

Tennessee Native Species Lumber Act Certification and Grading Rules

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Background and Rationale

43-28-313. Tennessee Native Species Lumber Act (“The TNSL Act”) provides the opportunity for sawyers in Tennessee to be trained to certify that the lumber they manufacture meets the requirements for TNSL Act #2 and Better. Lumber certified in this way can then be used to satisfy the relevant lumber requirements of the building code.

The TNSL Act states that rules for this certification program shall be developed by the Department of Agriculture, and that University of Tennessee Extension will conduct the training programs. This document was developed to establish these rules, including the requirements for the Tennessee Native Species Lumber Grade, and to serve as the educational basis for the training program.

Tennessee Native Species Lumber Grade Relationship to Other Grading Rules and Standards

Structural lumber used in buildings covered by the building code are required to have some assurance that the material is fit for its intended purpose. There are two common ways that this can be achieved:

1. Using lumber that has a ‘grade stamp’. This is by far the more common method and many of us are familiar with grade stamps that are seen on lumber sold for use as structural elements.
2. Having a licensed engineer evaluate the material, do any necessary calculations, and provide their assurance. This method is sometimes used to reuse reclaimed timbers, for example.

There is a large infrastructure behind the grade stamp system, but it is often not understood by the public. The [American Lumber Standards Committee \(ALSC\)](#) administers the [Voluntary Product Standard PS 20-20 American Softwood Lumber Standard](#). The ALSC and its Board of Review, through this Standard, set out rules for lumber measurement, grading systems, the development of design values, and the accreditation of grading and monitoring agencies. Currently there are [25 agencies accredited](#) under the ALSC lumber program, which operate under [six sets of grading](#) rules at about 900 lumber mills in 15 countries. Graders in this system are highly trained and their conformance with the relevant grading rules is regularly verified by independent, 3rd party inspection agencies.

Under this system, grades of lumber are linked to design values, which are data describing the mechanical properties. These design values are specific to the species and grade and can be used to determine specifications for the safe use of that lumber, for example in the form of span tables. Design values for the existing grades and species of lumber are published in the [National Design Specification Supplement \(NDS\)](#) <https://www.awc.org/pdf/codes-standards/publications/nds/AWC-NDS2018-Supplement-ViewOnly-171027.pdf>. Span tables for commonly used species and grades may be provided by grading agencies as a convenience ([for example](#)), but a generic method for converting design value data to span tables can be found [here](#).

While most grade stamped lumber is sawn at large mills that employ the needed graders on-site, accredited graders can also be hired to inspect lumber produced at small or portable sawmills. Further information in these services can be found by contacting, for example, [Timber Products](#) or the [Southern Pine Inspection Bureau](#).

The objective of the TNSL Act is to provide a third way in which lumber can be used in buildings conforming to the building code. For this reason, the grading rules and design values for lumber produced under the TNSL Act will build upon the rules and data developed under the existing grade stamped lumber system. However, this does not imply that lumber graded under the TNSL Act is “Grade Marked” or “Grade Stamped” lumber in the normal sense. There are several reasons that TNSL Act lumber cannot be considered equivalent, including:

1. Training requirements are minimal under the TNSL Act.
2. There is no requirement for 3rd-party verification of a grader’s performance under the TNSL Act
3. There are no design values specifically for the TNSL Act Grade of #2 & Better. The TNSL Act is deliberately conservative, to help ensure that lumber graded under the TNSL Act Grade of #2 & Better is similar in capability to #2 grades of various species established under the American Softwood Lumber Standard; however, this structural capacity has not been verified.
4. There are no existing grading rules and design values for several species that are native to Tennessee. In these cases, the species have been grouped with other species with similar mechanical properties; again however, this structural capacity has not been verified.

Because of these differences, lumber graded under the TNSL Act should not be labelled in a way to mimic or imply the lumber has been grade stamped under the American Softwood Lumber Standard.

Responsibility

While the TNSL Act offers a way to use structural lumber without the usual grade stamp or engineer’s approval, the building code official has the ultimate authority and responsibility to approve the materials used in the structure.

The participation of the University of Tennessee and the Tennessee Department of Agriculture in the training and certification program for the TNSL Act in no way implies their responsibility for the quality or performance of the lumber produced by participants in the program.

Process for Acquiring and Renewing Certification

The program will be open to sawmill owners or their employees. Only those completing the training course and passing the skills test will be certified under the TNSL Act.

Participants will be required to attend a one-day training course. As specified in the Act, training courses will be held biannually in each of the three grand divisions of Tennessee, unless demand is so low that no courses are held. If no courses are being offered locally in the upcoming 6 months, an individual can request a training course or skills test.

The day-long training will conclude with a skills test. Failure to pass the skills test (75%) will require retaking the skills test at a future training session.

Certification of passing the skills test will enable participants to sell lumber graded to the TNSL Act Number 2 and Better standard. Certification will be valid for the period of two years. Recertification will require passing the skills test at one of the training sessions.

Process for Selling and Using Lumber Certified Under the TNSL Act

The sawmill (the seller) providing lumber graded under the TNSL Act must provide a written summary for the lumber that includes the following information:

- 1) A declaration that the lumber has been graded by a certified grader (under the TNSL Act) to meet or exceed the specification for the TNSL Act Grade #2 and Better
- 2) The name of the wood species, and its design value group (Table 7)
- 3) The quantity of lumber, the date(s) it was cut and graded, and the name of the grader and the sawmill
- 4) The size (nominal or actual), whether it is rough-sawn or surface/planed, and the moisture content of the lumber when graded

Upon the request of the local building official, the end user shall provide a copy of this written summary, and information about the design values of the lumber (Table 6), based on its designated species group (Table 7).

This certification should be accepted by code officials in lieu of any grade stamp requirements.

Tennessee Native Species Lumber Act - Number 2 and Better Grade Specifications

Dimension lumber only: 2" to 4" nominal thickness, 2" and wider.

Characteristics permitted and limiting provisions:

- * Knots – Sound, firm, and encased knots, if tight and well-spaced, are permitted in sizes not to exceed the equivalent of one-fourth (25%) of the nominal width of the wide face of the piece. Knots appearing on the thickness faces of the piece are permitted in the same quality and size (Table 5).
- * Holes - any cause and includes unsound wood except wane, unsound knots, loose knots and not firmly fixed knots, not to exceed the equivalent of one-fourth (25%) of the nominal width of the piece or equivalent smaller holes per 2 lineal feet. (Holes appearing on the thickness faces of the piece (including unsound wood except wane, unsound knots, loose knots and not firmly fixed knots) are permitted in the same size or equivalent smaller (Table 5).
- * Unsound wood (except wane) – Not permitted.
- * Wane – 1/3 the thickness and 1/3 the width, full length, or equivalent, on each face, combined not to exceed 1/2 the thickness or 1/2 the width at any point.
- * Shake – Shake through at ends, limited as splits. Away from ends, shakes including through shakes up to 2 feet long permitted.
- * Splits – Equal in length to twice the width of the piece.
- * Checks – Drying checks on the face or edge not limited. Through checks at end are limited as splits.
- * Slope of grain – 1 in 8.
- * Warp – “Light” (Table 4)
- * Skips (or Scant) – “Heavy”. If surfaced, may have skips in places up to 1/8 inch deep. If rough, may be scant in places up to 1/8 inch scant. The areas of skip (or scant) are not to exceed 2 feet in length in any one place.
- * Manufacture – Admit manufacturing defects not greater than 1/8th inch
- * Pitch and pitch streaks – Not limited.
- * Pockets – Pitch or Bark – Not limited.
- * Stain – Not limited.
- * Lumber included in the Tennessee Native species lumber Number 2 and Better Grade is to reasonably represent the mill-run of dimension lumber produced at least meeting these requirements and limiting provisions, without sort-out removal of higher-grade dimension lumber. (This is not to constrain the simultaneous production of appearance grade boards and other lumber products other than dimension.)

Definitions and Explanations

Knots - A portion of a branch or a limb that is overgrown by the tree and has become incorporated into the piece of lumber

- The *size of a knot* is measured directly as the diameter (in inches) for a round knot, and for other than round knots (e.g., spike knots and oval knots) the equivalent diameter size is estimated by averaging the measurements (in inches) of the maximum width of the knot on its narrow axis and the maximum length on its long axis
- A *sound knot* contains no decay.
- A *firm knot* is solid across its face but contains incipient decay
- An *encased knot* is a knot which is not intergrown with the growth rings of the surrounding wood
- A *tight knot* is so fixed (by growth, shape, or position) that it retains its place (or is held in place) in the piece, while a loose knot or a not firmly fixed knot is one which is not so fixed (by growth, shape or position) such that it will not be held tightly in place in the piece,
- *Well-spaced knots* means that the sum of the sizes of knots in any 6-inch length cannot equal or exceed twice the size of the largest permitted knot.

Holes - Result from various causes but are commonly caused by insects or the sloughing of loose (black) knots. A hole may extend completely or partially through the piece. Hole sizes are measured as knots are.

Unsound Wood (decay) - Results from the attack of wood by wood-destroying fungi that leaves wood in a disintegrated condition, typically indicated by a loss of hardness and color change.

- *Incipient decay* is the early stage of decay where disintegration of the fibers has begun, and the wood has discolored but has not yet disintegrated to the point that it is significantly softened.

Wane - Bark or the absence of wood from any cause (except eased edges)

Shake - A lengthwise separation of the wood (primarily along the longitudinal axis) that occurs commonly between the growth rings.

- A *surface shake* occurs on only one surface of the piece of lumber.
- A *through shake* will extend from one surface face to an opposite or adjoining surface (e.g. completely through from one wide face to another, or from a wide face to an edge face).

Splits - A split is a separation of the wood due to the tearing apart of the wood cells that occurs through the piece to the opposite or an adjacent surface.

Checks - A separation of the wood that normally occurs across the wood growth rings, usually because of the drying (seasoning) process.

- A *surface check* occurs on a wide or thickness face of a piece.
- A *through check* will extend from one surface face to an opposite or adjoining surface (e.g. completely through from one wide face to another, or from a wide face to an edge face).

Slope of Grain - When the grain of the wood is not parallel to the edge of the piece. The slope of grain deviation is expressed as a ratio of the deviation over the length. E.g., for 1 in 8 slope in grain, there is 1 inch in deviation between the grain of the wood and the lumber's edge for every 8 inches of length.

Warp - Any deviation from a true (or flat plane) surface. Specific warp limits are included in Table 4.

- *Twist* is a deviation flatwise or a combination of flatwise and edgewise, in the form of a curve or spiral. It is measured as the point of distance that the edge of a piece is raised above a flat surface where both edges of the opposite end of the same piece are resting against the same flat surface.
- *Crook* is a deviation edgewise from a straight line drawn from end to end of the piece (i.e., a straight line from end to end along an edge or a thickness face). It is measured as the point of greatest distance
- *Bow* is a deviation flatwise from a straight line drawn from end to end of the piece (i.e., a straight line from end to end along a wide face). It is measured as the point of greatest distance from the straight line.
- *Cup* is a deviation in the face of a piece, from a straight line drawn from edge to edge of the piece (i.e., a straight line from edge to edge across the wide face). It is measured as the point of greatest distance from the straight line.

Skips - Places in surfaced lumber where the piece has failed to surface cleanly.

Scant - where the lumber is slightly less than the required size.

Manufacture

- *Torn grain* is where wood has been torn or broken out by surfacing
- *Raised grain* where a part of the growth ring rises above another
- *Loosened grain* is a separation of the latewood and earlywood of the growth ring
- *Machine bite* is a cut of the planer knives at the end of the piece
- *Machine gouge* is a groove cut by the machine
- *Chip marks* are shallow depressions typically caused by shavings (i.e., "chips") getting imbedded in the surface during the planing process
- *Wavy dressing* is uneven surface resulting from the variation of the saw or planer

Pitch - An accumulation of resinous material. A pitch streak is a well-defined accumulation of pitch in a streak.

Pocket - An opening between annual growth rings, developed as the tree grows, that typically contains pitch or bark.

Stain - Variation from the natural color of the wood that may result from fungal (e.g. sapstain) or bacterial action, or due to enzymatic oxidation (e.g. sticker stain). Stain does not significantly affect strength. Wood that is "stained" must be sound; if the wood appears to be weakened, it is unsound.

Moisture Content, Surface Conditions and Standard Sizes and Tally Practices for Tennessee Native Species Lumber

In most circumstances the grade stamped dimension lumber found in Tennessee's retail lumber yards is softwood lumber that has been kiln dried and then surfaced on all four sides to standard thickness and widths.

Both softwoods and hardwoods (as individual species and in groupings) may be used to produce Tennessee Native species lumber and the lumber may be sold for use either dry or the green, and in surfaced or rough condition.

Wood Moisture Content and Drying

Drying wood reduces the risk of mold and other deterioration, reduces weight, and lessens the tendency of the wood to warp after installation. Dimension lumber can be air dried or kiln dried, but kiln drying is commonly done because it is fast. Kiln drying also offers the chance to raise the temperature of the wood to levels high enough to kill any pests in the wood and, in the case of resinous woods, 'set the pitch, or evaporate the liquids that could cause subsequent 'resin bleed'.

Lumber produced under the TNSL Act should be designated as either "Green Lumber" or "Dry Lumber":

- Green Lumber –has moisture content more than 19 percent. This includes lumber that is graded just after sawing (i.e., very high moisture content) to lumber that has been stickered and dried but still have moisture content above 19%.
- Dry Lumber – meaning the lumber has been dried to a maximum moisture content of 19% MC oven-dry basis (at least 95% of the pieces in the shipment unit should meet this condition and no more than 5 % of the pieces should have a moisture content more than 19% MC) Lumber sold as Dry Lumber may be either kiln dried or air dried.
 - Kiln dried (KD) – meaning the lumber that has been dried in a drying chamber (kiln). The designation of Kiln dried (KD) may be used (if desired) as amplification to the Dry Lumber designation provided in the certification.

Moisture content of wood is measured by weighing a sample of wood before and after drying it in a hot oven (103C.220F). The moisture content (MC) is calculated as

$MC\% = (\text{wet weight} - \text{dry weight}) / \text{dry weight} \times 100.$

This oven-dry method is a slow and destructive process, so it is convenient to use electrical meters to estimate the moisture content. These meters are imprecise and inaccurate above about 20% MC but can be acceptable for distinguishing Dry from Green lumber. Moisture meter precision is improved by consulting the owner's manual on how to adjust for species and temperature, and how to properly align probes.

Wood Surface Conditions

When lumber is sawn from a log, its surface is 'rough', meaning saw marks are evident and there may be significant deviations in the dimensions. Planing provides a smooth surface and uniform dimensions.

Lumber produced under the TNSL Act should be designated as "Surfaced Lumber", "Sawn-To-Size Lumber" or "Rough Lumber":

Surfaced Lumber - (or dressed lumber) is generally considered to be lumber that has been surfaced by a machine (to attain smoothness of surface and uniformity of size). Unless otherwise specifically noted, within the Tennessee Native species lumber Grades refers to lumber that is S4S (surfaced four sides), typically to the (actual) dressed sizes equal the minimum thicknesses and widths for surfaced lumber (Table 2).

Sawn-To-Size Lumber – is lumber uniformly sawn to the dressed size for surfaced lumber (Table 2) but not planed on the faces. This designation specific to the Tennessee Native species lumber Grades recognizes that some producers may be able to hold dimensional tolerance well.

Rough Lumber – has not been dressed (surfaced). It differs from Sawn-To-Size Lumber (which it may resemble in appearance) in that Rough Lumber is oversized to allow for shrinkage and/or to allow surfacing. Rough Lumber is generally intended for further processing prior to use. Minimum suggested thicknesses and widths for Rough, Green lumber allow for shrinkage and planing losses (Table 2).

Standard Lumber Sizes

Thickness and Width – the nominal and actual thickness and width of lumber graded under the TNSL Act are like those used for lumber graded according to American Softwood Lumber Standard (Table 2). ‘Nominal’ width and thicknesses are commonly used names to identify lumber whose ‘actual’ dimensions are smaller. The distinction between nominal and actual sizes comes from a time when rough, green dimension were more commonly used, and large tolerances were provided to allow for sawing variation, shrinkage, and planing losses. Nominal widths and thicknesses are still used for convenience, but the actual dimensions are explicitly defined (Table 2).

Length - lumber should be six feet and longer, in two-foot length increments, (i.e., 8, 10, 12, 14, 16 etc.), unless the purchase agreement specifically stipulates different lengths. Lumber should clean, sound ends but it does not have to be double-end-trimmed to precise length. If not double-end-trimmed, there should be sufficient overlength to allow square end-trimming the lumber to its nominal length.

Tally

Lumber volume is usually measured in Board Feet, a unit equal to a piece 1” thick and 1’ square. Thus, the lumber volume can be counted (tallied) as:

Board Feet (BF) = (nominal thickness [inches] x nominal width [inches] x standard length [feet])/12.

Fractions can be rounded to the nearest 1/10th of a board foot. Table 3 lists some board foot volumes for lumber of common sizes.

The TNSL Act

T. C. A. § 43-28-313

§ 43-28-313. Tennessee Native Species Lumber Act

Effective: May 20, 2016

Currentness

- (a) This section shall be known and may be cited as the “Tennessee Native Species Lumber Act.”
- (b) As used in this section:
- (1) “Agricultural building” means any structure used primarily for agricultural purposes or for forest product production;
 - (2) “Commercial sawmill” means any type of sawmill that produces lumber for sale;
 - (3) “End user” means any person who purchases native lumber from a commercial sawmill for the purpose of residential construction;
 - (4) “Grader” means the owner of a commercial sawmill, or the owner’s designated employee, who has visually inspected each piece of lumber; and
 - (5) “Native timber” means any hardwood or softwood species growing within the borders of this state.
- (c)(1) The operator of any commercial sawmill that is certified to grade lumber pursuant to subsection (d) may, when requested by the end user of the native lumber, certify in writing to the purchaser that the quality and safe working stresses of the lumber are equal to or better than No. 2 grade, in accordance with the conditions set forth in the American Softwood Standard PS 20-70 of the United States department of commerce, as amended; provided, that the minimum grade of lumber used in load-bearing wall members shall be stud grade.
- (2) The certification provided pursuant to subdivision (c)(1) shall include:
- (A) The name of the wood species;
 - (B) The quantity of wood certified;
 - (C) The location where the wood is to be used;
 - (D) Whether or not the wood is seasoned;
 - (E) The name of the commercial sawmill where the wood was cut;
 - (F) The name of the grader; and
 - (G) The date on which the wood was cut at the commercial sawmill and graded.
- (3)(A) Upon the request of the local building official, the end user shall provide written certification of the quality and safe working stresses of the native lumber provided by the commercial sawmill operator pursuant to subdivision (c)(1), as part of the building permit application.
- (B) The certification provided pursuant to subdivision (c)(3)(A) shall be accepted by code officials in lieu of any grade stamp requirements.
- (d)(1) The University of Tennessee shall, through its agriculture extension service, offer a course in grading lumber to owners of commercial sawmills and the owners’ designated employees. Any person who successfully completes the lumber grading course will be issued a certificate that entitles the certificate holder to grade lumber pursuant to this section. The course shall be offered biannually in each of the three (3) grand divisions of this state.

(2) The department of agriculture shall promulgate rules to implement and administer the certification program created by subdivision (c)(1), including, but not limited to, establishing a course fee in an amount sufficient to defray the cost of implementing and administering the certification program.

(e) Any person who uses the native timber harvested from and used entirely on the person's own property shall, if required, certify that the lumber meets the requirements of any building codes.

(f) No certification of native lumber shall be required in the construction of an agricultural building.

Credits

2016 Pub.Acts, c. 1071, § 1, eff. May 20, 2016.

T. C. A. § 43-28-313, TN ST § 43-28-313

Current with laws from the 2021 First Extraordinary Sess. of the 112th Tennessee General Assembly, eff. through February 3, 2021. Pursuant to §§ 1-1-110, 1-1-111, and 1-2-114, the Tennessee Code Commission certifies the final, official version of the Tennessee Code and, until then, may make editorial changes to the statutes. References to the updates made by the most recent legislative session should be to the Public Chapter and not to the T.C.A. until final revisions have been made to the text, numbering, and hierarchical headings on Westlaw to conform to the official text.

Tables

Table 1 Inch fractions, and decimal and meter equivalents

Fractions to Decimal Inches and Millimeters				Feet to Meters	
Inches			Millimeters	Feet	Meters
Sixteenths	Simplified	Decimal			
1/16		0.0625	1.59	1	0.305
2/16	1/8"	0.1250	3.18	2	0.610
3/16		0.1875	4.76	3	0.914
4/16	1/4"	0.2500	6.35	4	1.22
5/16		0.3125	7.94	5	1.2
6/16	3/8"	0.3750	9.52	6	1.83
7/16		0.4375	11.1	7	2.13
8/16	1/2"	0.5000	12.7	8	2.44
9/16		0.5625	14.3	9	2.7
10/16	5/8"	0.6250	15.9	1	3.05
11/16		0.6875	17.5	11	3.35
12/16	3/4"	0.7500	19.0	12	3.66
13/16		0.8125	20.6	13	3.96
14/16	7/8"	0.8750	22.2	14	4.27
15/16		0.9375	23.8	15	4.57
16/16	1"	1.0	25.4	16	4.88
		2.2	50.8	17	5.18
		3.0	76.2	18	5.49
		4.0	102	19	5.79
		5.0	127	20	6.10
		6.0	152		
		7.0	178		
		8.0	203		
		9.0	229		
		10.0	254		
		11.0	279		
		12.0	305		
		13.0	330		
		14.0	356		
		15.0	381		
		16.0	406		

Table 2 Nominal and minimum actual thickness and width for TNSL Act lumber

Minimum Thickness (inches)					Minimum Width (inches)				
Nominal Thickness	Surfaced or sawn-to-size		Rough		Nominal Width	Surfaced or sawn-to-size		Rough	
	Dry	Green	Dry	Green (suggested)		Dry	Green	Dry	Green (suggested)
2	1 1/2	1 9/16	1 5/8	1 11/16	2	1 1/2	1 9/16	1 5/8	1 11/16
2 ½	2	2 1/16	2 1/8	2 1/4	2 ½	2	2 1/16	2 1/8	2 1/4
3	2 1/2	2 9/16	2 5/8	2 3/4	3	2 1/2	2 9/16	2 5/8	2 3/4
3 ½	3	3 1/16	3 1/8	3 1/4	3 ½	3	3 1/16	3 1/8	3 1/4
4	3 1/2	3 9/16	3 5/8	3 13/16	4	3 1/2	3 9/16	3 5/8	3 13/16
4 ½	4	4 1/16	4 1/8	4 5/16	4 ½	4	4 1/16	4 1/8	4 5/16
					5	4 1/2	4 5/8	4 5/8	4 13/16
					6	5 1/2	5 5/8	5 5/8	5 7/8
					8	7 1/4	7 1/2	7 3/8	7 3/4
					10	9 1/4	9 1/2	9 3/8	9 3/4
					12	11 1/4	11 1/2	11 3/8	11 7/8
					14	13 1/4	13 1/2	13 3/8	13 15/16
					16	15 1/4	15 1/2	15 3/8	16

Table 3 Board footage of lumber of varying width and length

Board foot volume of 2" Nominal Thickness of Varying Width and Length						
Length	Width in Inches					
	2	4	6.0	8	10	12
Feet	Board feet per piece (BF)					
6	2.0	4.0	6.0	8.0	10.0	12.0
7	2.3	4.7	7.0	9.3	11.7	14.0
8	2.7	5.3	8.0	10.7	13.3	16.0
9	3.0	6.0	9.0	12.0	15.0	18.0
10	3.3	6.7	10.0	13.3	16.7	20.0
11	3.7	7.3	11.0	14.7	18.3	22.0
12	4.0	8.0	12.0	16.0	20.0	24.0
13	4.3	8.7	13.0	17.3	21.7	26.0
14	4.7	9.3	14.0	18.7	23.3	28.0
15	5.0	10.0	15.0	20.0	25.0	30.0
16	5.3	10.7	16.0	21.3	26.7	32.0
17	5.7	11.3	17.0	22.7	28.3	34.0
18	6.0	12.0	18.0	24.0	30.0	36.0
19	6.3	12.7	19.0	25.3	31.7	38.0
20	6.7	13.3	20.0	26.7	33.3	40.0

Board foot volume of 4" Nominal Thickness of Varying Width and Length						
Length	Width in Inches					
	2	4	6	8	10	12
Feet	Board feet per piece (BF)					
6	4.0	8.0	12.0	16.0	20.0	24.0
7	4.7	9.3	14.0	18.7	23.3	28.0
8	5.3	10.7	16.0	21.3	26.7	32.0
9	6.0	12.0	18.0	24.0	30.0	36.0
10	6.7	13.3	20.0	26.7	33.3	40.0
11	7.3	14.7	22.0	29.3	36.7	44.0
12	8.0	16.0	24.0	32.0	40.0	48.0
13	8.7	17.3	26.0	34.7	43.3	52.0
14	9.3	18.7	28.0	37.3	46.7	56.0
15	10.0	20.0	30.0	40.0	50.0	60.0
16	10.7	21.3	32.0	42.7	53.3	64.0
17	11.3	22.7	34.0	45.3	56.7	68.0
18	12.0	24.0	36.0	48.0	60.0	72.0
19	12.7	25.3	38.0	50.7	63.3	76.0
20	13.3	26.7	40.0	53.3	66.7	80.0

Table 4 Warp limits

TWIST						
	Lumber Nominal Width (Inches)					
Lumber Length (Feet)	2	3 & 4	5 & 6	8	10	12 +
	Twist limit (Inches)					
6	1/8	1/4	3/8	1/2	5/8	3/4
8	1/4	1/2	3/4	1	1 1/4	1 1/2
10	5/16	5/8	7/8	1 1/4	1 1/2	1 7/8
12	3/8	3/4	1 1/4	1 1/2	1 7/8	2 1/4
14	7/16	7/8	1 1/4	1 3/4	2 1/4	2 5/8
16+	1/2	1	1 1/2	2	2 1/2	3
CROOK						
	Lumber Nominal Width (Inches)					
Lumber Length (Feet)	2	3 & 4	5 & 6	8	10	12 +
	Crook limit (Inches)					
6	1/4	1/4	3/16	1/8	1/16	1/16
8	3/8	3/8	5/16	1/4	3/16	1/8
10	3/4	1/2	7/16	3/8	1/4	3/16
12	1	11/16	5/8	1/2	7/16	3/8
14	1 1/4	7/8	3/4	5/8	1/2	3/8
16+	1 5/8	1	7/8	3/4	5/8	1/2
CUP						
	Lumber Nominal Width (Inches)					
	2	3 & 4	5 & 6	8	10	12 +
	Cup limit (Inches)					
All lengths	1/16	1/16	1/16	1/4	3/16	1/4
BOW						
	Lumber Nominal Thickness (Inches)					
Lumber Length (Feet)	2			3 & 4		
	Bow limit (Inches)					
6	1/2			1/4		
8	3/4			3/8		
10	1 1/2			3/4		
12	2			1		
14	2 1/2			1 1/4		
16+	3 1/4			1 5/8		

Table 5 Knot and hole limits

Nominal Width of Lumber (Inches)	Knot or hole maximum size or equivalent (inches)	
2	1/2	
2 1/2	5/8	
3	3/4	
3 1/2	7/8	
4	1	
4 1/2	1 1/8	
5	1 1/4	
6	1 1/2	
8	2	
10	2 1/2	
12	3	
Knots: sound, firm, encased & pith knots if tight and well-spaced		
Holes: Includes all unsound wood, except wane and unsound or loose knots		

Table 6 Design values of species groups for TNSL Act #2 and Better grade.

Species Group Name	Design Values (psi)							Specific Gravity G (od m/v)
	Bending	Tension parallel to grain	Shear parallel to grain	Compression perpendicular to grain	Compression parallel to grain	Modulus of Elasticity		
	F _b	F _t	F _v	F _{c⊥}	F _{c∥}	E	E _{min}	
Baldcypress	825	450	160	615	900	1,300,000	470,000	0.47
Beech-Birch-Hickory	1,000	600	195	715	750	1,500,000	550,000	0.71
Cottonwood	625	350	125	320	475	1,100,000	400,000	0.41
Eastern Softwoods	575	275	140	335	825	1,100,000	400,000	0.36
Mixed Maple	700	425	195	620	550	1,100,000	400,000	0.55
Mixed Oak	800	475	170	800	625	900,000	330,000	0.68
Mixed Southern Pine	750	450	175	565	1,250	1,400,000	510,000	0.51
Yellow Poplar	700	400	145	420	575	1,300,000	470,000	0.43

Data from the NDS® Supplement National Design Specification® Design Values for Wood Construction. American Wood Council

Design values can be used to calculate span limits: [Span Options Calculator for Wood Joists and Rafters - American Wood Council \(awc.org\)](https://www.awc.org/resources/education/learning-center/wood-joists-and-rafters-span-options-calculator)

Table 7 Species groups and component species, including species not in the National Design Supplement (*TN Species)

Species Group**	Common Name	Scientific name	Grading Agency***
Baldcypress	Baldcypress	<i>Taxodium distichum</i>	SPIB
Beech - Birch - Hickory	American Beech	<i>Fagus grandifolia</i>	NELMA
	Bitternut Hickory	<i>Carya cordiformis</i>	
	Mockernut Hickory	<i>Carya tomentosa</i>	
	Nutmeg Hickory	<i>Carya myristiciformis</i>	
	Pecan Hickory	<i>Carya illinoensis</i>	
	Pignut Hickory	<i>Carya glabra</i>	
	Shagbark Hickory	<i>Carya ovata</i>	
	Shellbark Hickory	<i>Carya laciniosa</i>	
	Sweet Birch	<i>Betula lenta</i>	
	Water Hickory	<i>Carya aquatica</i>	
	Yellow Birch	<i>Betula alleghaniensis</i>	
	Black Walnut	<i>Juglans nigra</i>	*TN Species
	Black Locust	<i>Robinia pseudoacacia</i>	
Honeylocust	<i>Gleditsia triacanthos</i>		
Cottonwood	Cottonwood	<i>Populus deltoides</i>	NSLB
	Basswood	<i>Tilia americana</i>	*TN Species
Eastern Softwoods	Balsam Fir	<i>Abies balsamea</i>	NELMA, NSLB
	Black Spruce	<i>Picea mariana</i>	
	Eastern Hemlock	<i>Tsuga canadensis</i>	
	Eastern White Pine	<i>Pinus strobus</i>	
	Jack Pine	<i>Pinus banksiana</i>	
	Red Pine	<i>Pinus resinosa</i>	
	Pitch Pine	<i>Pinus rigida</i>	
	Red Spruce	<i>Picea rubens</i>	
	Tamarack	<i>Larix laricina</i>	
	White Spruce	<i>Picea glauca</i>	
Mixed Maple	Black Maple	<i>Acer nigrum</i>	NELMA
	Red Maple	<i>Acer rubrum</i>	
	Silver Maple	<i>Acer saccharinum</i>	
	Sugar Maple	<i>Acer saccharum</i>	
			*TN Species
	Sycamore	<i>Platanus occidentalis</i>	
	Black Tupelo	<i>Nyssa sylvatica</i>	
Water Tupelo	<i>Nyssa aquatica</i>		

	Southern Magnolia	<i>Magnolia grandiflora</i>	
	Cucumbertree	<i>Magnolia acuminata</i>	
	Hackberry	<i>Celtis occidentalis</i>	
	American Elm	<i>Ulmus americana</i>	
	Rock Elm	<i>Ulmus thomasii</i>	
	Slippery Elm	<i>Ulmus rubra</i>	
	Black Cherry	<i>Prunus serotina</i>	
Mixed Oak	Black Oak	<i>Quercus velutina</i>	NELMA
	Cherrybark Oak	<i>Quercus falcata var. pagodaefolia</i>	
	Northern Red Oak	<i>Quercus rubra</i>	
	Southern Red Oak	<i>Quercus falcata</i>	
	Laurel Oak	<i>Quercus laurifolia</i>	
	Pin Oak	<i>Quercus palustris</i>	
	Scarlet Oak	<i>Quercus coccinea</i>	
	Water Oak	<i>Quercus nigra</i>	
	Chestnut Oak	<i>Quercus prinus</i>	
	Live Oak	<i>Quercus virginiana</i>	
	Post Oak	<i>Quercus stellata</i>	
	Swamp Chestnut Oak	<i>Quercus michauxii</i>	
	White Oak	<i>Quercus alba</i>	
	Bur Oak	<i>Quercus macrocarpa</i>	
	Overcup Oak	<i>Quercus lyrata</i>	
	Swamp White Oak	<i>Quercus bicolor</i>	
Mixed Southern Pine	Longleaf Pine	<i>Pinus palustris</i>	SPIB
	Slash Pine	<i>Pinus elliotti</i>	
	Shortleaf Pine	<i>Pinus echinata</i>	
	Loblolly Pine	<i>Pinus taeda</i>	
	Pond Pine	<i>Pinus serotina</i>	
	Virginia Pine	<i>Pinus virginiana</i>	
Yellow Poplar	Yellow Poplar	<i>Liriodendron tulipifera</i>	NSLB
	Sweetgum	<i>Liquidambar styraciflua</i>	*TN Species
	Honeylocust	<i>Gleditsia triacanthos</i>	
	Blue Ash	<i>Fraxinus quadrangulata</i>	
	Black Ash	<i>Fraxinus nigra</i>	
	Green Ash	<i>Fraxinus pennsylvanica</i>	
	White Ash	<i>Fraxinus americana</i>	
*TN Species – species that do not have established grading systems or design values. These species have been placed in groups bases on their relative average values for modulus of rupture and			

modulus of elasticity being equal to or greater than the other species in the group. Species not listed in this table (e.g. willow) do not fit into any pre-existing group for which there are design values and should not be used for structural applications.

Species Group** are those used in the National Design Supplement

Grading Agency*** are those organizations that have developed the grading system and design values for the species groups reported in the National Design Supplement.