LUMBER DESIGN VALUES

For Use in the U.S.
Approved by the
American Lumber Standard Committee
Board of Review

July 2006

900. LUMBER DESIGN VALUES

Recommended design procedures and allowable unit stresses for lumber manufactured under this Rule have been developed for use in the United States.

Lumber design values are regularly reviewed to reflect the latest available information on the physical properties of wood. The recommended allowable unit stresses published in this document have been reviewed by the U.S. Forest Products Laboratory and approved by the American Lumber Standard Committee Board of Review. Users should take care to ensure that they are using the latest published design values.

Recommended allowable unit stresses are developed in conformance to the American Softwood Lumber Standard, PS20 and are given in Paras. 905a. to 905o.

Load and Resistance Factor Design Values

The design values tabulated in Paras. 905i to 905o, as well as in Para. 910, are for use in the United States with Allowable Stress Design (ASD). More recently, a new design method called Load and Resistance Factor Design (LRFD) has been developed in the United States. The design values for LRFD, called reference strength, can be computed by multiplying the ASD design values by the factors listed in the following table:

Conversion Factors for LRFD Calculation

Extreme Fiber in Bending "F_b"	Tension Parallel to Grain "F_t"	Horizontal Shear "F_v"	Compression Perpendicular to Grain "$F_{C_{perp}}$"	Compression Parallel to Grain "$F_{C_{II}}$"	Modulus of Elasticity "E"
2.54	2.70	2.88	2.08	2.40	1.00

905. DESIGN VALUES FOR THE U.S.

905a. Recommended allowable unit stresses found in Paras. 905a. to 905o. of this section of the rules apply to lumber of species and combinations of species manufactured and shipped by mills in Canada for use in the United States. The values are calculated in accordance with the requirements of "Standard Practice for Establishing Allowable Properties for Visually Graded Dimension Lumber from in-Grade Tests of Full Size Specimens," ASTM D1990; and, where applicable, "Methods for Establishing Clear Wood Strength Values," ASTM D2555, and "Standard Practice for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber," ASTM D245; published by ASTM and in accordance with the requirements of Voluntary Product Standard PS 20, American Softwood Lumber Standard.

The allowable unit stresses shown herein are recommended for use in design for all normal construction. Higher and lower design stresses may be used to meet special structural requirements. The "National Design Specification for Wood Construction" published by the American Wood Council (AWC), sets forth design methods for normal and most special structural uses.

Recommended design values are assigned to six basic properties of wood. These are fibre stress in bending ($\mathbf{F_b}$), tension parallel to the grain ($\mathbf{F_t}$), horizontal shear ($\mathbf{F_v}$), compression parallel to grain ($\mathbf{F_{cII}}$), compression perpendicular to grain ($\mathbf{F_{Cperp}}$), and modulus of elasticity ($\mathbf{E}$).

Four of the above-mentioned lumber design properties relate directly to safety. These are fibre stress in bending ($\mathbf{F_b}$), tension parallel to grain ($\mathbf{F_t}$), compression parallel to grain ($\mathbf{F_{cII}}$) and horizontal shear ($\mathbf{F_v}$). For dimension lumber, four of the above-mentioned properties are derived from full-size tests of commercially graded lumber ("In-grade" tests).

These are fibre stress in bending ($\mathbf{F_b}$), tension parallel to grain ($\mathbf{F_t}$), compression parallel to grain ($\mathbf{F_{cll}}$), and modulus of elasticity (**E**). The other two properties, and all properties for timbers, are based on tests of clear wood for the various species.

Modifications are then made, in accordance with ASTM standards for moisture content, factors of safety and duration of load. For the clear wood case, values are further reduced to reflect the effects of grade characteristics (see ASTM D2555 & D245). During In-grade testing, species combinations were sampled from production; or, in the case of Northern Species, as individual species, which were grouped together using the criteria of ASTM D1990. For timbers, the grouping procedures of ASTM D2555 were followed.

The modulus of elasticity "**E**" is an experimental constant or ratio of the amount a material will deflect in proportion to an applied load. It, along with the moment of inertia, may be used to predict how much a member will deflect. It is a measure of stiffness and not a strength property or working stress, so is not related to safety except when used in column design where the listed averages shown herein are reduced more than three times in design formulas and computation. The tabulated "**E**" values in this book are average values and individual pieces having values both above and below the listed average occur in all lumber grades. For all normal construction, use of these average "**E**" values provides a conservative prediction of deflections which occur in wall, floor and roof assemblies. Tests by government, university and private research organizations show that deflections occurring when loads are applied to members in load sharing systems are less than predicted for single members. In such applications, the effect of a number of members sharing the load, together with the stiffening effects of fastenings and coverings, more than offset the variations inherent between the individual pieces.

The recommended "**E**" values for dimension lumber and decking shown in the tables of Paras. 905i. to 905m. apply to dry use of lumber manufactured in either dry or unseasoned condition. Recommended "**E**" values for Beams and Stringers and for Posts and Timbers shown in the tables of Paras. 905n. and 905o., apply to both wet and dry use of lumber manufactured in either dry or unseasoned condition.

For dimension lumber, values are based on In-grade testing and for timbers, values are derived from clear wood testing. The mean "**E**" values for various species based on the two test methods are comparable. Table 905h. compares "**E**" values for Select Structural grade, as an example.

In these rules, the various grades used for construction purposes are divided into size categories according to the principal end uses. The allowable unit stresses for these major grade categories are tabulated in Paras. 905i. to 905o. The tables show recommended design values for engineered use as single members, for normal duration of load in pounds per square inch. Adjustment of these values for other conditions of loading and the criteria for their use in the design of structures are outlined in the current "National Design Specification for Wood Construction," which is available from the American Wood Council (AWC)

Bending values, for all size categories except Decking and Scaffold Plank apply to pieces loaded on the narrow face as joists, rafters, or beams. For all categories except Beams and Stringers, Para. 905d. contains adjustment factors for pieces loaded on the wide face as plank or decking.

905b. ENGINEERING DESIGN VALUES

The recommended design values are derived from data or calculations that include consideration of the maximum strength reducing characteristics allowed in the grade. The values are premised on the assumption of the individual member carrying its own design load.

905c. REPETITIVE MEMBER DESIGN VALUES

In actual practice, only a few pieces will contain the maximum strength reducing characteristics permitted in the grade. Therefore, most of the pieces will have actual values higher than the assigned engineering value and when these pieces are used together in a repetitive member system, a 15% increase factor is allowed for fibre stress in bending.

A repetitive member system is defined as 3 or more framing or supporting members, such as joists, studs, planks or decking, that are adjacent or are spaced not more than 24-inches and are joined by floor, roof, or other load-distributing elements.

905d. FLATWISE USE OF LUMBER

Tabulated values are based on edgewise use for grades of Light Framing, Structural Light Framing, Studs, or Structural Joists & Planks, as well as for Machine Graded Lumber. When used flatwise rather than on edge, the allowable fibre stress in bending may be multiplied by the factors in the following table:

ADJUSTMENT FACTORS FOR FLATWISE USE
(Apply to allowable fibre stress in bending)

Width	Nominal Thickness	
	2" & 3"	4"
<4"	1.00	1.00
4"	1.10	1.00
5"	1.10	1.05
6"	1.15	1.05
8"	1.15	1.05
10" & Wider	1.20	1.10

These factors apply to all dimension lumber except for Scaffold Plank and Decking grades.

For Decking, the following adjustments may be used:

Nominal Thickness	2"	3"	4"
Flat-Use Factor	1.10	1.04	1.00

ADJUSTMENT FACTORS FOR BEAMS AND STRINGERS SUBJECTED TO LOADS APPLIED TO THE WIDE FACE

Grade	Factors		
	Bending "Fb"	Modulus of Elasticity "E"	Other Properties
Sel Str	0.86	1.0	1.0
No. 1	0.74	0.9	1.0
No. 2	1.0	1.0	1.0

905e. EFFECT OF MOISTURE CONTENT ON DESIGN VALUES

The design values shown in the tables in Paras. 905i. to 905o., are applicable to lumber that will be used under dry conditions such as in most covered structures. The section properties of lumber for use in design should be based on the surfaced sizes shown in these rules. For 2" to 4" thick lumber, the dry surfaced size should be used.

In calculating design values, the natural gain in strength and stiffness that occurs as lumber dries has been taken into consideration as well as the reduction in size that occurs when unseasoned lumber shrinks. The gain in load carrying capacity due to increased strength and stiffness resulting from drying offsets the design effect of size reductions due to shrinkage. By adjusting design values to compensate for loss in size by shrinkage of unseasoned lumber, use of the surfaced sizes shown is possible and design is simplified.

Because of the built-in adjustments explained above, dry surfaced sizes should be used for design purposes in all instances. There are two situations where the tabulated design values should be adjusted:

i) M.C. Adjustment Factors for Nominal 2" to 4" Thick Lumber

(Use only when moisture content will exceed 19% in use)

When 2" to 4" thick dimension lumber or decking is designed for exposed uses where the moisture content will exceed 19% for an extended period of time, the design values shown in the tables in Paras. 905i to 905m should be multiplied by the following adjustment factors:

Bending "F_b"	Tension "F_t"	Compression Parallel to Grain "F_{cll}"	Horizontal Shear "F_v"	Compression Perpendicular to Grain "$F_{c_{perp}}$"	Modulus of Elasticity "E"
0.85*	1.0	0.8 *	0.97	0.67	0.9

* Where the size-adjusted bending value (F_b x size factor) does not exceed 1150 psi, or the size-adjusted compression value (F_C x size factor) does not exceed 750 psi, a factor of unity may be used.

ii) M.C. Adjustment Factors for Nominal 5" and Thicker Lumber

(Use only when moisture content will exceed 19% in use)

When lumber 5" and thicker is designed for exposed uses where the moisture content will exceed 19% for an extended period of time, the design values shown in the tables in Paras. 905n. and 905o. should be multiplied by the following adjustment factors:

Bending "F*b*"	Tension "F*t*"	Compression Parallel to Grain "Fcll"	Horizontal Shear "F*v*"	Compression Perpendicular to Grain "$F_{c_{perp}}$"	Modulus of Elasticity "E"
1.00	1.00	0.91	1.00	0.67	1.00

905f. HORIZONTAL SHEAR DESIGN VALUES FOR LUMBER & TIMBERS

Shear design values for lumber have recently been revised and approved by the American Lumber Standard Committee, in accordance with changes to ASTM Standard D245, ***Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber***. These new lumber shear design values are higher than earlier assigned values and are shown in the tables in Paras. 905i to 905o.

Revisions have also been made to design equations for use with the new shear design values. These equations no longer include increase factors to account for splits or checks in the lumber, and the notching equations have been revised. For further information, see American Wood Council website: www.awc.org

905g. ADJUSTMENT FACTOR FOR WIDTH

i) Tabulated design values for dimension lumber apply to 12" width for Structural Joists and Planks, and Structural Light Framing. For all other sizes of these grades, use the following adjustment factors:

Width (Depth)	Bending		Tension Parallel to Grain	Compression Parallel to Grain	All Other
	<4" thick	4" thick			
≤ 4"	1.5	1.5	1.5	1.15	1.0
5"	1.4	1.4	1.4	1.1	1.0
6"	1.3	1.3	1.3	1.1	1.0
8"	1.2	1.3	1.2	1.05	1.0
10"	1.1	1.2	1.1	1.0	1.0
12"	1.0	1.1	1.0	1.0	1.0
≥ 14"	0.9	1.0	0.9	0.9	1.0

ii) Tabulated values for Light Framing grades (Construction, Standard, Utility) apply to 4" and narrower lumber, except that values for Utility grade apply only to 2" by 4" lumber.

iii) Tabulated design values for Stud grade apply to 5" and 6" widths. For 6" and narrower Stud grade, use the factors listed below. For Stud grade lumber wider than 6", use the property values for No.3 grade (Table 905i) and width adjustment factors as listed in Table 905g(i) above.

Width (Depth)	Bending	Tension Parallel to Grain	Compression Parallel to Grain	All Other
≤4"	1.1	1.1	1.05	1.0
5" to 6"	1.0	1.0	1.0	1.0

905h. MODULUS OF ELASTICITY

Select Structural Values* (Para. 124)

Species Group	Clear Wood Basis Dry E Values (psi)	In-Grade Basis Dry E Values (psi)
D Fir - L (N)	1,800,000	1,900,000
Hem-Fir (N)	1,500,000	1,700,000
S-P-F	1,500,000	1,500,000
Northern Species	1,100,000	1,100,000

* The In-grade "E" values were derived from tests of dimension lumber; the clear wood values were derived for dimension lumber from tests of small clear specimens.

905i. STRUCTURAL LIGHT FRAMING (2" to 4" Thick, 2" to 4" Wide) & JOISTS AND PLANKS (2" to 4" Thick, 5" and Wider) (Para. 124)

Recommended Allowable Unit Stresses (in psi) - 2" by 12" Basis (for Size Adjustment Factors, see Para. 905g)

Species Group	Grade	Extreme Fibre in Bending F_b	Tension Parallel to Grain F_t	Horizontal Shear F_v	Compression		Modulus of Elasticity (million psi) E
					Parallel to Grain $F_{c\|\|}$	Perp. to Grain Fc_{perp}	
D Fir-L (N)	Select Structural	1350	825	180	1900	625	1.9
	No. 1 & Btr	1150	750		1800		1.8
	No. 1	850	500		1400		1.6
	No. 2	850	500		1400		1.6
	No. 3	475	300		825		1.4
Hem-Fir (N)	Select Structural	1300	775	145	1700	405	1.7
	No. 1 & Btr	1200	725		1550		1.7
	No. 1	1000	575		1450		1.6
	No. 2	1000	575		1450		1.6
	No. 3	575	325		850		1.4
S-P-F	Select Structural	1250	700	135	1400	425	1.5
	No. 1	875	450		1150		1.4
	No. 2	875	450		1150		1.4
	No. 3	500	250		650		1.2
Northern Species	Select Structural	975	425	110	1100	350	1.1
	No. 1	625	275		850		1.1
	No. 2	625	275		850		1.1
	No. 3	350	150		500		1.0

905i. (cont.) STRUCTURAL LIGHT FRAMING (2" to 4" Thick, 2" to 4" Wide) & JOISTS AND PLANKS (2" to 4" Thick, 5" and Wider) (Para. 124)

Recommended Allowable Unit Stresses (in psi) - 2" by 12" Basis (for Size Adjustment Factors, see Para. 905g)

Species Group	Grade	Extreme Fibre in Bending F_b	Tension Parallel to Grain F_t	Horizontal Shear F_v	Compression		Modulus of Elasticity (million psi) E
					Parallel to Grain F_{cll}	Perp. to Grain $F_{c_{perp}}$	
Y Cedar (N)	Select Structural	1200	725	175	1200	540	1.6
	No. 1	800	475		1000		1.4
	No. 2	800	475		1000		1.4
	No. 3	475	275		575		1.2
C Sitka	Select Structural	1300	950	125	1200	455	1.7
	No. 1	925	550		1100		1.5
	No. 2	925	550		1100		1.5
	No. 3	525	325		625		1.4

905j. LIGHT FRAMING (2" to 4" Thick, 2" to 4" Wide) (Para. 122)

Recommended Allowable Unit Stresses (in psi) - 2" by 4" Basis (for Size Adjustment Factors, see Para.905g)

D Fir-L (N)	Construction	950	575	180	1800	625	1.5
	Standard	525	325		1450		1.4
	Utility	250	150		950		1.3
Hem-Fir (N)	Construction	1150	650	145	1750	405	1.5
	Standard	650	350		1500		1.4
	Utility	300	175		975		1.3

905j. (cont.) LIGHT FRAMING (2" to 4" Thick, 2" to 4" Wide) (Para. 122)

Recommended Allowable Unit Stresses (in psi) - 2" by 4" Basis (for Size Adjustment Factors, see Para.905g)

Species Group	Grade	Extreme Fibre in Bending F_b	Tension Parallel to Grain F_t	Horizontal Shear F_v	Compression		Modulus of Elasticity (million psi) E
					Parallel to Grain F_{cII}	Perp. to Grain $F_{c_{perp}}$	
S-P-F	Construction Standard Utility	1000 550 275	500 275 125	135	1400 1150 750	425	1.3 1.2 1.1
Northern Species	Construction Standard Utility	700 400 175	325 175 75	110	1050 875 575	350	1.0 0.9 0.9
Y Cedar	Construction Standard Utility	925 525 250	550 300 150	175	1200 1050 675	540	1.3 1.2 1.1
C Sitka	Construction Standard Utility	1050 600 275	650 350 175	125	1300 1100 725	455	1.4 1.3 1.2

Note: *Values for Utility grade apply only to 2" by 4" lumber.*

LUMBER DESIGN VALUES FOR U.S.

905k. SELECT STRUCTURAL SCAFFOLD PLANK (Para. 180)

(1 1/4" and Thicker, 8" and Wider)

Recommended Allowable Unit Stresses (psi)
(No Width Adjustment Factors Apply)

Species	2" Maximum Nominal Thickness [1] Wet Service Condition [2]		3" Maximum Nominal Thickness [3] Wet Service Condition [4]	
	Extreme Fibre in Bending (F_b) Single Member	**Modulus of Elasticity E**	**Extreme Fibre in Bending (F_b)** Single Member	**Modulus of Elasticity E**
D Fir-L (N)	2050	2,000,000	1550	1,700,000
Hem-Fir (N)	1450	1,700,000	1100	1,500,000
S-P-F	1350	1,500,000	1000	1,300,000
Hem-Tam(N)	1700	1,400,000	1300	1,300,000
W Hem (N)	1800	1,800,000	1350	1,600,000
C Sitka	1400	1,700,000	1050	1,500,000
P Pine	1450	1,400,000	1100	1,200.000
WW Pine	1250	1,400,000	925	1,300,000
R Pine	1250	1,300,000	950	1,100,000
EW Pine (N)	1300	1,400,000	975	1,300,000

[1] The standard dressed "**Dry**" sizes shall be used in all calculations for 2 inch nominal material.

[2] For **"Wet"** use conditions where the moisture content in service will exceed 19%, the values for 2 inch nominal thick planks shall be multiplied by the following adjustment factors:

Extreme fibre in bending, **F_b = 0.86**
Modulus of Elasticity, **E = 0.97**

[3] The actual manufactured sizes shall be used in all calculations for 3 inch nominal material.

[4] Values for 3 inch nominal material are not dependent on service conditions.

905l. STUDS (2" to 4" Thick, 2" to 6" Wide) (Para. 121)

Recommended Allowable Unit Stresses (psi) – 2" by 6" basis

(for Size Adjustment Factors, see Table 905g {iii}) (for Studs wider than 6", use the property values for the No. 3 grade {Table 905i} and width adjustment factors as listed in Table 905g{i})

Species Group	Grade	Extreme Fibre in Bending F_b	Tension Parallel to Grain F_t	Horizontal Shear F_v	Compression		Modulus of Elasticity (million psi) E
					Parallel to Grain $F_{c_{II}}$	Perpendicular to Grain $F_{c_{perp}}$	
D Fir-L (N)	Stud	650	400	180	900	625	1.4
Hem-Fir (N)	Stud	775	450	145	925	405	1.4
S-P-F	Stud	675	350	135	725	425	1.2
Northern Species	Stud	475	225	110	550	350	1.0
Y Cedar	Stud	625	375	175	650	540	1.2
C Sitka	Stud	725	450	125	675	455	1.4

905m. DECKING (2" to 4" Thick, 4" and Wider) (Para. 127 only)

Recommended Allowable Unit Stresses (psi) (No Width Adjustment Factors Apply)

Species	Grade	Extreme Fibre in Bending (F_b)	Compression Perpendicular to Grain Fc_{perp}	Modulus of Elasticity E
		Single Member		
D Fir-L (N)	Select Commercial	1750 1450	625	1,800,000 1,700,000
Hem-Fir (N)	Select Commercial	1350 1100	405	1,500,000 1,400,000
Hem-Tam (N)	Select Commercial	1500 1250	555	1,300,000 1,100,000
S-P-F	Select Commercial	1200 1000	425	1,500,000 1,300,000
W Hem (N)	Select Commercial	1500 1300	410	1,600,000 1,400,000
Coast Sitka Spruce	Select Commercial	1250 1050	455	1,700,000 1,500,000
Ponderosa Pine	Select Commercial	1200 1000	535	1,300,000 1,100,000

905m. (cont.) **DECKING (2" to 4" Thick, 4" and Wider) (Para. 127 only)**

Species	Grade	Extreme Fibre in Bending (F_b) Single Member	Compression Perpendicular to Grain $F_{c_{perp}}$	Modulus of Elasticity E
Western Cedars (N)	Select Commercial	1200 1050	425	1,100,000 1,000,000
Western White Pine	Select Commercial	1100 925	375	1,400,000 1,300,000
Red Pine	Select Commercial	1150 975	440	1,300,000 1,200,000
Eastern White Pine (N)	Select Commercial	900 775	350	1,200,000 1,100,000
Northern Species	Select Commercial	900 775	350	1,100,000 1,000,000
Coast Species	Select Commercial	1250 1050	370	1,500,000 1,400,000

Note 1: *Allowable fibre stress in bending (F_b) applies only when plank is used flatwise, e.g., when loaded on wide face.*

Note 2: *See Paras. 905a through 905f for conditions of use and adjustment factors.*

905n. BEAMS AND STRINGERS (5" and Thicker, Width more than 2" greater than thickness) (Para. 130)

Recommended Allowable Unit Stresses (psi)

Species	Grade	Extreme Fibre in Bending F_b Single Member	Tension Parallel to Grain F_t	Horizontal Shear F_v	Compression Perp. to Grain $F_{C_{perp}}$	Compression Parallel to Grain $F_{c_{||}}$	Modulus of Elasticity E
D Fir-L (N)	Sel Str	1600	950	170	625	1100	1,600,000
	No. 1 Str	1300	675			925	1,600 000
	No. 2 Str	875	425			600	1,300 000
Hem-Fir (N)	Sel Str	1250	725	135	405	900	1,300,000
	No. 1 Str	1000	500			750	1,300,000
	No. 2 Str	675	325			475	1,100,000
Hem-Tam (N)	Sel Str	1450	850	165	555	950	1,300,000
	No. 1 Str	1200	600			800	1,300,000
	No. 2 Str	775	400			500	1,100,000
S-P-F	Sel Str	1100	650	125	425	775	1,300,000
	No. 1 Str	900	450			625	1,300,000
	No. 2 Str	600	300			425	1,000,000
W Hem (N)	Sel Str	1400	825	135	410	1000	1,400,000
	No. 1 Str	1150	575			850	1,400,000
	No. 2 Str	750	375			550	1,100,000

905n. (cont.) **BEAMS AND STRINGERS** (5" and Thicker, Width more than 2" greater than thickness) (Para. 130)

Coast Sitka Spruce	Sel Str	1150	675	115	455	775	1,500,000
	No. 1 Str	950	475			650	1,500,000
	No. 2 Str	625	325			425	1,200 000
P Pine	Sel Str	1100	725	130	535	750	1,100,000
	No. 1 Str	925	500			625	1,100,000
	No. 2 Str	600	300			400	900,000
Western Cedars (N)	Sel Str	1150	675	130	425	850	1,000,000
	No. 1 Str	925	475			700	1,000,000
	No. 2 Str	625	300			450	800,000
WW Pine	Sel Str	1050	600	120	375	775	1,300,000
	No. 1 Str	850	425			625	1,300,000
	No. 2 Str	550	275			400	1,000,000
R Pine	Sel Str	1050	625	130	440	725	1,100,000
	No. 1 Str	875	450			600	1,100,000
	No. 2 Str	575	300			375	900,000
EW Pine (N), N. Aspen, Black Cottonwood, Northern Species & Coast Species	No stresses provided in NLGA Grading Rules						

Note 1: *Allowable fibre stress in bending (F_b) applies only when member is loaded on narrow face.*
Note 2: *See Paras. 905a through 905h for conditions of use and adjustment factors.*

905o. POST AND TIMBERS (5" x 5" and Thicker, Width not more than 2" Greater than Thickness) (Para. 131)

Recommended Allowable Unit Stresses (psi)

Species	Grade	Extreme Fibre in Bending F_b Single Member	Tension Parallel to Grain F_t	Horizontal Shear F_v	Compression Perp. to Grain $F_{c_{perp}}$	Compression Parallel to Grain $F_{c_{\|\|}}$	Modulus of Elasticity E
D Fir-L (N)	Sel Str	1500	1000	170	625	1150	1,600,000
	No. 1 Str	1200	825			1000	1,600,000
	No. 2 Str	725	475			700	1,300,000
Hem-Fir (N)	Sel Str	1150	775	135	405	950	1,300,000
	No. 1 Str	925	625			850	1,300,000
	No. 2 Str	550	375			575	1,100,000
Hem-Tam (N)	Sel Str	1350	900	165	555	1000	1,300,000
	No. 1 Str	1100	725			875	1,300,000
	No. 2 Str	650	425			600	1,100,000
S-P-F	Sel Str	1050	700	125	425	800	1,300,000
	No. 1 Str	850	550			700	1,300,000
	No. 2 Str	500	325			500	1,000,000
W Hem (N)	Sel Str	1300	875	135	410	1100	1,400,000
	No. 1 Str	1050	700			950	1,400,000
	No. 2 Str	650	425			650	1,100,000

905o. (cont.) **POST AND TIMBERS** (5" x 5" and Thicker, Width not more than 2" Greater than Thickness) (Para. 131)

Coast Sitka Spruce	Sel Str No. 1 Str No. 2 Str	1100 875 525	725 575 350	115	455	825 725 500	1,500,000 1,500,000 1,200,000
P Pine	Sel Str No. 1 Str No. 2 Str	1000 825 475	675 550 325	130	535	800 700 325	1,100,000 1,100,000 900,000
Western Cedars (N)	Sel Str No. 1 Str No. 2 Str	1050 875 500	700 575 350	130	425	900 800 550	1,000,000 1,000,000 800,000
WW Pine	Sel Str No. 1 Str No. 2 Str	975 775 450	650 525 300	120	375	800 700 500	1,300,000 1,300,000 1,000,000
Red Pine	Sel Str No. 1 Str No. 2 Str	1000 800 475	675 550 325	130	440	775 675 475	1,100,000 1,100,000 900,000
EW Pine (N), N. Aspen Black Cottonwood, , Northern Species & Coast Species		No stresses provided in NLGA Grading Rules					

Note 1: *If Post and Timber sizes are graded to Beam and Stringer requirements, design values for Beams and Stringers apply.*
Note 2: *See Paras. 905a through 905f for conditions of use and adjustment factors.*

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910. MACHINE GRADED LUMBER:

2" or less in thickness - 2" & wider

910a. SPECIFIC GRAVITY (SG) [1]

i) SG for **D Fir-L (N)**: **SG** values for D Fir-L vary depending on the **Grade E** values, and are as follows:

Grade E (million psi)	**SG Value**
1.2 to 1.9	0.49
2.0 to 2.2	0.53
2.3 & higher	0.57

ii) SG for **Hem-Fir (N)**: All Grade E values: 0.46

iii) SG for **S-P-F**: **SG** values for S-P-F vary depending on the **Grade E** values, and are as follows:

Grade E (million psi)	**SG Value**
1.2 to 1.7	0.42
1.8 to 1.9	0.46
2.0 & higher	0.50

[1] ***Note:*** *Specific gravity values for all MSR/MEL grades are shown above, unless otherwise qualified by tests and shown on the grade stamp.*

910b. HORIZONTAL SHEAR (F_v)

i) F_v for **D Fir-L (N)**: **F_v** values for D Fir-L vary depending on the grade **E** values, and are as follows:

Grade E (million psi)	**F_v Value**
1.2 to 2.2	180 psi
2.3 & higher	190 psi

ii) F_v for **Hem-Fir (N)**: All Grade E values: 145 psi

iii) F_v for **S-P-F**: **F_v** values for S-P-F vary depending on the **Grade E** values, and are as follows:

Grade E (million psi)	**F_v Value**
1.2 to 1.7	135 psi
1.8 to 1.9	160 psi
2.0 & higher	170 psi

When a grade is qualified by test and daily quality controlled for specific gravity and the **SG** is shown on the grade stamp, the horizontal shear value may be calculated from the following formula:

$$F_v = 284.8 \times S_o + 26.6 \text{ (psi)}$$

910c. COMPRESSION PERPENDICULAR TO GRAIN (Fc_{perp})

i) Fc_{perp} for D Fir-L (N): **Fc_{prep}** values for D Fir-L vary depending on the **Grade E** values, and are as follows:

Grade E (million psi)	**Fc_{perp} Value**
1.2 to 1.9	625 psi
2.0 & higher	715 psi

ii) Fc_{perp} for Hem-Fir(N): All Grade E values: 405 psi

iii) Fc_{perp} for S-P-F: **Fc_{perp}** values for S-P-F vary depending on the **Grade E** values, and are as follows:

Grade E (million psi)	**Fc_{perp} Value**
1.2 to 1.7	425 psi
1.8 to 1.9	525 psi
2.0 & higher	615 psi

Compression perpendicular to grain and horizontal shear values, as shown above, are the same as assigned by ASTM methods to visually graded lumber except for S-P-F MSR/MEL grades where indicated which was established using experimental data and relationships between measured properties and **Fc_{perp}** and **F_v**.

When a grade is qualified by test and daily quality controlled for specific gravity and the **SG** is shown on the grade stamp, the allowable compression perpendicular to grain value may be calculated from the following formula:

$$Fc_{perp\ .04} = 2243.8 \times S_o - 473.8 \text{ (psi)}$$

Note: *Calculated values to be rounded to the nearest 5 psi.*

Compression perpendicular to grain values are based on a 0.04 inch deformation limit and are standard design for most structures. Values at 0.02 inch deformation can be obtained with the following formula:

$$Fc_{perp\ .02} = 0.71 \times Fc_{perp\ .04} + 15 \text{ (psi)}$$

910d. MACHINE STRESS-RATED LUMBER (MSR):

2" or less in thickness - 2" & wider
Design Values, psi, normal loading.
Grade Description as per Para. 128a.

MSR Grade	Bending at Extreme F_b	Modulus of Elasticity E	Tension Parallel to Grain F_t	Compression Parallel to Grain F_{cll}
$1200F_b$-1.2E	1,200	1,200,000	600	1,400
$1350F_b$-1.3E	1,350	1,300,000	750	1,600
$1450F_b$-1.3E	1,450	1,300,000	800	1,625
$1500F_b$-1.4E	1,500	1,400,000	900	1,650
$1650F_b$-1.5E	1,650	1,500,000	1,020	1,700
$1800F_b$-1.6E	1,800	1,600,000	1,175	1,750
$1950F_b$-1.7E	1,950	1,700,000	1,375	1,800
$2100F_b$-1.8E	2,100	1,800,000	1,575	1,875
$2250F_b$-1.9E	2,250	1,900,000	1,750	1,925
$2400F_b$-2.0E	2,400	2,000,000	1,925	1,975
$2550F_b$-2.1E	2,550	2,100,000	2,050	2,025
$2700F_b$-2.2E	2,700	2,200,000	2,150	2,100
$2850F_b$-2.3E	2,850	2,300,000	2,300	2,150
$3000F_b$-2.4E	3,000	2,400,000	2,400	2,200

The following grades provide a modulus of elasticity with higher corresponding strengths. For these MSR grades, qualification and daily quality control for tensile strength are required.

MSR Grade	Bending at Extreme F_b	Modulus of Elasticity E	Tension Parallel to Grain F_t	Compression Parallel to Grain F_{cll}
$1400F_b$-1.2E	1,400	1,200,000	800	1,600
$1600F_b$-1.4E	1,600	1,400,000	950	1,675
$1650F_b$-1.3E	1,650	1,300,000	1,020	1,700
$1800F_b$-1.5E	1,800	1,500,000	1,300	1,750
$2000F_b$-1.6E	2,000	1,600,000	1,300	1,825
$2250F_b$-1.7E	2,250	1,700,000	1,750	1,925
$2250F_b$-1.8E	2,250	1,800,000	1,750	1,925
$2400F_b$-1.8E	2,400	1,800,000	1,925	1,975

i) The grade MOE is assigned in increments of 100,000 psi.

Note: *Grades of MSR may be produced with alternate design stress assignments when provided for in the NLGA rules.*

910e. MACHINE EVALUATED LUMBER (MEL):

2" or less in thickness - all widths
Design Values, psi, normal loading.
Grade Description as per Para. 128b.

MEL Grade	Bending at Extreme F_b	Modulus of Elasticity E	Tension Parallel to Grain F_t	Compression Parallel to Grain F_{cll}
M - 10	1,400	1,200,000	800	1,600
M - 11	1,550	1,500,000	850	1,675
M - 12	1,600	1,600,000	850	1,675
M - 13	1,600	1,400,000	950	1,675
M - 14	1,800	1,700,000	1,000	1,750
M - 15	1,800	1,500,000	1,100	1,750
M - 18	2,000	1,800,000	1,200	1,825
M - 19	2,000	1,600,000	1,300	1,825
M - 21	2,300	1,900,000	1,400	1,950
M - 22	2,350	1,700,000	1,500	1,950
M - 23	2,400	1,800,000	1,900	1,975
M - 24	2,700	1,900,000	1,800	2,100
M - 25	2,750	2,200,000	2,000	2,100
M - 26	2,800	2,000,000	1,800	2,150

i) MEL allowable stresses are assigned in the following increments:

Mechanical Property	Increment
Modulus of Elasticity **(MOE)**	100,000 psi
Fiber Stress in Bending **(F_b)**	50 psi
Fiber Stress in Tension **(F_t)**	50 psi
Compression Parallel to Grain **(F_{cll})**	25 psi
Compression Perpendicular to Grain **(Fc_{perp})**	5 psi

Note: *Grades of MEL may be produced with alternate design value assignments when provided for in the NLGA rules.*

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General Instruction No. 1

NLGA Standard Grading Rules
for Canadian Lumber

August 1, 2017

NLGA Standard Grading Rules for Canadian Lumber consists of **284** pages plus the NLGA Interpretations & EU Export Annex.

This book like all NLGA Standards, is subject to periodic review, and may be amended from time to time.

Check the publication section of the website (**www.nlga.org**) for the date of the latest edition of NLGA Standard Grading Rules for Canadian Lumber.