,200	870	0.52	9.2	23.9
Maple, Red <i>Acer rubrum</i>	0.52	0.59	4,400	8,500	1,590	0.71	11.8	30.7
Maple, Silver <i>Acer saccharinum</i>	0.46	0.51	3,300	6,800	1,320	0.46	10.4	24.7
Maple, Sugar <i>Acer saccharum</i>	0.60	0.70	5,000	10,200	1,700	0.82	18.2	42.3
Oak, Black <i>Quercus velutina</i>	0.60	0.68	4,300	9,200	1,560	0.68	17.7	50.1
Oak, Bur <i>Quercus macrocarpa</i>	0.60	0.69	2,800	6,000	770	0.58	18.6	46.8
Oak, Red <i>Quercus rubra</i>	0.58	0.66	4,200	9,400	1,560	0.65	16.7	45.1
Oak, White <i>Quercus alba</i>	0.65	0.78	3,700	8,700	1,510	0.52	18.6	55.0
Aspen, Trembling <i>Populus tremuloides</i>	0.37	0.42	2,900	5,500	1,310	0.37	6.9	20.2
Aspen, Largetooth <i>Populus grandidentata</i>	0.39	0.43	2,700	5,300	1,080	0.39	8.2	23.4
Poplar, Balsam <i>Populus balsamifera</i>	0.37	0.42	2,700	5,000	1,150	0.36	5.1	13.9
Cottonwood, Eastern <i>Populus deltoides</i>	0.35	0.39	2,500	4,700	870	0.43	9.7	28.2
Cottonwood, Black <i>Populus trichocarpa</i>	0.30	0.33	2,300	4,100	970	0.30	4.8	6.1
Walnut, Black <i>Juglans nigra</i>	0.55	0.63	4,600	9,000	1,550	0.80	17.9	48.7

Compression Parallel to Grain			Compression Perpendicular to Grain	Hardness		Shear Parallel to Grain	Cleavage	Tension Perpendicular to Grain
Stress at Proportional Limit (psi)	Maximum Crushing Stress (psi)	Modulus of Elasticity (1,000 psi)	Stress at Proportional Limit (psi)	Load Required to Imbed 0.444 in. Sphere to Half Diameter (lb.)		Maximum Stress (psi)	Splitting Strength (lb. per in. width; length 3")	Maximum Stress (psi)
				Side	End			
2,860	3,800	1,350	560	710	830	1,260	400	790
1,580	2,370	960	340	540	580	940	260	490
2,540	3,610	1,700	550	760	890	1,210	390	740
1,980	2,930	1,540	370	590	700	970	290	650
2,980	4,560	1,890	850	1,180	1,330	1,620	530	1,040
2,060	3,960	1,480	780	1,030	1,220	1,370	480	930
1,540	2,670	920	760	970	1,070	1,280	400	820
2,430	3,940	1,560	790	1,030	1,240	1,360	490	950
2,130	3,580	1,680	720	1,260	1,270	1,260	490	870
1,510	2,350	1,250	200	320	340	720	180	440
1,200	2,390	1,210	210	400	370	790	200	410
1,260	2,110	1,260	180	290	310	670	160	310
1,180	1,970	940	210	420	420	770	220	490
1,130	1,860	1,120	100	200	260	560	140	290
2,650	4,200	1,560	700	910	1,160	1,320	490	900

TABLE 2—1 AVERAGE VALUES* (Air-dry Condition)—CONIFERS

SPECIES	Specific Gravity		Static Bending					
	Nominal	Oven-dry	Stress at Proportional Limit (psi)	Modulus of Rupture (psi)	Modulus of Elasticity (1,000 psi)	Work in Bending (in. lb/cu. in.)		
	Volume Air-dry Weight Oven-dry	Volume Oven-dry Weight Oven-dry				To Proportional Limit	To Maximum Load	Total
Cedar, Eastern White	0.30	0.31	3,600	6,100	640	1.22	10.5	15.2
Cedar, Western Red	0.34	0.34	5,000	7,800	1,200	1.18	5.4	8.4
Cypress, Yellow	0.43	0.46	6,700	11,600	1,600	1.62	12.6	16.4
Douglas Fir	0.49	0.51	7,800	12,800	1,960	1.78	10.4	22.0
Fir, Amabilis	0.39	0.41	5,800	10,000	1,650	1.18	8.5	17.3
Fir, Balsam	0.35	0.37	4,400	8,500	1,400	0.82	8.8	14.2
Hemlock, Eastern	0.43	0.45	6,000	9,700	1,410	1.48	8.4	13.5
Hemlock, Western	0.43	0.47	7,800	11,800	1,790	1.97	10.0	18.9
Tamarack	0.51	0.54	8,000	11,000	1,360	2.82	7.7	16.8
Larch, Western	0.58	0.64	9,800	15,500	2,080	2.59	12.6	23.0
Pine, Jack	0.44	0.45	7,100	11,300	1,480	1.98	9.9	15.8
Pine, Lodgepole	0.41	0.46	7,100	11,000	1,580	1.83	8.9	12.5
Pine, Red	0.40	0.42	5,900	10,100	1,370	1.44	9.7	16.1
Pine, Western White	0.37	0.40	5,600	9,300	1,460	1.24	8.9	12.4
Pine, Ponderosa	0.46	0.49	6,500	10,600	1,380	1.74	9.1	15.4
Pine, Eastern White	0.37	0.38	6,000	9,400	1,360	1.49	8.8	12.2
Spruce, Black	0.43	0.44	6,500	11,400	1,510	1.64	9.1	16.9
Spruce, Engelmann	0.40	0.42	6,400	10,100	1,550	1.42	8.6	14.6
Spruce, Red	0.40	0.42	6,800	10,400	1,600	1.67	9.1	16.6
Spruce, Sitka	0.39	0.39	6,400	10,100	1,630	1.43	9.6	19.8
Spruce, White	0.37	0.39	5,300	9,100	1,440	1.12	7.3	12.2

*Adjusted to a moisture content of 12 per cent.

Compression Parallel to Grain			Compression Perpendicular to Grain	Hardness		Shear Parallel to Grain	Cleavage	Tension Perpendicular to Grain
Stress at Proportional Limit (psi)	Maximum Crushing Stress (psi)	Modulus of Elasticity (1,000 psi)	Stress at Proportional Limit (psi)	Load Required to Imbed 0.444 in. Sphere to Half Diameter (lb.)		Maximum Stress (psi)	Splitting Strength (lb. per in. width; length 3")	Maximum Stress (psi)
				Side	End			
2,280	3,600	710	390	310	540	1,000	190	380
3,970	4,910	1,320	500	330	680	810	140	210
4,580	6,650	1,460	690	560	890	1,340	260	510
4,950	7,270	1,970	870	670	900	1,380	220	440
4,150	5,920	1,750	520	440	840	1,090	210	440
3,320	4,980	1,410	460	410	710	910	160	300
4,430	5,950	1,650	620	540	820	1,270	160	300
5,290	6,780	1,750	660	620	990	940	210	420
4,030	6,500	1,530	890	720	850	1,310	220	500
6,040	8,840	2,000	1,060	950	1,280	1,340	270	520
3,450	5,880	1,530	830	580	720	1,190	260	530
4,450	6,270	1,660	530	490	670	1,240	300	550
3,410	5,490	1,360	720	480	570	1,090	240	510
4,150	5,240	1,460	470	380	510	920	200	380
4,140	6,140	1,450	760	590	760	1,020	280	500
3,670	5,250	1,410	490	370	480	880	190	380
4,390	6,020	1,780	620	550	720	1,250	280	500
4,430	6,150	1,590	540	450	600	1,100	230	400
3,400	5,590	1,810	550	510	700	1,340	280	540
3,180	5,480	1,760	590	490	700	980	220	360
3,710	5,350	1,650	500	420	560	980	220	480

TABLE 2—2 AVERAGE VALUES* (Air-dry Condition)—BROAD-LEAVED

SPECIES	Specific Gravity		Static Bending					
	Nominal	Oven-dry	Stress at Proportional Limit (psi)	Modulus of Rupture (psi)	Modulus of Elasticity (1,000 psi)	Work in Bending (in. lb/cu. in.)		
	Volume Air-dry Weight Oven-dry	Volume Oven-dry Weight Oven-dry				To Proportional Limit	To Maximum Load	Total
Alder, Red	0.41	0.42	5,900	10,700	1,460	1.34	9.6	13.3
Ash, Black	0.49	0.54	5,600	12,200	1,960	0.93	12.7	34.6
Ash, Green	0.51	0.56	3,600	8,100	1,010	0.81	11.4	—
Ash, White	0.61	0.65	8,000	15,700	1,860	1.92	22.9	49.6
Basswood	0.42	0.42	4,200	8,800	1,370	0.73	10.6	16.1
Beech	0.67	0.70	9,000	16,800	2,030	2.21	23.0	41.3
Birch, White	0.57	0.59	7,400	13,800	1,870	1.67	20.7	39.0
Birch, Western White	0.56	0.60	7,800	14,900	2,160	1.58	18.5	34.2
Birch, Yellow	0.61	0.65	8,000	15,400	2,040	1.79	20.8	45.4
Butternut	0.39	0.40	3,800	8,600	1,480	0.55	7.6	13.0
Cherry, Black	0.55	0.62	8,300	12,600	1,720	2.26	10.6	19.3
Chestnut	0.45	0.47	7,800	10,900	1,360	2.51	8.7	15.7
Elm, Slippery	0.60	0.64	4,800	13,000	1,710	0.81	18.9	63.8
Elm, Rock	0.66	0.73	8,000	16,700	1,810	1.98	29.3	58.0
Elm, White	0.56	0.62	5,900	12,500	1,510	1.33	22.0	55.7
Hickory, Bitternut	0.68	0.76	10,600	21,200	2,690	2.42	31.0	75.0
Hickory, Shagbark	0.72	0.79	9,500	17,200	1,970	2.47	21.4	77.3
Ironwood	0.73	0.79	9,900	19,600	2,290	2.41	27.8	78.1

*Adjusted to a moisture content of 12 per cent.

Compression Parallel to Grain			Compression Perpendicular to Grain	Hardness		Shear Parallel to Grain	Cleavage	Tension Perpendicular to Grain
Stress at Proportional Limit (psi)	Maximum Crushing Stress (psi)	Modulus of Elasticity (1,000 psi)	Stress at Proportional Limit (psi)	Load Required to Imbed 0.444 in. Sphere to Half Diameter (lb.)		Maximum Stress (psi)	Splitting Strength (lb. per in. width; length 3")	Maximum Stress (psi)
				Side	End			
3,990	5,800	1,330	580	560	980	1,160	300	420
3,360	5,920	2,020	850	950	1,100	1,760	430	710
2,070	4,720	1,690	1,060	960	1,390	1,410	400	930
3,550	7,220	1,960	1,450	1,590	1,930	2,150	500	1,080
2,560	4,870	1,960	420	480	570	1,170	250	700
4,400	8,010	2,120	1,210	1,460	1,790	2,100	570	1,290
3,710	6,480	1,950	1,000	970	980	1,630	480	1,040
5,310	7,500	2,110	780	920	1,040	1,840	480	960
4,230	7,560	2,210	1,050	1,330	1,640	2,130	590	1,090
2,510	5,160	1,510	450	590	860	1,060	270	540
4,290	7,310	1,780	1,100	1,040	1,550	1,650	430	880
3,700	5,790	1,330	780	660	1,010	1,320	260	570
2,910	6,600	2,010	860	1,380	1,530	1,770	550	970
4,390	7,480	1,910	1,290	1,560	1,680	2,150	530	1,060
3,080	6,000	1,620	1,000	1,120	1,340	1,700	460	910
3,460	8,430	2,340	1,970	2,140	2,320	2,750	790	1,560
4,400	8,620	2,320	1,900	2,150	2,330	2,720	680	1,340
4,630	8,680	2,190	1,530	2,000	2,280	2,300	610	1,100

TABLE 2—3 AVERAGE VALUES* (Air-dry Condition)—BROAD-LEAVED

SPECIES	Specific Gravity		Static Bending					
	Nominal	Oven-dry	Stress at Proportional Limit (psi)	Modulus of Rupture (psi)	Modulus of Elasticity (1,000 psi)	Work in Bending (in. lb/cu. in.)		
	Volume Air-dry Weight Oven-dry	Volume Oven-dry Weight Oven-dry				To Proportional Limit	To Maximum Load	Total
Maple, Broadleaf	0.51	0.53	6,000	13,200	1,660	1.21	15.8	25.6
Maple, Manitoba	0.46	0.50	—	—	—	—	—	—
Maple, Red	0.54	0.59	8,000	14,200	1,610	2.22	18.8	24.7
Maple, Silver	0.48	0.51	5,100	11,900	1,630	0.93	10.0	15.8
Maple, Sugar	0.66	0.70	9,400	16,700	2,040	2.45	20.5	40.8
Oak, Black	0.62	0.68	7,800	13,500	1,570	2.21	19.3	37.7
Oak, Bur	0.65	0.69	5,800	11,900	980	1.91	21.6	46.8
Oak, Red	0.61	0.66	8,600	14,300	1,730	2.41	17.0	37.6
Oak, White	0.68	0.78	5,500	17,500	2,250	0.74	16.7	54.7
Aspen, Trembling	0.41	0.42	5,200	9,800	1,630	0.99	10.3	21.0
Aspen, Largetooth	0.40	0.43	4,600	9,500	1,260	0.96	8.9	15.9
Poplar, Balsam	0.42	0.42	4,800	10,100	1,670	0.83	10.7	18.4
Cottonwood, Eastern	0.39	0.39	3,400	7,500	1,130	0.63	16.9	35.6
Cottonwood, Black	0.32	0.33	4,100	7,100	1,280	0.75	6.4	9.8
Walnut, Black	0.59	0.63	8,800	14,900	1,900	2.32	17.3	34.4

*Adjusted to a moisture content of 12 per cent.

Compression Parallel to Grain			Compression Perpendicular to Grain	Hardness		Shear Parallel to Grain	Cleavage	Tension Perpendicular to Grain
Stress at Proportional Limit (psi)	Maximum Crushing Stress (psi)	Modulus of Elasticity (1,000 psi)	Stress at Proportional Limit (psi)	Load Required to Imbed 0.444 in. Sphere to Half Diameter (lb.)		Maximum Stress (psi)	Splitting Strength (lb. per in. width; length 3")	Maximum Stress (psi)
				Side	End			
3,890	6,120	1,430	830	920	1,300	1,760	500	780
3,260	4,950	1,270	780	720	1,050	1,360	350	660
3,470	6,800	1,930	1,040	980	1,400	1,520	430	910
3,420	6,020	1,840	660	850	1,270	1,620	450	900
4,820	8,180	2,240	1,410	1,640	1,970	2,420	630	1,340
3,540	6,750	1,940	1,330	1,480	1,580	2,000	500	1,130
2,930	6,140	1,400	1,420	1,330	1,630	1,910	580	1,030
3,870	7,230	1,980	1,290	1,390	1,650	2,080	490	950
3,530	8,720	2,290	1,420	1,600	1,900	2,240	690	1,250
3,280	5,270	1,840	510	480	630	980	260	610
2,400	4,750	1,650	470	420	570	1,100	260	580
2,950	5,030	1,850	420	410	620	890	220	450
2,120	3,850	1,180	470	420	640	1,160	280	700
2,560	4,020	1,510	260	300	450	860	190	500
4,340	7,780	1,880	1,290	1,330	1,650	2,140	550	1,100

TABLE 3—1 STATISTICAL VALUES* FOR PHYSICAL PROPERTIES AND BEND-

SPECIES	Place of Growth of Material Tested	Sample Size		Moisture Condition	Specific Gravity			Shrinkage		
		No. of Locations Sampled	No. of Trees Tested		Basic	Nominal	Oven-dry	Green to Oven-dry Green to Air-dry Based on Dimensions when Green (per cent)		
					Volume Green Weight Oven-dry	Volume Air-dry Weight Oven-dry	Volume Oven-dry Weight Oven-dry	Radial	Tan-gential	Volumetric
Cedar, Eastern White <i>Thuja occidentalis</i>	Que. N.B.	2	19	green	0.299 76 7.4		0.308 38 7.0	1.7	3.6	6.4
				air-dry		0.302	—	—	3.8	
Cedar, Western Red <i>Thuja plicata</i>	B.C.	2	12	green	0.312 407 8.4		0.338 72 7.8	2.1	4.5	7.8
				air-dry		0.339	—	—	4.8	
Cypress, Yellow <i>Chamaecyparis nootkatensis</i>	B.C.	3	17	green	0.419 463 8.9		0.462 102 8.6	3.7	6.0	9.4
				air-dry		0.431	—	—	5.0	
Douglas Fir <i>Pseudotsuga menziesii</i>	B.C.	12	78	green	0.450 2169 11.4		0.510 438 12.3	4.8	7.4	11.9
				air-dry		0.487	—	—	7.0	
Fir, Amabilis <i>Abies amabilis</i>	B.C.	4	26	green	0.360 843 10.6		0.412 156 11.4	4.2	8.9	12.5
				air-dry		0.389	—	—	7.5	
Fir, Balsam <i>Abies balsamea</i>	Que. Man. Sask.	4	26	green	0.335 198 8.0		0.367 51 9.0	2.7	7.5	10.7
				air-dry		0.350	1.2	4.3	5.7	
Hemlock, Eastern <i>Tsuga canadensis</i>	N.B. Que.	3	31	green	0.404 1041 9.5		0.447 146 8.3	3.5	6.7	11.2
				air-dry		0.427	2.4	4.7	6.2	
Hemlock, Western <i>Tsuga heterophylla</i>	B.C.	4	21	green	0.409 422 9.4		0.470 120 10.9	5.4	8.5	13.0
				air-dry		0.429	—	—	8.1	
Tamarack <i>Larix laricina</i>	Que. Man.	2	11	green	0.485 127 8.1		0.544 39 8.0	2.8	6.2	11.2
				air-dry		0.506	—	—	7.1	
Larch, Western <i>Larix occidentalis</i>	B.C.	3	17	green	0.549 317 11.9		0.640 101 13.9	5.1	8.9	14.0
				air-dry		0.577	—	—	8.0	

*Four statistics are included for most properties. On the first line of the box is the species mean for material in green condition. Directly below is the species mean for air-dry material adjusted to a moisture content of 12 per cent. On the middle line to the left is the number of tests, and to the right the coefficient of variation.

ING STRENGTH—CONIFERS

Rings Per Inch	Summer-wood (per cent)	Static Bending						
		Weight per cu. ft. Air-dry (lb.)	Stress at Proportional Limit (psi)	Modulus of Rupture (psi)	Modulus of Elasticity (1,000 psi)	Work in Bending (in. lb/cu. in.)		
						To Proportional Limit	To Maximum Load	Total
32	26		2,020	3,860	515	0.46	8.5	13.1
—	—	21	18 23.4 3,610	18 10.0 6,130	18 18.2 635	18 38.7 1.22	18 49.9 10.5	15 40.2 15.2
15	27		3,100	5,300	1,050	0.53	4.9	8.3
18	29	24	204 19.9 4,990	204 13.2 7,810	204 12.7 1,200	204 36.6 1.18	204 18.7 5.4	75 31.0 8.4
41	18		3,700	6,640	1,340	0.59	8.2	21.8
42	23	30	262 14.3 6,740	262 11.9 11,560	262 19.3 1,600	262 25.7 1.62	262 26.8 12.6	101 28.8 16.4
15	35		4,320	7,540	1,610	0.66	7.1	18.8
14	32	34	1057 18.8 7,750	1057 13.8 12,850	1057 17.7 1,960	1057 31.3 1.78	1056 27.2 10.4	385 32.7 22.0
15	22		2,990	5,480	1,350	0.38	5.6	12.6
16	24	27	433 19.3 5,810	433 12.8 9,990	433 15.9 1,650	433 35.7 1.18	433 20.6 8.5	156 38.9 17.3
9	26		2,800	5,290	1,130	0.40	7.2	13.2
—	—	24	52 14.0 4,420	52 10.6 8,460	52 14.3 1,400	52 29.2 0.82	52 54.1 8.8	29 54.1 14.2
28	30		3,930	6,780	1,270	0.70	6.9	21.1
—	—	30	359 14.3 5,980	359 12.4 9,730	359 18.1 1,410	359 23.7 1.48	352 31.4 8.4	126 38.0 13.5
19	31		4,110	6,960	1,480	0.66	6.7	17.2
—	—	30	204 17.9 7,800	204 12.1 11,760	204 13.4 1,790	204 30.8 1.97	204 23.6 10.0	77 48.0 18.9
21	29		3,160	6,820	1,240	0.49	9.9	35.6
—	—	35	35 19.5 7,960	35 11.3 11,020	35 25.0 1,360	35 56.9 2.82	35 30.4 7.7	18 22.5 16.8
23	32		5,000	8,680	1,650	0.86	7.9	25.0
26	30	40	160 17.9 9,750	160 14.8 15,530	160 14.1 2,080	160 28.2 2.59	160 29.0 12.6	63 40.0 23.0

TABLE 3—2 STATISTICAL VALUES* FOR PHYSICAL PROPERTIES AND BEND-

SPECIES	Place of Growth of Material Tested	Sample Size		Moisture Condition	Specific Gravity			Shrinkage		
		No. of Locations Sampled	No. of Trees Tested		Basic	Nominal	Oven-dry	Green to Oven-dry Green to Air-dry Based on Dimensions when Green (per cent)		
					Volume Green Weight Oven-dry	Volume Air-dry Weight Oven-dry	Volume Oven-dry Weight Oven-dry	Radial	Tangential	Volumetric
Pine, Jack <i>Pinus banksiana</i>	N.B. Ont. Man. Sask.	4	25	green	0.421 309 8.8		0.454 84 9.6	4.0	5.9	9.6
				air-dry		0.444		2.1	3.8	5.7
Pine, Lodgepole <i>Pinus contorta</i> var. <i>latifolia</i>	B.C. Alta.	2	13	green	0.403 139 8.8		0.455 65 7.8	4.7	6.8	11.4
				air-dry		0.412		—	—	6.6
Pine, Red <i>Pinus resinosa</i>	N.S. N.B. Ont.	4	25	green	0.392 687 10.2		0.419 102 11.7	3.7	6.3	9.6
				air-dry		0.401		1.9	4.1	6.5
Pine, Western White <i>Pinus monticola</i>	B.C.	3	17	green	0.355 614 7.6		0.398 102 7.5	3.7	6.8	10.7
				air-dry		0.366		—	—	6.0
Pine, Ponderosa <i>Pinus ponderosa</i>	B.C.	3	17	green	0.438 408 9.0		0.489 102 9.1	4.6	5.9	10.5
				air-dry		0.459		—	—	6.1
Pine, Eastern White <i>Pinus strobus</i>	N.B. Que. Ont.	4	25	green	0.364 821 11.3		0.384 69 11.8	2.5	6.3	8.2
				air-dry		0.368		—	—	4.5
Spruce, Black <i>Picea mariana</i>	N.B. Que. Man. Sask.	6	32	green	0.406 216 9.4		0.445 66 9.3	3.8	7.5	11.1
				air-dry		0.428		1.7	4.0	6.5
Spruce, Engelmann <i>Picea engelmannii</i>	B.C.	2	11	green	0.375 181 8.6		0.425 66 9.6	4.2	8.2	11.6
				air-dry		0.395		—	—	6.8
Spruce, Red <i>Picea rubens</i>	N.S. N.B.	2	13	green	0.380 106 6.3		0.425 33 6.9	4.0	7.9	11.7
				air-dry		0.401		—	—	6.2
Spruce, Sitka <i>Picea sitchensis</i>	B.C.	3	14	green	0.347 737 10.1		0.394 84 11.9	4.6	7.8	11.7
				air-dry		0.387		—	—	6.0
Spruce, White <i>Picea glauca</i>	N.B. Que. Man. Sask. Alta.	7	43	green	0.354 510 10.2		0.393 125 11.8	3.2	6.9	11.3
				air-dry		0.372		1.4**	4.0**	6.8

*Four statistics are included for most properties. On the first line of the box is the species mean for material in green condition. Directly below is the species mean for air-dry material adjusted to a moisture content of 12 per cent. On the middle line to the left is the number of tests, and to the right the coefficient of variation.

**Two locations only.

NG STRENGTH—CONIFERS

Rings Per Inch	Summer-wood (per cent)	Weight per cu. ft. Air-dry (lb.)	Static Bending					
			Stress at Proportional Limit (psi)	Modulus of Rupture (psi)	Modulus of Elasticity (1,000 psi)	Work in Bending (in. lb/cu. in.)		
						To Proportional Limit	To Maximum Load	Total
14	25		3,450	6,310	1,170	0.60	7.1	24.6
—	—	31	69 16.7 7,080	69 11.3 11,300	69 19.8 1,480	69 33.7 1.98	68 27.7 9.9	37 29.3 15.8
25	23		2,970	5,650	1,270	0.40	5.3	15.0
25	26	29	78 20.1 7,050	78 10.9 11,020	78 14.3 1,580	78 33.0 1.83	78 22.1 8.9	40 10.9 12.5
17	25		2,890	5,010	1,070	0.45	6.0	25.3
—	—	28	234 19.3 5,890	234 14.0 10,110	234 16.1 1,370	234 37.2 1.44	234 25.3 9.7	72 22.0 16.1
19	24		2,890	4,830	1,190	0.40	5.2	12.2
19	23	26	317 15.5 5,650	317 11.6 9,290	317 15.2 1,460	317 30.8 1.24	317 30.3 8.9	121 34.9 12.4
26	16		3,320	5,700	1,130	0.55	5.4	20.0
26	18	32	212 16.2 6,520	212 12.6 10,630	212 14.4 1,380	212 27.2 1.74	212 31.7 9.1	81 35.0 15.4
15	22		3,000	5,140	1,180	0.44	5.4	12.8
—	—	26	238 16.8 6,020	238 15.7 9,430	238 19.9 1,360	238 31.4 1.49	238 37.1 8.8	81 36.7 12.2
19	27		3,090	5,870	1,320	0.42	8.4	25.6
—	—	30	44 14.7 6,470	44 13.3 11,360	44 22.3 1,510	44 30.6 1.64	44 37.0 9.1	41 43.4 16.9
18	20		3,070	5,660	1,250	0.47	5.4	19.4
19	22	28	93 19.2 6,420	93 11.1 10,080	93 14.8 1,550	93 46.7 1.42	93 21.0 8.6	41 38.9 14.6
17	23		3,000	5,880	1,320	0.38	8.0	18.5
—	—	28	39 12.2 6,750	39 8.4 10,370	39 10.0 1,600	39 24.7 1.67	30 17.3 9.1	15 46.3 16.6
13	23		3,080	5,420	1,370	0.40	4.8	16.8
11	22	27	380 20.3 6,410	380 13.5 10,120	380 16.8 1,630	380 34.3 1.43	380 24.6 9.6	125 14.3 19.8
15	21		2,780	5,100	1,150	0.39	5.9	15.8
—	—	26	191 15.0 5,320	191 12.5 9,090	191 18.6 1,440	191 27.2 1.12	189 23.2 7.3	88 44.4 12.2

TABLE 4—1 STATISTICAL VALUES* FOR IMPACT, COMPRESSION, HARDNESS

SPECIES	Sample Size		Moisture Condition	Specific Gravity		Impact Bending			
	No. of Locations Sampled	No. of Trees Tested		Basic	Nominal	Stress at Proportional Limit (psi)	Modulus of Elasticity (1,000 psi)	Work to Proportional Limit (in. lb/cu. in.)	Drop of 50 lb. Hammer a Complete Failure (in.)
				Volume Green Weight Oven-dry	Volume Air-dry Weight Oven-dry				
Cedar, Eastern White <i>Thuja occidentalis</i>	2	19	green	0.299		6,680	854	2.92	20
			air-dry		0.302	6 10.3 8,270	6 17.0 891	6 11.4 4.31	6 13.1 21
Cedar, Western Red <i>Thuja plicata</i>	2	12	green	0.312		7,590	1,380	2.37	16
			air-dry		0.339	100 10.6 9,710	100 17.0 1,500	100 19.5 3.58	100 23. 17
Cypress, Yellow <i>Chamaecyparis nootkatensis</i>	3	17	green	0.419		10,430	1,720	3.57	31
			air-dry		0.431	143 13.4 13,120	143 19.8 2,110	143 16.9 4.62	144 16. 30
Douglas Fir <i>Pseudotsuga menziesii</i>	12	78	green	0.450		10,630	2,000	3.21	26
			air-dry		0.487	568 15.8 14,350	568 24.0 2,820	568 19.1 4.26	569 25. 34
Fir, Amabilis <i>Abies amabilis</i>	4	26	green	0.360		8,680	1,610	2.69	20
			air-dry		0.389	215 15.4 12,000	215 22.5 2,260	215 23.3 3.67	215 27. 26
Fir, Balsam <i>Abies balsamea</i>	4	26	green	0.335		7,890	1,320	2.70	17
			air-dry		0.350	24 12.2 10,060	24 19.6 1,730	24 24.3 3.26	24 28. 19
Hemlock, Eastern <i>Tsuga canadensis</i>	3	31	green	0.404		9,740	1,620	3.31	24
			air-dry		0.427	109 11.8 11,340	109 17.5 2,130	109 17.9 3.40	111 21. 23
Hemlock, Western <i>Tsuga heterophylla</i>	4	21	green	0.409		9,000	1,970	2.32	23
			air-dry		0.429	108 13.0 11,200	108 17.4 2,310	108 19.4 3.05	111 23. 27
Tamarack <i>Larix laricina</i>	2	11	green	0.485		8,950	1,370	3.28	36
			air-dry		0.506	23 13.3 10,320	23 21.1 1,830	23 16.3 3.21	23 21. 15
Larch, Western <i>Larix occidentalis</i>	3	17	green	0.549		10,510	2,120	2.96	27
			air-dry		0.577	79 13.5 15,230	79 20.9 3,040	79 17.9 4.48	80 21. 30

*Four statistics are included for most properties. On the first line of the box is the species mean for material in green condition. Directly below is the species mean for air-dry material adjusted to a moisture content of 12 per cent. On the middle line to the left is the number of tests, and to the right the coefficient of variation.

SHEAR, CLEAVAGE, AND TENSION VALUES—CONIFERS

Compression Parallel to Grain			Com- pression Perpen- dicular to Grain	Hardness		Shear Parallel to Grain	Cleavage	Tension Perpen- dicular to Grain
Stress at Propor- tional Limit (psi)	Maximum Crushing Stress (psi)	Modulus of Elas- ticity (1,000 psi)	Stress at Propor- tional Limit (psi)	Load Required to Imbed 0.444 in. Sphere to Half Diameter (lb.)		Maximum Stress (psi)	Splitting Strength (lb./in. width; length 3")	Maximum Stress (psi)
				Side	End			
1,230 49 19.7 2,280	1,890 84 12.2 3,600	546 49 19.1 714	196 40 27.4 389	270 72 14.9 306	364 36 13.0 535	660 52 13.7 1,005	160 51 13.4 193	328 50 12.8 382
2,310 108 17.6 3,970	2,780 406 15.1 4,910	1,170 108 13.4 1,320	279 114 28.4 498	266 222 20.1 331	432 111 16.0 675	696 72 13.8 810	136 72 15.9 145	238 72 26.9 212
2,510 160 20.6 4,580	3,240 460 12.3 6,650	1,280 160 22.5 1,460	350 212 26.3 687	444 418 14.5 564	517 209 10.8 890	880 102 11.9 1,336	203 102 14.3 259	390 102 20.0 506
2,810 700 24.7 4,950	3,610 2158 17.3 7,270	1,670 700 21.4 1,970	460 860 30.9 871	480 1710 20.8 672	589 854 18.0 903	922 441 14.0 1,382	216 442 19.0 222	407 436 24.2 444
2,140 263 22.3 4,150	2,770 843 14.5 5,920	1,460 263 18.9 1,750	234 378 30.3 523	322 742 21.5 442	406 371 18.1 835	714 156 14.0 1,093	168 154 19.5 210	274 155 31.2 444
1,690 92 23.8 3,320	2,440 207 11.9 4,980	1,240 92 19.8 1,410	243 96 21.9 456	288 168 16.6 409	328 84 14.1 712	679 146 13.6 906	147 127 17.8 156	293 127 28.2 302
2,430 370 22.4 4,430	3,430 1046 13.7 5,950	1,410 371 23.4 1,650	404 506 27.3 621	450 628 16.2 536	542 312 10.8 825	914 516 15.1 1,269	186 468 26.9 165	342 518 37.5 299
2,980 125 17.2 5,290	3,580 425 14.1 6,780	1,620 125 16.6 1,750	373 129 27.9 657	468 260 19.5 617	561 130 15.6 992	752 123 14.5 940	202 120 18.2 214	390 118 20.4 425
2,000 41 30.2 4,030	3,130 127 15.5 6,500	1,290 41 27.6 1,530	413 44 21.2 892	424 92 16.1 724	486 46 13.5 846	919 73 9.5 1,306	214 72 17.8 225	401 69 23.8 504
3,440 93 23.5 6,040	4,420 315 15.6 8,840	1,880 93 17.9 2,000	519 93 26.8 1,060	584 186 21.3 946	639 93 20.7 1,275	920 102 15.7 1,342	242 102 19.8 274	416 102 21.4 525

TABLE 4—2 STATISTICAL VALUES* FOR IMPACT, COMPRESSION, HARDNESS,

SPECIES	Sample Size		Moisture Condition	Specific Gravity		Impact Bending			
	No. of Locations Sampled	No. of Trees Tested		Basic	Nominal	Stress at Proportional Limit (psi)	Modulus of Elasticity (1,000 psi)	Work to Proportional Limit (in. lb./cu. in.)	Drop of 50 lb. Hammer at Complete Failure (in.)
				Volume Green Weight Oven-dry	Volume Air-dry Weight Oven-dry				
Pine, Jack <i>Pinus banksiana</i>	4	25	green	0.421		8,700 36 14.0	1,500 36 16.8	2.92 36 28.4	27 38 18.4
			air-dry		0.444	10,660	1,970	3.22	25
Pine, Lodgepole <i>Pinus contorta</i> var. <i>latifolia</i>	2	13	green	0.403		7,660 44 9.1	1,370 44 19.4	2.43 44 13.7	21 44 20.2
			air-dry		0.412	10,780	1,830	3.76	22
Pine, Red <i>Pinus resinosa</i>	4	25	green	0.392		8,650 79 19.9	1,380 79 19.9	3.06 79 28.2	28 89 25.6
			air-dry		0.401	10,950	1,950	3.45	25
Pine, Western White <i>Pinus monticola</i>	3	17	green	0.355		7,630 163 15.2	1,380 163 23.8	2.39 163 6.4	18 164 19.2
			air-dry		0.366	12,210	2,180	3.87	24
Pine, Ponderosa <i>Pinus ponderosa</i>	3	17	green	0.438		8,370 115 12.2	1,740 115 14.6	2.27 115 19.5	24 115 18.8
			air-dry		0.459	11,820	2,380	3.34	24
Pine, Eastern White <i>Pinus strobus</i>	4	25	green	0.364		7,860 145 16.7	1,380 145 24.6	2.54 145 19.6	18 154 25.3
			air-dry		0.368	11,700	1,910	4.04	20
Spruce, Black <i>Picea mariana</i>	6	32	green	0.406		8,500 26 10.3	1,530 26 11.5	2.67 26 17.6	25 26 24.3
			air-dry		0.428	10,460	1,880	3.24	26
Spruce, Engelmann <i>Picea engelmannii</i>	2	11	green	0.375		8,310 51 14.7	1,580 51 18.7	2.47 51 20.2	22 51 20.4
			air-dry		0.395	11,840	2,450	3.23	25
Spruce, Red <i>Picea rubens</i>	2	13	green	0.380		8,830 21 8.6	1,660 21 13.0	2.68 21 17.2	23 21 17.6
			air-dry		0.401	10,290	2,090	2.84	22
Spruce Sitka <i>Picea sitchensis</i>	3	14	green	0.347		6,990 190 14.9	1,510 190 15.5	1.83 190 24.0	20 189 25.5
			air-dry		0.387	9,710	1,930	2.77	22
Spruce, White <i>Picea glauca</i>	7	46	green	0.354		8,350 126 15.1	1,370 126 20.0	2.90 126 19.9	23 126 21.8
			air-dry		0.372	10,920	2,000	3.36	24

*Four statistics are included for most properties. On the first line of the box is the species mean for material in green condition. Directly below is the species mean for air-dry material adjusted to a moisture content of 12 per cent. On the middle line to the left is the number of tests, and to the right the coefficient of variation.

SHEAR, CLEAVAGE, AND TENSION VALUES—CONIFERS

Compression Parallel to Grain			Compression Perpendicular to Grain	Hardness		Shear Parallel to Grain	Cleavage	Tension Perpendicular to Grain
Stress at Proportional Limit (psi)	Maximum Crushing Stress (psi)	Modulus of Elasticity (1,000 psi)	Stress at Proportional Limit (psi)	Load Required to Imbed 0.444 in. Sphere to Half Diameter (lb.)		Maximum Stress (psi)	Splitting Strength (lb./in. width; length 3")	Maximum Stress (psi)
				Side	End			
2,010	2,950	1,190	335	394	412	822	188	354
103 26.7	318 15.9	102 23.9	149 28.5	244 15.7	122 14.4	185 13.3	174 13.3	167 18.6
3,450	5,880	1,530	827	575	719	1,194	264	530
2,220	2,860	1,420	276	362	339	724	186	332
55 18.9	139 15.3	55 16.1	55 23.6	110 12.9	55 12.9	76 14.0	76 10.3	76 14.2
4,450	6,270	1,660	529	492	673	1,238	297	548
1,600	2,370	1,140	281	336	323	711	184	349
212 23.4	695 19.0	212 23.0	273 28.0	450 16.9	225 16.0	356 11.1	360 14.0	353 20.1
3,410	5,490	1,360	719	476	572	1,088	236	513
2,030	2,520	1,300	235	277	291	652	146	228
197 17.2	611 12.0	197 18.4	215 23.5	428 14.1	214 14.1	101 12.0	102 17.9	100 27.3
4,150	5,240	1,460	469	382	513	920	202	383
2,140	2,840	1,260	349	421	403	720	208	390
120 17.4	408 11.4	120 15.1	115 25.4	236 17.0	118 15.0	100 9.6	102 13.6	102 18.2
4,140	6,140	1,450	757	594	755	1,020	276	504
1,950	2,590	1,260	238	284	305	635	166	320
260 24.2	843 17.4	260 22.5	308 28.6	644 21.1	321 20.4	471 12.8	460 17.8	452 26.3
3,670	5,250	1,410	492	372	481	885	193	381
1,840	2,760	1,470	300	378	414	796	180	340
104 26.4	223 14.9	104 23.0	109 25.4	198 16.4	98 18.7	148 10.8	141 18.1	142 23.1
4,390	6,020	1,780	617	546	721	1,254	281	497
2,190	2,810	1,260	268	343	342	702	182	316
56 23.7	182 11.3	56 23.7	58 16.3	114 15.5	57 17.8	66 10.1	66 12.4	66 21.3
4,430	6,150	1,590	537	454	599	1,095	230	395
1,940	2,810	1,480	273	362	448	807	178	350
60 18.3	111 9.9	60 13.8	38 22.1	72 15.5	36 12.6	70 11.1	68 13.0	70 19.8
3,400	5,590	1,810	547	513	703	1,335	283	537
2,070	2,560	1,510	291	328	406	634	163	306
97 22.4	755 14.4	197 22.9	219 32.5	424 22.2	212 18.0	83 16.4	84 23.0	84 34.2
3,180	5,480	1,760	594	494	695	983	217	359
1,820	2,470	1,310	245	279	320	670	156	308
246 21.8	670 15.2	246 23.7	341 23.1	345 16.5	324 15.0	307 12.1	309 14.5	307 22.6
3,710	5,350	1,650	500	423	555	985	221	475

TABLE 5—1 STATISTICAL VALUES* FOR PHYSICAL PROPERTIES AND BEND.

SPECIES	Place of Growth of Material Tested	Sample Size		Moisture Condition	Specific Gravity			Shrinkage		
		No. of Locations Sampled	No. of Trees Tested		Basic	Nominal	Oven-dry	Green to Oven-dry Green to Air-dry Based on Dimensions when Green (per cent)		
					Volume Green Weight Oven-dry	Volume Air-dry Weight Oven-dry	Volume Oven-dry Weight Oven-dry	Radial	Tan-gential	Volumetric
Alder, Red <i>Alnus rubra</i>	B.C.	1	6	green	0.373 103 6.9		0.422 36 6.1	4.2	7.0	11.7
				air-dry		0.409		—	—	8.0
Ash, Black <i>Fraxinus nigra</i>	Ont.	1	5	green	0.468 27 8.5		0.539 16 8.3	4.3	8.2	13.8
				air-dry		0.494		—	—	7.9
Ash, Green <i>Fraxinus pennsylvanica</i> var. <i>subintegerrima</i>	Man.	1	2	green	0.486 28 7.6		0.556 19 10.5	3.8	5.4	11.4
				air-dry		0.506		—	—	8.3
Ash, White <i>Fraxinus americana</i>	N.B. Ont.	2	13	green	0.570 148 8.4		0.650 30 8.7	4.2	7.0	13.1
				air-dry		0.613		—	—	7.2
Basswood <i>Tilia americana</i>	Que.	1	4	green	0.360 34 10.6		0.423 17 14.6	6.7	9.3	18.4
				air-dry		0.417		—	—	13.4
Beech <i>Fagus grandifolia</i>	N.B. Que.	3	17	green	0.590 206 5.2		0.705 51 6.0	5.2	10.1	17.3
				air-dry		0.667		—	—	11.7
Birch, White <i>Betula papyrifera</i>	N.B. Man. Sask.	3	16	green	0.506 168 5.7		0.588 35 7.1	5.2	7.2	13.8
				air-dry		0.571		4.4	6.6	10.5
Birch, Western White <i>Betula papyrifera</i> var. <i>commutata</i>	B.C.	2	18	green	0.508 234 6.0		0.605 108 6.9	6.8	9.3	16.0
				air-dry		0.564		—	—	10.0
Birch, Yellow <i>Betula alleghaniensis</i>	N.B. N.S. Que.	4	25	green	0.559 295 5.4		0.649 56 5.9	5.8	7.1	15.1
				air-dry		0.608		—	—	9.9
Butternut <i>Juglans cinerea</i>	Ont.	1	5	green	0.368 46 9.2		0.399 19 9.7	2.8	4.9	9.6
				air-dry		0.388		—	—	5.4
Cherry, Black <i>Prunus serotina</i>	Ont.	1	5	green	0.510 88 6.9		0.623 21 8.0	4.0	7.1	12.7
				air-dry		0.551		—	—	8.6

*Four statistics are included for most properties. On the first line of the box is the species mean for material in green condition. Directly below is the species mean for air-dry material adjusted to a moisture content of 12 per cent. On the middle line to the left is the number of tests, and to the right the coefficient of variation.

ING STRENGTH—BROAD-LEAVED

Rings Per Inch	Summer-wood (per cent)	Weight per cu. ft. Air-dry (lb.)	Static Bending					
			Stress at Proportional Limit (psi)	Modulus of Rupture (psi)	Modulus of Elasticity (1,000 psi)	Work in Bending (in. lb/cu. in.)		
						To Proportional Limit	To Maximum Load	Total
6	—	—	3,530	6,290	1,200	0.58	8.0	14.9
			45 12.6	45 9.9	45 10.3	45 22.4	45 25.5	23 32.4
			29 5,900	10,700	1,460	1.34	9.6	13.3
18	—	—	2,920	6,370	1,240	0.39	19.6	53.3
			12 13.2	12 10.9	12 10.8	12 24.1	12 32.0	5 24.5
			35 5,550	12,180	1,960	0.93	12.7	34.6
21	—	—	2,320	5,040	830	0.40	12.8	26.2
			14 16.8	14 7.1	14 30.3	14 43.1	14 24.9	10 30.1
			35 3,620	8,070	1,010	0.81	11.4	—
10	—	—	4,000	8,320	1,440	0.66	23.5	61.0
			35 22.1	35 12.8	35 19.9	35 50.2	35 34.4	23 13.9
			43 7,970	15,670	1,860	1.92	22.9	49.6
10	—	—	2,640	4,940	1,050	0.38	6.2	20.4
			17 17.3	17 13.8	17 20.3	17 30.9	17 34.8	7 12.1
			29 4,220	8,820	1,370	0.73	10.6	16.1
13	—	—	4,210	9,140	1,510	0.68	13.5	39.9
			71 19.7	71 9.7	71 11.0	71 40.1	70 35.3	30 24.6
			47 8,980	16,840	2,030	2.21	23.0	41.3
13	—	—	3,200	6,850	1,450	0.40	14.6	48.5
			46 12.9	46 8.3	46 16.5	46 26.4	46 59.4	21 21.4
			40 7,430	13,750	1,870	1.67	20.7	39.0
18	—	—	3,400	7,290	1,590	0.42	10.7	37.3
			120 22.5	120 10.1	120 12.4	120 37.7	120 27.7	43 24.2
			39 7,750	14,900	2,160	1.58	18.5	34.2
18	—	—	4,000	8,240	1,540	0.62	18.3	55.1
			104 23.3	104 16.1	104 22.3	104 50.2	73 40.9	41 39.5
			42 8,010	15,420	2,040	1.79	20.8	45.4
9	—	—	2,480	4,990	940	0.38	8.8	19.4
			20 18.9	20 13.8	20 19.1	20 36.6	20 29.5	7 54.0
			27 3,840	8,610	1,480	0.55	7.6	13.0
8	—	—	3,720	7,930	1,450	0.55	13.4	37.5
			32 17.3	32 8.6	32 12.6	32 35.0	32 21.8	10 14.1
			38 8,310	12,630	1,720	2.26	10.6	19.3

TABLE 5—2 STATISTICAL VALUES* FOR PHYSICAL PROPERTIES AND BEND-

SPECIES	Place of Growth of Material Tested	Sample Size		Moisture Condition	Specific Gravity			Shrinkage		
		No. of Locations Sampled	No. of Trees Tested		Basic	Nominal	Oven-dry	Green to Oven-dry Green to Air-dry Based on Dimensions when Green (per cent)		
					Volume Green Weight Oven-dry	Volume Air-dry Weight Oven-dry	Volume Oven-dry Weight Oven-dry	Radial	Tan-gential	Volu-metric
Chestnut <i>Castanea dentata</i>	Ont.	1	5	green	0.423 54 8.0		0.466 20 9.8	2.8	5.3	10.0
				air-dry		0.449		—	—	7.3
Elm, Slippery <i>Ulmus rubra</i>	Ont.	1	5	green	0.547 48 12.9		0.643 20 11.5	4.4	9.8	15.5
				air-dry		0.602		—	—	9.8
Elm, Rock <i>Ulmus thomasi</i>	Ont.	3	13	green	0.625 632 10.3		0.732 78 14.2	5.2	9.2	14.8
				air-dry		0.661		3.1	6.6	10.7
Elm, White <i>Ulmus americana</i>	Que. Ont. Man.	4	23	green	0.524 510 9.6		0.617 83 9.2	4.4	7.8	15.2
				air-dry		0.562		2.9	5.9	9.4
Hickory, Bitternut <i>Carya cordiformis</i>	Ont.	1	5	green	0.628 21 6.8		0.760 20 9.5	6.5	10.2	17.8
				air-dry		0.675		—	—	10.8
Hickory, Shagbark <i>Carya ovata</i>	Que. Ont.	2	11	green	0.654 108 6.5		0.788 42 6.7	4.9	8.4	17.2
				air-dry		0.724		—	—	11.1
Ironwood <i>Ostrya virginiana</i>	Que.	1	6	green	0.652 29 3.5		0.786 16 4.8	4.8	8.0	18.2
				air-dry		0.728		—	—	12.4
Maple, Broadleaf <i>Acer macrophyllum</i>	B.C.	1	6	green	0.466 78 4.7		0.530 36 5.3	4.1	7.6	12.1
				air-dry		0.507		—	—	8.2
Maple, Manitoba <i>Acer negundo</i>	Man.	1	6	green	0.416 73 7.8		0.501 28 8.8	3.9	7.4	14.8
				air-dry		0.457		—	—	9.4
Maple, Red <i>Acer rubrum</i>	Ont.	1	6	green	0.516 76 5.2		0.586 24 4.4	3.6	6.0	12.4
				air-dry		0.545		—	—	8.2
Maple, Silver <i>Acer saccharinum</i>	Ont.	1	5	green	0.461 58 6.6		0.509 20 5.2	3.2	6.4	12.8
				air-dry		0.478		—	—	7.3

*Four statistics are included for most properties. On the first line of the box is the species mean for material in green condition. Directly below is the species mean for air-dry material adjusted to a moisture content of 12 per cent. On the middle line to the left is the number of tests, and to the right the coefficient of variation.

ING STRENGTH—BROAD-LEAVED

Rings Per Inch	Summer-wood (per cent)	Weight per cu. ft. Air-dry (lb.)	Static Bending					
			Stress at Proportional Limit (psi)	Modulus of Rupture (psi)	Modulus of Elasticity (1,000 psi)	Work in Bending (in. lb/cu. in.)		
						To Proportional Limit	To Maximum Load	Total
10	—	31	3,740	7,320	1,130	0.72	12.8	26.4
			19 25.6	19 10.6	19 11.0	19 49.3	19 29.5	8 33.7
12	—	42	7,780	10,870	1,360	2.51	8.7	15.7
			3,730	8,030	1,240	0.65	20.6	51.3
23	—	46	22 17.7	23 13.2	22 16.1	22 37.5	23 44.7	9 30.1
			4,840	13,000	1,710	0.81	18.9	63.8
16	—	39	4,710	9,460	1,370	0.92	22.0	62.9
			238 26.7	238 17.1	238 21.4	238 39.9	237 46.5	81 32.3
11	—	47	8,030	16,710	1,810	1.98	29.3	58.0
			3,570	7,520	1,110	0.67	16.7	46.9
15	—	51	166 24.4	166 21.5	166 24.3	166 46.5	166 48.2	82 38.4
			5,870	12,510	1,510	1.33	22.0	55.7
15	—	51	3,980	10,000	1,750	0.52	23.7	70.1
			17 15.5	17 12.7	17 24.5	17 22.8	17 52.8	6 24.0
15	—	51	10,580	21,160	2,690	2.42	31.0	75.0
			4,790	10,580	1,540	0.68	22.3	64.0
15	—	51	33 28.3	33 20.8	28 29.8	28 36.1	27 45.9	9 33.3
			9,540	17,230	1,970	2.47	21.4	77.3
9	—	35	5,020	10,130	1,730	0.83	24.4	79.8
			7 10.6	7 8.9	7 15.6	7 23.7	7 48.5	5 10.6
11	—	32	9,930	19,550	2,290	2.41	27.8	78.1
			4,320	8,110	1,300	0.81	12.4	28.7
11	—	32	41 17.7	41 11.8	41 12.2	41 29.2	41 31.5	18 33.0
			6,000	13,200	1,660	1.21	15.8	25.6
13	—	38	2,810	5,220	870	0.52	9.2	23.9
			17 23.0	17 18.3	17 19.4	17 39.8	17 34.7	9 48.5
9	—	33	—	—	—	—	—	—
			4,410	8,540	1,590	0.71	11.8	30.7
9	—	33	26 15.5	26 7.9	26 10.4	26 33.4	26 32.0	8 23.5
			7,980	14,150	1,610	2.22	18.8	24.7
9	—	33	3,270	6,820	1,320	0.46	10.4	24.7
			21 11.0	21 9.2	21 8.8	21 24.2	21 28.3	8 23.0
9	—	33	5,120	11,890	1,630	0.93	10.0	15.8

TABLE 5—3 STATISTICAL VALUES* FOR PHYSICAL PROPERTIES AND BEND-

SPECIES	Place of Growth of Material Tested	Sample Size		Moisture Condition	Specific Gravity			Shrinkage		
		No. of Locations Sampled	No. of Trees Tested		Basic	Nominal	Oven-dry	Green to Oven-dry Green to Air-dry Based on Dimensions when Green (per cent)		
					Volume Green Weight Oven-dry	Volume Air-dry Weight Oven-dry	Volume Oven-dry Weight Oven-dry	Radial	Tan-gential	Volu-metric
Maple, Sugar <i>Acer saccharum</i>	N.B. Que. Ont.	4	19	green	0.597 310 5.2		0.702 71 5.3	4.6	8.8	15.7
				air-dry		0.659	2.9	6.4	9.3	
Oak, Black <i>Quercus velutina</i>	Ont.	1	5	green	0.597 51 3.9		0.677 31 4.5	3.8	6.9	13.2
				air-dry		0.621	—	—	7.0	
Oak, Bur <i>Quercus macrocarpa</i>	Man.	1	6	green	0.599 34 6.7		0.694 21 8.1	4.2	5.4	13.7
				air-dry		0.653	—	—	10.2	
Oak, Red <i>Quercus rubra</i>	Que. Ont.	2	11	green	0.581 136 5.1		0.655 50 6.7	3.6	6.7	12.0
				air-dry		0.612	—	—	6.9	
Oak, White <i>Quercus alba</i>	Ont.	1	5	green	0.654 75 4.2		0.775 21 6.0	4.7	6.0	16.6
				air-dry		0.676	—	—	9.6	
Aspen, Trembling <i>Populus tremuloides</i>	N.B. Man. Sask.	3	20	green	0.374 181 6.4		0.424 34 6.8	3.6	6.6	11.8
				air-dry		0.408	2.7	5.7	8.3	
Aspen, Largetooth <i>Populus grandidentata</i>	Ont.	1	10	green	0.390 69 9.4		0.431 30 8.4	3.2	6.8	11.7
				air-dry		0.401	—	—	8.8	
Poplar, Balsam <i>Populus balsamifera</i>	Ont. Man.	2	10	green	0.372 88 8.7		0.416 36 6.4	3.9	6.4	11.6
				air-dry		0.415	—	—	9.5	
Cottonwood, Eastern <i>Populus deltoides</i>	Ont.	1	5	green	0.352 121 10.7		0.386 20 10.8	3.1	7.8	11.8
				air-dry		0.386	—	—	9.8	
Cottonwood, Black <i>Populus trichocarpa</i>	B.C.	1	7	green	0.295 167 9.2		0.334 42 10.5	3.6	8.8	11.7
				air-dry		0.320	—	—	8.4	
Walnut, Black <i>Juglans nigra</i>	Ont.	1	3	green	0.546 104 6.1		0.626 23 5.8	4.8	7.8	13.8
				air-dry		0.594	—	—	9.4	

*Four statistics are included for most properties. On the first line of the box is the species mean for material in green condition. Directly below is the species mean for air-dry material adjusted to a moisture content of 12 per cent. On the middle line to the left is the number of tests, and to the right the coefficient of variation.

ING STRENGTH—BROAD-LEAVED

Rings Per Inch	Summer- wood (per cent)	Weight per cu. ft. Air-dry (lb.)	Static Bending					
			Stress at Proportional Limit (psi)	Modulus of Rupture (psi)	Modulus of Elasticity (1,000 psi)	Work in Bending (in. lb/cu. in.)		
						To Proportional Limit	To Maximum Load	Total
19	—	46	4,950	10,220	1,700	0.82	18.2	42.3
			119 16.5	119 10.7	119 13.9	119 27.1	105 24.6	45 26.0
9	—	43	9,400	16,700	2,040	2.45	20.5	40.8
			4,290	9,220	1,560	0.68	17.7	50.1
28	—	46	14 20.3	14 11.2	14 16.3	14 35.8	14 22.9	6 25.2
			7,810	13,470	1,570	2.21	19.3	37.7
10	—	43	2,750	6,030	771	0.58	18.6	46.8
			14 15.6	14 14.8	14 28.7	14 29.9	14 38.7	10 17.9
20	—	47	5,820	11,940	985	1.91	21.6	46.8
			4,190	9,350	1,560	0.65	16.7	45.1
12	—	28	50 16.1	50 8.7	50 14.0	50 34.4	50 31.3	17 22.7
			8,600	14,310	1,730	2.41	17.0	37.6
8	—	28	3,730	8,710	1,510	0.52	18.6	55.0
			31 17.7	31 16.0	31 17.5	31 28.2	31 36.3	10 21.3
13	—	29	5,490	17,530	2,250	0.74	16.7	54.7
			2,890	5,460	1,310	0.37	6.9	20.2
3	—	27	70 14.6	70 9.2	70 17.1	70 30.5	69 36.1	27 35.0
			5,250	9,800	1,630	0.99	10.3	21.0
5	—	22	2,690	5,340	1,080	0.39	8.2	23.4
			24 11.7	24 13.6	24 21.0	24 29.4	24 30.7	18 36.8
6	—	41	4,570	9,490	1,260	0.96	8.9	15.9
			2,680	5,010	1,150	0.36	5.1	13.9
3	—	27	28 5.7	28 11.5	28 13.9	28 42.0	27 32.3	18 28.0
			4,820	10,120	1,670	0.83	10.7	18.4
5	—	22	2,510	4,740	869	0.43	9.7	28.2
			39 30.5	39 25.0	39 36.1	39 47.5	39 48.5	12 38.3
6	—	41	3,350	7,490	1,130	0.63	16.9	35.6
			2,260	4,060	971	0.30	4.8	6.1
6	—	41	60 19.7	60 15.1	60 20.6	60 26.6	60 26.0	23 43.3
			4,090	7,140	1,280	0.75	6.4	9.8
6	—	41	4,630	8,960	1,550	0.80	17.9	48.7
			44 23.7	44 14.5	44 12.1	44 42.0	44 33.0	12 24.1
6	—	41	8,830	14,930	1,900	2.32	17.3	34.4

TABLE 6—1 STATISTICAL VALUES* FOR IMPACT, COMPRESSION, HARDNESS,

SPECIES	Sample Size		Moisture Condition	Specific Gravity		Impact Bending			
	No. of Locations Sampled	No. of Trees Tested		Basic	Nominal	Stress at Proportional Limit (psi)	Modulus of Elasticity (1,000 psi)	Work to Proportional Limit (in. lb/cu. in.)	Drop of 50 lb. Hammer at Complete Failure (in.)
				Volume Green Weight Oven-dry	Volume Air-dry Weight Oven-dry				
Alder, Red <i>Alnus rubra</i>	1	6	green	0.373		9,020	1,630	2.83	24
			air-dry		0.409	28 12.0 12,400	28 14.7 2,000	28 21.9 4.32	27 19.4 29
Ash, Black <i>Fraxinus nigra</i>	1	5	green	0.468		10,850	1,180	5.88	60
			air-dry		0.494	10 14.7 14,550	10 33.9 1,840	10 32.4 6.38	10 20.0 56
Ash, Green <i>Fraxinus pennsylvanica</i> var. <i>subintegerrima</i>	1	2	green	0.486		8,820	1,190	3.66	42
			air-dry		0.506	10 12.1 —	10 11.3 —	10 22.0 —	10 34.5 —
Ash, White <i>Fraxinus americana</i>	2	13	green	0.570		12,010	1,770	5.02	76
			air-dry		0.613	25 12.5 17,960	25 30.8 2,370	25 35.6 7.36	24 29.5 56
Basswood <i>Tilia americana</i>	1	4	green	0.360		8,790	1,450	2.98	23
			air-dry		0.417	11 10.9 11,320	11 14.9 2,220	11 13.1 3.21	11 11.5 27
Beech <i>Fagus grandifolia</i>	3	17	green	0.590		14,150	1,870	6.54	53
			air-dry		0.667	42 11.5 18,710	42 24.9 2,900	42 34.2 6.87	42 24.4 75
Birch, White <i>Betula papyrifera</i>	3	16	green	0.506		9,700	1,930	2.77	42
			air-dry		0.571	27 10.2 12,990	27 14.0 2,500	27 24.8 3.76	27 27.5 47
Birch, Western White <i>Betula papyrifera</i> var. <i>commutata</i>	2	18	green	0.508		11,740	2,200	3.58	38
			air-dry		0.564	66 11.2 16,380	66 21.6 3,330	66 17.6 4.86	66 18.2 51
Birch, Yellow <i>Betula alleghaniensis</i>	4	25	green	0.559		12,190	1,950	4.42	55
			air-dry		0.608	67 14.8 18,250	67 19.4 2,860	67 34.3 6.63	67 28.4 60
Butternut <i>Juglans cinerea</i>	1	5	green	0.368		8,810	1,500	2.90	21
			air-dry		0.388	14 9.8 9,600	14 13.7 1,870	14 11.8 2.76	14 21.4 21
Cherry, Black <i>Prunus serotina</i>	1	5	green	0.510		13,010	1,710	5.54	44
			air-dry		0.551	22 11.0 15,680	22 11.0 2,250	22 26.3 6.12	22 19.9 41

*Four statistics are included for most properties. On the first line of the box is the species mean for material in green condition. Directly below is the species mean for air-dry material adjusted to a moisture content of 12 per cent. On the middle line to the left is the number of tests, and to the right the coefficient of variation.

SHEAR, CLEAVAGE, AND TENSION—BROAD-LEAVED

Compression Parallel to Grain			Com- pression Perpen- dicular to Grain	Hardness		Shear Parallel to Grain	Cleavage	Tension Perpen- dicular to Grain
Stress at Propor- tional Limit (psi)	Maximum Crushing Stress (psi)	Modulus of Elas- ticity (1,000 psi)	Stress at Propor- tional Limit (psi)	Load Required to Imbed 0.444 in. Sphere to Half Diameter (lb.)		Maximum Stress (psi)	Splitting Strength (lb./in. width; length 3")	Maximum Stress (psi)
				Side	End			
2,370	3,020	1,200	360	432	534	911	236	454
51 21.7	103 11.5	51 12.9	29 21.5	64 18.8	32 16.3	36 14.8	32 20.0	36 20.0
3,990	5,800	1,330	580	560	980	1,155	305	415
1,460	2,420	1,440	378	736	760	835	348	648
12 15.9	31 14.0	12 9.2	15 22.9	30 14.4	15 13.4	24 20.8	19 17.8	21 20.8
3,360	5,920	2,020	847	948	1,102	1,758	432	714
1,180	2,150	990	518	703	752	988	322	690
11 4.8	31 7.6	11 40.1	16 13.0	34 15.9	17 8.2	22 5.5	22 12.5	22 13.1
2,070	4,720	1,690	1,060	965	1,394	1,410	401	933
2,380	3,690	1,590	776	1,047	1,084	1,376	477	948
48 30.4	155 20.7	48 21.8	56 22.5	110 21.5	55 16.8	80 20.4	78 22.9	80 22.5
3,550	7,220	1,960	1,450	1,586	1,926	2,147	499	1,076
1,110	2,220	1,170	199	324	386	718	169	446
9 20.6	35 15.2	9 18.0	10 24.8	22 17.8	11 14.5	23 10.2	24 18.8	24 11.2
2,560	4,870	1,960	421	481	573	1,172	250	698
2,620	3,820	1,540	660	1,036	1,125	1,327	461	914
74 24.1	216 11.1	74 15.1	81 17.8	162 13.8	81 11.3	132 14.4	131 17.8	130 23.5
4,400	8,010	2,120	1,210	1,458	1,791	2,105	572	1,286
1,670	2,690	1,490	358	620	562	944	292	618
55 32.9	173 12.1	55 22.0	72 15.7	134 13.3	67 14.3	91 11.1	96 17.7	54 20.8
3,710	6,480	1,950	997	972	979	1,634	485	1,040
1,960	3,080	1,570	358	554	626	1,040	288	597
82 29.0	233 13.1	82 18.8	98 21.3	196 17.9	98 15.6	108 12.0	108 18.5	108 16.5
5,310	7,500	2,110	785	923	1,044	1,836	480	956
2,220	3,390	1,630	487	830	894	1,190	378	756
91 31.8	304 17.3	91 23.0	92 18.6	182 16.6	91 16.5	148 12.5	145 18.2	144 21.0
4,230	7,560	2,210	1,050	1,332	1,635	2,128	591	1,090
1,240	2,450	1,170	243	409	457	685	216	482
14 22.1	51 15.8	14 12.2	18 24.0	36 21.9	18 17.7	32 18.1	32 27.8	30 29.3
2,510	5,160	1,510	449	588	864	1,062	270	540
1,760	3,440	1,510	497	714	928	1,154	382	796
27 27.7	90 9.5	27 7.6	35 18.7	72 14.2	36 9.3	44 9.2	40 23.0	42 17.6
4,290	7,310	1,780	1,100	1,040	1,554	1,652	427	881

TABLE 6—2 STATISTICAL VALUES* FOR IMPACT, COMPRESSION, HARDNESS,

SPECIES	Sample Size		Moisture Condition	Specific Gravity		Impact Bending			
	No. of Locations Sampled	No. of Trees Tested		Basic	Nominal	Stress at Proportional Limit (psi)	Modulus of Elasticity (1,000 psi)	Work to Proportional Limit (in. lb./cu. in.)	Drop of 50 lb. Hammer at Complete Failure (in.)
				Volume Green Weight Oven-dry	Volume Air-dry Weight Oven-dry				
Chestnut <i>Castanea dentata</i>	1	5	green	0.423		9,680 14 11.1	1,770 14 18.9	2.98 14 14.9	34 14 21.5
			air-dry		0.449	10,460	1,720	3.62	22
Elm, Slippery <i>Ulmus rubra</i>	1	5	green	0.547		12,160 12 7.5	1,640 12 11.1	5.05 12 16.4	76 12 21.6
			air-dry		0.602	17,700	2,380	7.34	92
Elm, Rock <i>Ulmus thomasi</i>	3	13	green	0.625		15,250 69 16.8	1,740 69 24.2	7.90 69 26.4	75 70 40.7
			air-dry		0.661	17,780	2,460	7.34	70
Elm, White <i>Ulmus americana</i>	4	23	green	0.524		10,930 80 16.2	1,340 80 27.7	5.12 80 20.1	62 82 32.0
			air-dry		0.562	16,440	2,320	6.66	60
Hickory, Bitternut <i>Carya cordiformis</i>	1	5	green	0.628		15,210 12 13.5	2,190 12 18.3	5.92 12 13.9	62 12 43.1
			air-dry		0.675	19,440	2,890	7.34	96
Hickory, Shagbark <i>Carya ovata</i>	2	11	green	0.654		14,880 22 12.5	1,900 22 19.2	6.56 22 11.8	86 23 28.7
			air-dry		0.724	18,390	3,010	6.37	80
Ironwood <i>Ostrya virginiana</i>	1	6	green	0.652		14,520 9 19.0	2,170 9 30.5	5.46 9 12.2	112 9 12.7
			air-dry		0.717	19,480	3,030	7.00	93
Maple, Broadleaf <i>Acer macrophyllum</i>	1	6	green	0.466		11,620 21 8.0	2,070 21 8.0	3.67 21 16.7	42 21 24.1
			air-dry		0.507	13,000	2,180	4.34	41
Maple, Manitoba <i>Acer negundo</i>	1	6	green	0.416		8,660 15 12.2	1,420 15 18.2	2.98 15 19.6	33 15 18.2
			air-dry		0.457	—	—	—	—
Maple, Red <i>Acer rubrum</i>	1	6	green	0.516		11,110 14 9.0	2,300 14 27.5	3.07 14 14.2	36 15 35.6
			air-dry		0.545	—	—	—	—
Maple, Silver <i>Acer saccharinum</i>	1	5	green	0.461		10,020 20 7.5	1,840 20 10.0	3.06 20 14.8	29 20 15.4
			air-dry		0.478	12,440	2,220	3.90	30

*Four statistics are included for most properties. On the first line of the box is the species mean for material in green condition. Directly below is the species mean for air-dry material adjusted to a moisture content of 12 per cent. On the middle line to the left is the number of tests, and to the right the coefficient of variation.

SHEAR, CLEAVAGE, AND TENSION—BROAD-LEAVED

Compression Parallel to Grain			Com- pression Perpen- dicular to Grain	Hardness		Shear Parallel to Grain	Cleavage	Tension Perpen- dicular to Grain
Stress at Propor- tional Limit (psi)	Maximum Crushing Stress (psi)	Modulus of Elas- ticity (1,000 psi)	Stress at Propor- tional Limit (psi)	Load Required to Imbed 0.444 in. Sphere to Half Diameter (lb.)		Maximum Stress (psi)	Splitting Strength (lb./in. width; length 3")	Maximum Stress (psi)
				Side	End			
1,900	3,170	1,260	328	602	692	1,021	280	661
18 21.7	56 19.7	18 18.3	31 32.3	60 19.4	30 17.8	38 13.5	40 20.5	36 22.3
3,700	5,790	1,330	775	664	1,008	1,320	258	570
1,700	3,420	1,410	557	951	977	1,125	420	814
15 23.7	52 15.9	15 21.7	21 25.6	44 28.7	22 19.9	30 15.3	29 17.6	29 23.3
2,910	6,600	2,010	858	1,378	1,529	1,770	552	967
2,620	4,080	1,500	813	1,174	1,200	1,438	499	973
223 25.0	632 18.9	223 20.9	272 25.4	468 28.8	234 21.9	332 16.5	324 20.1	322 20.6
4,390	7,480	1,910	1,287	1,564	1,679	2,148	529	1,061
1,760	3,060	1,240	556	778	848	1,104	392	782
217 31.3	509 21.9	217 24.1	213 23.4	342 24.9	171 20.4	270 14.5	239 19.0	228 21.2
3,080	6,000	1,620	1,000	1,120	1,342	1,700	456	912
2,240	4,320	1,930	800	1,360	1,410	1,455	525	1,000
15 27.8	41 14.3	15 24.6	16 12.6	32 12.0	16 10.3	30 6.9	29 11.5	30 13.8
3,460	8,430	2,340	1,973	2,138	2,315	2,746	792	1,560
2,580	4,490	1,850	914	1,343	1,425	1,556	546	1,029
33 27.1	120 15.5	33 26.8	48 16.0	96 17.2	48 11.1	69 13.4	60 16.8	58 18.5
4,400	8,620	2,320	1,900	2,153	2,331	2,724	677	1,344
2,040	3,890	1,710	712	1,297	1,295	1,392	428	826
15 39.6	31 16.3	15 25.9	16 9.7	42 9.7	21 7.6	38 6.8	23 9.9	21 15.4
4,630	8,680	2,190	1,532	2,005	2,279	2,296	606	1,097
2,860	3,800	1,350	564	710	826	1,265	395	790
36 23.9	78 13.0	36 13.4	23 15.1	46 14.6	23 12.5	36 11.4	36 15.0	36 24.7
3,890	6,120	1,430	830	925	1,300	1,765	495	785
1,580	2,370	965	342	540	578	936	258	488
24 26.5	76 18.0	24 11.8	31 26.5	64 14.7	32 13.1	40 17.9	38 23.7	40 25.9
3,260	4,950	1,270	784	720	1,052	1,365	349	658
2,540	3,610	1,700	550	760	886	1,213	388	736
20 23.0	78 10.7	20 14.7	43 25.4	86 14.3	43 10.4	54 9.0	54 21.8	52 24.6
3,470	6,800	1,930	1,035	984	1,400	1,524	426	908
1,980	2,930	1,540	374	586	702	972	287	649
16 16.3	65 9.3	16 8.2	24 19.7	50 13.5	25 10.6	32 10.1	30 14.5	32 13.8
3,420	6,020	1,840	662	850	1,271	1,623	452	896

TABLE 6—3 STATISTICAL VALUES* FOR IMPACT, COMPRESSION, HARDNESS,

SPECIES	Sample Size		Moisture Condition	Specific Gravity		Impact Bending			
	No. of Locations Sampled	No. of Trees Tested		Basic	Nominal	Stress at Proportional Limit (psi)	Modulus of Elasticity (1,000 psi)	Work to Proportional Limit (in. lb/cu. in.)	Drop of 50 lb. Hammer at Complete Failure (in.)
				Volume Green Weight Oven-dry	Volume Air-dry Weight Oven-dry				
Maple, Sugar <i>Acer saccharum</i>	4	19	green	0.597		14,410	2,570	4.60	54
			air-dry		0.659	71 13.5 19,150	71 17.7 3,480	71 20.3 5.99	71 20.9 57
Oak, Black <i>Quercus velutina</i>	1	5	green	0.597		14,360	1,810	6.40	66
			air-dry		0.621	10 12.9 16,410	10 8.9 2,430	10 21.3 6.24	10 16.4 64
Oak, Bur <i>Quercus macrocarpa</i>	1	6	green	0.599		10,310	1,060	5.71	84
			air-dry		0.653	7 4.3 —	7 28.1 —	7 21.0 —	7 25.7 —
Oak, Red <i>Quercus rubra</i>	2	11	green	0.581		13,670	2,170	5.06	63
			air-dry		0.612	42 20.5 18,310	42 13.0 2,480	42 42.3 7.56	42 20.2 57
Oak, White <i>Quercus alba</i>	1	5	green	0.654		14,630	1,910	6.29	81
			air-dry		0.676	22 11.9 21,720	22 18.1 2,810	22 11.9 9.36	22 15.1 71
Aspen, Trembling <i>Populus tremuloides</i>	3	20	green	0.374		8,140	1,510	2.47	26
			air-dry		0.408	42 7.7 10,800	42 14.6 1,960	42 15.7 3.33	42 15.7 28
Aspen, Largetooth <i>Populus grandidentata</i>	2	10	green	0.390		8,090	1,380	2.71	32
			air-dry		0.401	13 11.4 —	13 19.0 —	13 21.1 —	13 27.8 —
Poplar, Balsam <i>Populus balsamifera</i>	2	10	green	0.372		7,530	1,260	2.53	19
			air-dry		0.415	18 10.7 —	18 19.0 —	18 14.8 —	18 24.1 —
Cottonwood, Eastern <i>Populus deltoides</i>	1	5	green	0.352		6,950	1,070	2.60	39
			air-dry		0.386	25 15.4 9,600	25 32.1 1,690	25 13.6 3.06	25 33.3 26
Cottonwood, Black <i>Populus trichocarpa</i>	1	7	green	0.295		8,210	1,150	3.32	17
			air-dry		0.320	51 10.1 11,910	51 14.9 1,880	51 15.6 4.25	51 21.6 21
Walnut, Black <i>Juglans nigra</i>	1	3	green	0.546		15,310	2,250	5.91	72
			air-dry		0.594	28 14.1 18,040	28 15.4 2,470	28 25.0 7.37	28 24.0 59

*Four statistics are included for most properties. On the first line of the box is the species mean for material in green condition. Directly below is the species mean for air-dry material adjusted to a moisture content of 12 per cent. On the middle line to the left is the number of tests, and to the right the coefficient of variation.

SHEAR, CLEAVAGE, AND TENSION—BROAD-LEAVED

Compression Parallel to Grain			Com- pression Perpen- dicular to Grain	Hardness		Shear Parallel to Grain	Cleavage	Tension Perpen- dicular to Grain
Stress at Propor- tional Limit (psi)	Maximum Crushing Stress (psi)	Modulus of Elas- ticity (1,000 psi)	Stress at Propor- tional Limit (psi)	Load Required to Imbed 0.444 in. Sphere to Half Diameter (lb.)		Maximum Stress (psi)	Splitting Strength (lb./in. width; length 3'')	Maximum Stress (psi)
				Side	End			
2,980	4,560	1,890	854	1,175	1,330	1,615	532	1,042
96 20.6	319 11.0	96 14.7	98 15.3	176 12.3	88 10.9	125 11.2	125 15.6	127 15.7
4,820	8,180	2,240	1,410	1,638	1,973	2,424	626	1,336
2,060	3,960	1,480	783	1,026	1,217	1,369	484	929
13 34.2	53 13.4	13 22.0	31 13.8	60 12.0	30 9.4	43 8.3	43 11.6	42 15.2
3,540	6,750	1,940	1,330	1,483	1,584	1,999	503	1,131
1,540	2,670	919	765	970	1,071	1,285	402	822
16 26.5	36 11.6	16 23.0	20 13.4	40 16.5	20 12.8	34 7.3	34 16.2	34 14.8
2,930	6,140	1,400	1,420	1,330	1,631	1,908	582	1,029
2,430	3,940	1,560	789	1,032	1,243	1,360	486	948
44 20.1	140 10.9	44 14.3	47 15.7	94 13.2	47 9.1	82 8.7	81 11.6	80 15.6
3,870	7,230	1,980	1,290	1,388	1,649	2,085	488	946
2,130	3,580	1,680	716	1,260	1,270	1,264	488	869
21 31.4	79 18.4	21 14.1	16 10.5	32 12.7	16 11.8	30 13.1	30 10.8	30 16.0
3,530	8,720	2,290	1,420	1,602	1,900	2,244	694	1,254
1,510	2,350	1,250	199	324	339	718	183	441
56 23.0	187 9.2	56 17.8	89 14.4	164 14.2	82 14.1	108 14.2	101 21.1	100 25.7
3,280	5,270	1,840	511	482	633	981	260	607
1,200	2,390	1,210	212	396	373	789	202	412
26 29.0	75 13.1	26 18.5	29 24.9	58 19.5	29 14.1	47 12.1	49 22.1	50 35.4
2,400	4,750	1,650	473	415	566	1,098	260	581
1,260	2,110	1,260	178	292	309	666	162	310
24 32.2	87 20.2	24 19.3	29 28.1	64 20.9	32 23.3	52 18.0	49 15.6	47 22.0
2,950	5,030	1,850	424	413	615	886	221	452
1,180	1,970	941	210	419	419	770	221	488
37 31.1	123 25.1	37 33.6	50 22.2	106 16.0	53 14.0	75 12.4	73 25.9	62 30.2
2,120	3,850	1,180	472	422	636	1,157	280	696
1,130	1,860	1,120	101	204	257	558	136	286
57 27.3	167 15.5	57 21.5	82 34.0	156 17.9	78 14.5	42 14.3	42 25.6	41 39.8
2,560	4,020	1,510	259	304	450	862	192	498
2,650	4,200	1,560	695	912	1,164	1,322	490	900
35 27.8	106 16.4	35 14.6	39 24.7	78 14.4	39 13.9	50 12.0	48 17.4	47 19.3
4,340	7,780	1,880	1,290	1,328	1,647	2,138	546	1,105

TABLE 7—1 AVERAGE VALUES (Green Condition)—CONIFERS

SPECIES	Specific Gravity		Static Bending					
	Basic	Oven-dry	Stress at Proportional Limit (kg/cm ²)	Modulus of Rupture (kg/cm ²)	Modulus of Elasticity (1,000 kg/cm ²)	Work in Bending (kg m/cm ²)10 ⁻³		
	Volume Green Weight Oven-dry	Volume Oven-dry Weight Oven-dry				To Proportional Limit	To Maximum Load	Total
Cedar, Eastern White	0.30	0.31	142	271	36	0.32	6.0	9.2
Cedar, Western Red	0.31	0.34	218	373	74	0.37	3.4	5.8
Cypress, Yellow	0.42	0.46	260	467	94	0.41	5.8	15.3
Douglas Fir	0.45	0.51	303	530	113	0.46	5.0	13.2
Fir, Amabilis	0.36	0.41	210	385	95	0.27	3.9	8.9
Fir, Balsam	0.34	0.37	197	372	79	0.28	5.1	9.3
Hemlock, Eastern	0.40	0.45	276	477	89	0.49	4.8	14.8
Hemlock, Western	0.41	0.47	289	489	104	0.46	4.7	12.1
Tamarack	0.48	0.54	222	479	87	0.34	7.0	25.0
Larch, Western	0.55	0.64	352	610	116	0.60	5.6	17.6
Pine, Jack	0.42	0.45	243	444	82	0.42	5.0	17.3
Pine, Lodgepole	0.40	0.46	209	397	90	0.28	3.7	10.5
Pine, Red	0.39	0.42	203	352	75	0.32	4.2	17.8
Pine, Western White	0.36	0.40	203	340	83	0.28	3.6	8.5
Pine, Ponderosa	0.44	0.49	233	401	80	0.39	3.8	14.1
Pine, Eastern White	0.36	0.38	211	361	83	0.31	3.8	9.0
Spruce, Black	0.41	0.44	217	413	93	0.30	5.9	18.0
Spruce, Engelmann	0.38	0.43	216	398	88	0.33	3.8	13.6
Spruce, Red	0.38	0.42	211	413	93	0.27	5.6	13.0
Spruce, Sitka	0.35	0.39	217	380	96	0.28	3.4	11.8
Spruce, White	0.35	0.39	195	358	81	0.27	4.1	11.1

METRIC UNITS

Compression Parallel to Grain			Com- pression Perpen- dicular to Grain	Hardness		Shear Parallel to Grain	Cleavage	Tension Perpen- dicular to Grain
Stress at Propor- tional Limit (kg/cm ²)	Maximum Crushing Stress (kg/cm ²)	Modulus of Elas- ticity (1,000 kg/cm ²)	Stress at Propor- tional Limit (kg/cm ²)	Load Required to Imbed 11.278 mm Sphere to Half Diameter (kg)		Maximum Stress (kg/cm ²)	Splitting Strength (kg/cm width; length 7.62 cm)	Maximum Stress (kg/cm ²)
				Side	End			
86	133	38	14	120	160	46	29	23
162	196	82	20	120	200	49	24	17
176	228	90	25	200	240	62	36	27
198	254	118	32	220	270	65	39	29
150	195	102	16	150	180	50	30	19
119	172	87	17	130	150	48	26	21
171	241	99	28	200	250	64	33	24
209	251	114	26	210	250	53	36	27
141	220	91	29	190	220	65	38	28
242	310	132	36	260	290	65	43	29
141	207	84	24	180	190	58	34	25
156	201	100	19	160	150	51	33	23
112	166	80	20	150	150	50	33	24
143	177	92	16	130	130	46	26	16
150	200	89	24	190	180	51	37	27
137	182	89	17	130	140	45	30	22
129	194	103	21	170	190	56	32	24
154	198	90	19	160	160	49	32	22
136	198	104	19	160	200	57	32	25
146	180	106	20	150	180	45	29	22
128	174	92	17	130	140	47	28	22

TABLE 7—2 AVERAGE VALUES (Green Condition)—BROAD-LEAVED

SPECIES	Specific Gravity		Static Bending					
	Basic	Oven-dry	Stress at Proportional Limit (kg/cm ²)	Modulus of Rupture (kg/cm ²)	Modulus of Elasticity (1,000 kg/cm ²)	Work in Bending (kg m/cm ²)10 ⁻³		
	Volume Green Weight Oven-dry	Volume Oven-dry Weight Oven-dry				To Proportional Limit	To Maximum Load	Total
Alder, Red	0.37	0.42	248	442	84	0.41	5.6	10.5
Ash, Black	0.47	0.54	205	448	87	0.27	13.8	37.5
Ash, Green	0.49	0.56	163	354	58	0.28	9.0	18.4
Ash, White	0.57	0.65	281	585	101	0.46	16.5	43.0
Basswood	0.36	0.42	186	347	74	0.27	4.4	14.3
Beech	0.59	0.70	296	643	106	0.48	9.5	28.0
Birch, White	0.51	0.59	225	482	102	0.28	10.3	34.1
Birch, Western White	0.51	0.60	239	512	112	0.30	7.5	26.2
Birch, Yellow	0.56	0.65	281	579	108	0.44	12.9	38.7
Butternut	0.37	0.40	174	351	66	0.27	6.2	13.6
Cherry, Black	0.51	0.62	262	557	102	0.39	9.4	26.4
Chestnut	0.42	0.47	263	515	79	0.51	9.0	18.6
Elm, Slippery	0.55	0.64	262	564	87	0.46	14.5	36.1
Elm, Rock	0.62	0.73	331	665	96	0.65	15.5	44.2
Elm, White	0.52	0.62	251	529	78	0.47	11.7	33.0
Hickory, Bitternut	0.63	0.76	280	703	123	0.37	16.7	49.3
Hickory, Shagbark	0.65	0.79	337	744	108	0.48	15.7	45.0
Ironwood	0.65	0.79	353	712	122	0.58	17.2	56.1

METRIC UNITS

Compression Parallel to Grain			Com- pression Perpen- dicular to Grain	Hardness		Shear Parallel to Grain	Cleavage	Tension Perpen- dicular to Grain
Stress at Propor- tional Limit (kg/cm ²)	Maximum Crushing Stress (kg/cm ²)	Modulus of Elas- ticity (1,000 kg/cm ²)	Stress at Propor- tional Limit (kg/cm ²)	Load Required to Imbed 11.278 mm Sphere to Half Diameter (kg)		Maximum Stress (kg/cm ²)	Splitting Strength (kg/cm width; length 7.62 cm)	Maximum Stress (kg/cm ²)
				Side	End			
167	212	84	25	200	240	64	42	32
103	170	101	27	330	340	59	62	46
83	151	70	36	320	340	70	58	48
167	259	112	55	480	490	97	85	67
78	156	82	14	150	180	50	30	31
184	269	108	46	470	510	93	82	64
117	189	105	25	280	260	66	52	43
138	217	111	25	250	280	73	51	42
156	238	115	34	380	410	84	68	53
87	172	82	17	190	210	48	39	34
124	242	106	35	320	420	81	68	56
134	223	89	23	270	310	72	50	46
120	240	99	39	430	440	79	75	57
184	287	105	57	530	540	101	89	68
124	215	87	39	350	380	78	70	55
157	304	136	56	620	640	102	94	70
181	316	130	64	610	650	109	98	72
143	273	120	50	590	590	98	76	58

TABLE 7—3 AVERAGE VALUES (Green Condition)—BROAD-LEAVED

SPECIES	Specific Gravity		Static Bending					
	Basic	Oven-dry	Stress at Proportional Limit (kg/cm ²)	Modulus of Rupture (kg/cm ²)	Modulus of Elasticity (1,000 kg/cm ²)	Work in Bending (kgm/cm ²)10 ⁻³		
	Volume Green Weight Oven-dry	Volume Oven-dry Weight Oven-dry				To Proportional Limit	To Maximum Load	Total
Maple, Broadleaf	0.47	0.53	304	570	91	0.57	8.7	20.2
Maple, Manitoba	0.42	0.50	198	367	61	0.37	6.5	16.8
Maple, Red	0.52	0.59	310	600	112	0.50	8.3	21.6
Maple, Silver	0.46	0.51	230	479	93	0.32	7.3	17.4
Maple, Sugar	0.60	0.70	348	718	120	0.58	12.8	29.7
Oak, Black	0.60	0.68	302	648	110	0.48	12.4	35.2
Oak, Bur	0.60	0.69	193	424	54	0.41	13.1	32.9
Oak, Red	0.58	0.66	295	657	110	0.46	11.7	31.7
Oak, White	0.65	0.78	262	612	106	0.37	13.1	38.7
Aspen, Trembling	0.37	0.42	203	384	92	0.26	4.9	14.2
Aspen, Largetooth	0.39	0.43	189	375	76	0.27	5.8	16.5
Poplar, Balsam	0.37	0.42	188	352	81	0.25	3.6	9.8
Cottonwood, Eastern	0.35	0.39	176	333	61	0.30	6.8	19.8
Cottonwood, Black	0.30	0.33	159	285	68	0.21	3.4	4.3
Walnut, Black	0.55	0.63	325	630	109	0.56	12.6	34.2

METRIC UNITS

Compression Parallel to Grain			Com- pression Perpen- dicular to Grain	Hardness		Shear Parallel to Grain	Cleavage	Tension Perpen- dicular to Grain
Stress at Propor- tional Limit (kg/cm ²)	Maximum Crushing Stress (kg/cm ²)	Modulus of Elas- ticity (1,000 kg/cm ²)	Stress at Propor- tional Limit (kg/cm ²)	Load Required to Imbed 11.278 mm Sphere to Half Diameter (kg)		Maximum Stress (kg/cm ²)	Splitting Strength (kg/cm width; length 7.62 cm)	Maximum Stress (kg/cm ²)
				Side	End			
201	267	95	40	320	380	89	70	56
111	167	68	24	240	260	66	46	34
179	254	120	39	340	400	85	69	52
139	206	108	26	270	320	68	51	46
209	321	133	60	530	600	114	95	73
145	278	104	55	460	550	96	86	65
108	188	65	54	440	490	90	72	58
171	277	110	56	470	560	96	87	67
150	252	118	50	570	580	89	87	61
106	165	88	14	150	150	50	33	31
84	168	85	15	180	170	56	36	29
89	148	89	12	130	140	47	29	22
83	138	66	15	190	190	54	40	34
79	131	79	7	90	120	39	24	20
186	295	110	49	410	530	93	88	63

TABLE 8—1 AVERAGE VALUES* (Air-dry Condition)—CONIFERS

SPECIES	Specific Gravity		Static Bending					
	Nominal	Oven-dry	Stress at Proportional Limit (kg/cm ²)	Modulus of Rupture (kg/cm ²)	Modulus of Elasticity (1,000 kg/cm ²)	Work in Bending (kg m/cm ³)10 ⁻³		
	Volume Air-dry Weight Oven-dry	Volume Oven-dry Weight Oven-dry				To Proportional Limit	To Maximum Load	Total
Cedar, Eastern White	0.30	0.31	254	431	45	0.86	7.4	10.7
Cedar, Western Red	0.34	0.34	351	549	85	0.83	3.8	5.9
Cypress, Yellow	0.43	0.46	474	812	112	1.14	8.9	11.5
Douglas Fir	0.49	0.51	545	903	138	1.25	7.3	15.5
Fir, Amabilis	0.39	0.41	409	702	116	0.83	6.0	12.2
Fir, Balsam	0.35	0.37	311	595	99	0.58	6.2	9.9
Hemlock, Eastern	0.43	0.45	421	684	99	1.04	5.9	9.5
Hemlock, Western	0.43	0.47	548	827	126	1.38	7.0	13.3
Tamarack	0.51	0.54	559	774	96	1.98	5.4	11.8
Larch, Western	0.58	0.64	686	1,090	146	1.82	8.8	16.1
Pine, Jack	0.44	0.45	498	790	104	1.39	7.0	11.1
Pine, Lodgepole	0.41	0.46	496	770	111	1.29	6.2	8.8
Pine, Red	0.40	0.42	414	711	96	1.01	6.8	11.3
Pine, Western White	0.37	0.40	397	653	103	0.87	6.3	8.7
Pine, Ponderosa	0.46	0.49	458	747	97	1.22	6.4	10.8
Pine, White	0.37	0.38	423	663	96	1.04	6.2	8.6
Spruce, Black	0.43	0.44	455	799	106	1.15	6.4	11.9
Spruce, Engelmann	0.40	0.42	451	709	109	1.00	6.0	10.2
Spruce, Red	0.40	0.42	474	729	113	1.17	6.4	11.6
Spruce, Sitka	0.39	0.39	450	712	115	1.00	6.7	13.9
Spruce, White	0.37	0.39	374	639	102	0.79	5.2	8.6

*Adjusted to a moisture content of 12 per cent.

METRIC UNITS

Compression Parallel to Grain			Com- pression Perpen- dicular to Grain	Hardness		Shear Parallel to Grain	Cleavage	Tension Perpen- dicular to Grain
Stress at Propor- tional Limit (kg/cm ²)	Maximum Crushing Stress (kg/cm ²)	Modulus of Elas- ticity (1,000 kg/cm ²)	Stress at Propor- tional Limit (kg/cm ²)	Load Required to Imbed 11.278 mm Sphere to Half Diameter (kg)		Maximum Stress (kg/cm ²)	Splitting Strength (kg/cm width; length 7.62 cm)	Maximum Stress (kg/cm ²)
				Side	End			
160	253	50	27	140	240	71	34	27
279	345	92	35	150	310	57	26	15
322	467	103	48	260	400	94	46	36
348	511	139	61	300	410	97	40	31
292	416	123	37	200	380	77	38	31
233	350	99	32	190	320	64	28	21
311	418	116	44	240	370	89	30	21
372	477	123	46	280	450	66	38	30
283	457	108	63	330	380	92	40	35
424	622	141	74	430	580	94	49	37
243	413	108	58	260	330	84	47	37
313	441	116	37	220	300	87	53	38
240	386	96	50	220	260	76	42	36
292	368	103	33	170	230	65	36	27
291	432	102	53	270	340	72	49	35
258	369	99	35	170	220	62	34	27
309	423	125	43	250	330	88	50	35
311	432	112	38	210	270	77	41	28
239	393	127	38	230	320	94	50	38
223	386	124	42	220	320	69	39	25
261	376	116	35	190	250	69	40	33

TABLE 8—2 AVERAGE VALUES* (Air-dry Condition)—BROAD-LEAVED

SPECIES	Specific Gravity		Static Bending					
	Nominal	Oven-dry	Stress at Proportional Limit (kg/cm ²)	Modulus of Rupture (kg/cm ²)	Modulus of Elasticity (1,000 kg/cm ²)	Work in Bending (kg m/cm ²)10 ⁻³		
	Volume Air-dry Weight Oven-dry	Volume Oven-dry Weight Oven-dry				To Proportional Limit	To Maximum Load	Total
Alder, Red	0.41	0.42	415	752	103	0.94	6.7	9.3
Ash, Black	0.49	0.54	390	856	138	0.65	8.9	24.3
Ash, Green	0.51	0.56	254	567	71	0.57	8.0	—
Ash, White	0.61	0.65	560	1,100	131	1.35	16.1	34.9
Basswood	0.42	0.42	297	620	96	0.51	7.4	11.3
Beech	0.67	0.70	632	1,180	143	1.55	16.2	29.0
Birch, White	0.57	0.59	522	967	131	1.17	14.6	27.4
Birch, Western White	0.56	0.60	545	1,050	152	1.11	13.0	24.0
Birch, Yellow	0.61	0.65	563	1,080	144	1.26	14.6	31.9
Butternut	0.39	0.40	270	605	104	0.38	5.4	9.1
Cherry, Black	0.55	0.62	584	888	121	1.59	7.4	13.6
Chestnut	0.45	0.47	547	764	96	1.76	6.1	11.0
Elm, Slippery	0.60	0.64	340	914	120	0.57	13.3	44.8
Elm, Rock	0.66	0.73	564	1,170	127	1.39	20.6	40.8
Elm, White	0.56	0.62	413	879	106	0.93	15.5	39.2
Hickory, Bitternut	0.68	0.76	744	1,490	189	1.70	21.8	52.7
Hickory, Shagbark	0.72	0.79	671	1,210	138	1.74	15.0	54.3
Ironwood	0.73	0.79	698	1,370	161	1.69	19.5	54.9

*Adjusted to a moisture content of 12 per cent.

METRIC UNITS

Compression Parallel to Grain		Modulus of Elasticity (1,000 kg/cm ²)	Compression Perpendicular to Grain	Hardness		Shear Parallel to Grain	Cleavage	Tension Perpendicular to Grain
Stress at Proportional Limit (kg/cm ²)	Maximum Crushing Stress (kg/cm ²)		Stress at Proportional Limit (kg/cm ²)	Load Required to Imbed 11.278 mm Sphere to Half Diameter (kg)		Maximum Stress (kg/cm ²)		Splitting Strength (kg/cm width; length 7.62 cm)
					Side	End		
280	408	94	41	250	440	81	54	29
236	416	142	60	430	500	124	77	50
146	332	119	74	440	630	99	72	66
250	508	138	102	720	870	151	89	76
180	342	138	30	220	260	82	45	49
309	563	149	85	660	810	148	102	90
261	456	137	70	440	440	115	87	73
373	527	148	55	420	470	129	86	67
297	531	155	74	600	740	150	106	77
176	363	106	32	270	390	75	48	38
302	514	125	77	470	700	116	76	62
260	407	94	54	300	460	93	46	40
205	464	141	60	620	690	124	99	68
309	526	134	90	710	760	151	94	75
217	422	114	70	510	610	120	81	64
243	593	164	139	970	1,050	193	141	110
309	606	163	134	980	1,060	191	121	94
325	610	154	108	910	1,030	161	108	77

TABLE 8—3 AVERAGE VALUES* (Air-dry Condition)—BROAD-LEAVED

SPECIES	Specific Gravity		Static Bending					
	Nominal	Oven-dry	Stress at Proportional Limit (kg/cm ²)	Modulus of Rupture (kg/cm ²)	Modulus of Elasticity (1,000 kg/cm ²)	Work in Bending (kg m/cm ³)10 ⁻³		
	Volume Air-dry Weight Oven-dry	Volume Oven-dry Weight Oven-dry				To Proportional Limit	To Maximum Load	Total
Maple, Broadleaf	0.51	0.53	422	928	117	0.85	11.1	18.0
Maple, Manitoba	0.46	0.50	—	—	—	—	—	—
Maple, Red	0.54	0.59	561	995	113	1.56	13.2	17.4
Maple, Silver	0.48	0.51	360	836	115	0.65	7.0	11.1
Maple, Sugar	0.66	0.70	661	1,170	143	1.72	14.4	28.7
Oak, Black	0.62	0.68	549	947	110	1.55	13.6	26.5
Oak, Bur	0.65	0.69	409	839	69	1.34	15.2	32.9
Oak, Red	0.61	0.66	605	1,010	122	1.69	12.0	26.4
Oak, White	0.68	0.78	386	1,230	158	0.52	11.7	38.5
Aspen, Trembling	0.41	0.42	369	689	115	0.70	7.2	14.8
Aspen, Largetooth	0.40	0.43	321	667	89	0.67	6.3	11.2
Poplar, Balsam	0.42	0.42	339	711	117	0.58	7.5	12.9
Cottonwood, Eastern	0.39	0.39	236	527	79	0.44	11.9	25.0
Cottonwood, Black	0.32	0.33	288	502	90	0.53	4.5	6.9
Walnut, Black	0.59	0.63	621	1,050	134	1.63	12.2	24.2

*Adjusted to a moisture content of 12 per cent.

METRIC UNITS

Compression Parallel to Grain			Com- pression Perpen- dicular to Grain	Hardness		Shear Parallel to Grain	Cleavage	Tension Perpen- dicular to Grain
Stress at Propor- tional Limit (kg/cm ²)	Maximum Crushing Stress (kg/cm ²)	Modulus of Elas- ticity (1,000 kg/cm ²)	Stress at Propor- tional Limit (kg/cm ²)	Load Required to Imbed 11.278 mm Sphere to Half Diameter (kg)		Maximum Stress (kg/cm ²)	Splitting Strength (kg/cm width; length 7.62 cm)	Maximum Stress (kg/cm ²)
				Side	End			
273	430	100	58	420	590	124	88	55
229	348	89	55	330	480	96	62	46
244	478	136	73	450	640	107	76	64
240	423	129	46	390	580	114	81	63
339	575	157	99	740	900	170	112	94
249	475	136	94	670	720	140	90	80
206	432	98	100	600	740	134	104	72
272	508	139	91	630	750	147	87	66
248	613	161	100	730	860	158	124	88
231	370	129	36	220	290	69	46	43
169	334	116	33	190	260	77	46	41
207	354	130	30	190	280	62	40	32
149	271	83	33	190	290	81	50	49
180	283	106	18	140	200	61	34	35
305	547	132	91	600	750	150	98	78