

Lumber Grading

A guide for the perplexed

by William W. Rice

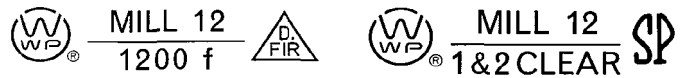
When I hear a woodworker exclaim, "How can that board be a Select? It has a knot as big as your fist!" I sympathize with his frustration. But I also know that he, like many, is confused about commercial lumber grading. A bewildering assortment of grades confronts the buyer. There are different standards for hardwoods and for softwoods, and the rules make exceptions for certain species like walnut.

Lumber grading is a way of evaluating the usable lumber in a board. It takes into account the number, size and degree of defects, and the number and size of clear pieces that will remain when the defects are cut away. But not every project needs a perfect board 12 ft. long. Once a cabinetmaker learns his way through the intricacies of the grading system, he will be able to select the most suitable lumber for the job at hand. He may well find that he can cut the size pieces he needs from No. 1 Common as well as he could from Firsts and Seconds—at considerable saving.

As far back as the early 1700s the need for classifying lumber by grades was recognized. Originally, appearance was the primary requisite, but with increased knowledge about wood properties and methods of utilization, lumber grades now also take into account strength characteristics and yield potential. Modern lumber-grading rules provide standards for the manufacture of the same product by different mills. They also serve as common specifications both buyer and seller can use to determine that full value is received and sold.

In the United States, the American Lumber Standards Committee (ALSC) of the Department of Commerce is responsible for general establishment and administration of lumber grades. Application and enforcement of specific grading rules are the responsibility of various lumber inspection associations. For example, the California Redwood Association has jurisdiction over member mills and dealers handling redwood, and the Western Wood Products Association monitors the standards for several West Coast species, including ponderosa pine and Douglas fir. Some other associations are the Southern Pine Inspection Bureau, the Northeastern Lumber Manufacturers Association and the National Hardwood Lumber Association. Altogether there are about 15 associations that oversee the grading of wood products; each is represented on the American Lumber Standards Committee and all operate under its certification. Grading rules are voluntary standards set by the lumber industry through the ALSC, not dictated by the government.

Lumber grading is judging the surface quality of boards with respect to established standards, which are different for softwoods and hardwoods. Softwoods are graded from the best face, usually as surfaced material, and it is assumed that the piece will be used as is, without further manufacturing. Select and Common softwood boards are graded for appearance from the best face, while dimension lumber and timbers are graded for strength by inspecting all four surfaces, with



Typical grade stamps of the Western Wood Products Association (top: Douglas fir, sugar pine) and the Northeastern Lumber Manufacturers Association (right: Eastern white pine, balsam fir). Stamps indicate the association mark, the species, the mill, the grade and sometimes the relative dryness.



the poorest surface determining the grade. Hardwoods are graded in the rough, from the poor face, and it is assumed that each board will be cut into clear-face parts. Softwoods are generally grade-stamped, hardwoods are not. Both softwood and hardwood grading rules describe the poorest piece permitted in each grade. Softwood Select and Common grades specify a moisture level of 15% or less. There is no moisture-content rule for hardwoods, and generally grading is done while the lumber is green, unless buyer and seller make special arrangements.

Softwood grading

Softwood species most often used for cabinetry and furniture are Eastern white pine and the western pines: sugar, Idaho white, ponderosa and lodgepole. Other species used include Douglas fir, Englemann spruce, Sitka spruce and Western larch. Eastern white pine is graded under the rules of the Northeastern Lumber Manufacturers Association (NELMA). The others are graded under the rules of the Western Wood Products Association (WWPA) and/or West Coast Lumber Inspection Bureau (WCLB). Upper grades are designated Select or Finish and usually are further separated by the letters B, C, and D to indicate descending quality. The exception to the rule is Idaho white pine (IWP), which carries the grade names Supreme, Choice, and Quality in place of B Select, C Select and D Select respectively.

Lower lumber grades are called Commons, and quality within this category is designated by the numbers, 1, 2, 3, 4, 5—with the highest number assigned to the lowest grade. But Idaho white pine Commons carry the names Colonial, Sterling, Standard, Utility and Industrial, with Colonial corresponding to 1 Common, and so on.

While grade descriptions may vary slightly from one softwood association to another, in general each grade describes the type, size and number of defects permitted in the worst board in that grade. For example, the WWPA grade of B and Better Select (B & BTR) for all species permits on the best face: light stain (blue or brown) over not more than 10% of the face; small ($\frac{1}{32}$ in. deep by 4 in. long) season checks, one at each end of the board or 3 or 4 if away from the ends; very light torn grain ($\frac{1}{64}$ in. by 3 in.); two sound, tight pin knots ($\frac{1}{2}$ in. dia.) or slight traces of pitch or a very small pitch pocket ($\frac{1}{2}$ in. by 3 in.); very slight cup ($\frac{1}{16}$ in. in an 8-in. wide board); very light crook ($\frac{1}{4}$ in. in an 8-in. by 12-ft. board). In addition to the above, the poor face may have wane (bark) $\frac{1}{4}$ the thickness by $\frac{1}{6}$ the length of the piece.

As another example, a Premium (No. 2 Common) Eastern white pine board graded under NELMA rules could contain on the best face: medium surface checks ($\frac{1}{32}$ in. by 10 in.);

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red knots (2¼-in. dia. in 8-in. wide boards); sound pith; medium pitch (⅓ the width by ⅓ the length of the piece); short splits; medium stain (not affecting a paint finish); one knothole (½-in. dia. in a 6-in. wide board); one ¼-in. wormhole for every 6 lineal feet of board. The poor face could have all that plus wane ½ the thickness by ¼ the width by ¼ the length of the board.

At first glance the reader might think that anything goes as far as defects in a board. In practice the grader exercises judgment about the number allowed and seldom, if ever, do all the permitted defects occur in a single board. In fact, there may be some pieces in a pile that would make the next higher grade except for one unacceptable defect. For example, a perfectly clear board with too much wane on the reverse face grades as C Select instead of B, or a No. 3 Common board misses the No. 2 Common grade because of one oversize knot. The softwood grade is stamped on each piece when it leaves the mill, although retail lumber dealers often cut long boards into shorter lengths and in the process lose the stamp. Inspection by the association quality-control people ensures that the grade is correct on at least 95% of the pieces.

Hardwood grading

Except for specialty grades such as Factory and Shop or Furniture (NELMA), softwood grading depends on the grader's experience and good judgment and assumes lumber use in full widths and lengths. In contrast, hardwood grading is based on the assumption that the boards will be cut into furniture parts ranging from 2 ft. to 7 ft. long, and that each part should have a clear face. The grade of individual boards is related to the yield of clear parts as determined by a mathematical system called the Cutting Unit Method. In addition, hardwoods are always graded from the poor face.

While there are rules similar to softwood rules for grading hardwood timbers and framing, they are seldom applied commercially. For this reason hardwood grades are usually considered to be furniture grades. There is only one association, the National Hardwood Lumber Association (NHLA), responsible for the grading of native hardwoods as well as many imported foreign and tropical species. Hardwood grading rules define standard requirements for all hardwood species and, in addition, spell out modifications that apply to individual woods. A cabinetmaker who understands the general rules will usually be able to purchase any hardwood species on grade without major problems. An exception might be walnut which, because of the decreasing size of the available trees, has required a number of adjustments.

The standard grades assigned to hardwoods are Firsts, Seconds, Selects, Numbers 1, 2, 3A and 3B Common, and Sound Wormy. Firsts and Seconds are usually combined into the one grade of Firsts And Seconds (FAS). Sound Wormy is essentially No. 1 Common with an allowance for wormholes. As with softwood grades, the more defects in a board, the lower the grade. However, in grading hardwoods the concern is for the yield of clear material, not the number of defects.

A grader spends only 10 or 15 seconds inspecting each hardwood board. In that time, he determines its width, length and surface measure (area in square feet); selects the poor face; visualizes a series of clear face cuttings on the surface; determines the percent of clear material available; and assigns a grade based on board size, number of cuttings, percent of clear area and defect or species restrictions.

The heart of this grading operation is the determination of clear material available and this is done by the Cutting Unit Method. A cutting is a portion of the board that can be obtained by crosscutting, ripping, or both. A cutting must be

MINIMUM GRADE REQUIREMENTS FOR HARDWOODS

Grade	Minimum Board Size width length	Conversion Factor (% clear face)	Minimum Size of Cuttings	Maximum Number of Cuttings for Board SM
Firsts	6" 8'-16'	11xSM (91 ⅔ %)	4"x5' Or 3"x7'	1 for SM 4'-9' 2 for SM 10'-14' 3 for SM 15' or more
Seconds	6" 8'-16'	10xSM (81 ⅔ %)	4"x5' or 3"x7'	1 for SM 4'-7' 2 for SM 8'-11' 3 for SM 12'-15' 4 for SM 16' or more
Selects	4" 6'-16'	11xSM (91 ⅔ %) 10xSM (83 ⅓ %)	4"x5' or 3"x7'	1 for SM 2'-3' 1 for SM 4'-7' 2 for SM 8'-11' 3 for SM 12'-15' 4 for SM 16' or more
No. 1 Common	3" 4'-16'	9xSM (75%) 8xSM (66 ⅔ %)	4"x2' or 3"x3'	1 for SM 2' 1 for SM 3'-4' 2 for SM 5'-7' 3 for SM 8'-10' 4 for SM 11'-13' 5 for SM 14' or more
No. 2 Common	3" 4'-16'	6xSM (50%)	3" x 2'	1 for SM 2'-3' 2 for SM 4'-5' 3 for SM 6'-7' 4 for SM 8'-9' 5 for SM 10'-11' 6 for SM 12'-13' 7 for SM 14' or more

The chart gives the minimum requirements a board must meet to merit a particular grade. In general, a high-grade board is relatively long and wide and a high percentage of its area is free of defect. The clear lumber in a high-grade board must be obtainable in relatively few and large cuttings.

To grade a board, first note its dimensions—they will eliminate some grades immediately. For example, a board that is only 5 in. wide cannot be a First or Second. Next, note the board's surface measure (SM)—its area expressed in square feet. Mentally lay out the largest clear cuttings that could be obtained by straight ripping and crosscuts, and measure each cutting in inches of width and feet of length (cutting units). Then total the number of cutting units available, and count the number of cuttings necessary to obtain the total. The last two columns give the minimum size of a cutting and the maximum number of cuttings allowed for each grade.

The percentage of clear face required for each grade can be found by dividing the number of cutting units by the area of the board, but instead, lumber graders use a conversion factor, which is given in the third column of the table. The surface measure of the board multiplied by the conversion factor gives the minimum number of cutting units required for the grade.

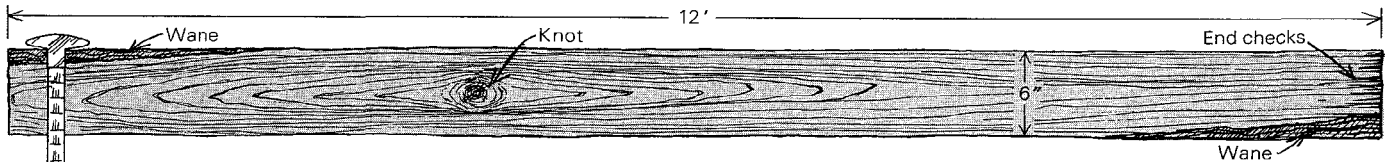
For example, the smallest board that can be a First is 6 in. wide and 8 ft. long, or 4 ft. surface measure. If this board were perfect, it would contain 48 cutting units. It must contain its surface measure times the conversion factor of 11, or 44 cutting units, to be graded a First. This much clear lumber must be obtainable in one cutting.

The two examples that follow show how lumber is graded. The diagrams were derived from real boards, but the defects that determined the grade were too small to reproduce photographically.

parallel to the edges of the board. Further, a cutting must be clear of all defects on one face and it must be of a certain minimum size, depending on the grade to be assigned to the board. Based on the surface area of the board, each grade specifies the maximum number of cuttings that can be used in determining the grade. Note that grading does not consider the thickness of the board, only the surface area. The

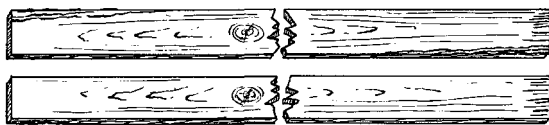
grader visualizes the various cuttings, but does not actually make the sawcuts. How the buyer ultimately cuts the board may not coincide with the grader's visualization. What is important is that the yield of clear material is mathematically available in specified cuttings and therefore anyone checking the inspector should arrive at the same grade. The mathematics of the Cutting Unit Method are relatively

EXAMPLE 1: RED OAK BOARD



In about 15 seconds, the lumber grader:

- 1 Measures the length (12') and width (6") of the board, multiplies to get its surface measure (area in square feet): $\frac{1}{2} \times 12 = 6 \text{ SM}$.
- 2 Selects the poorer face and visualizes on it a series of clear cuttings, which he measures in inches of width and feet of length.



Board's poor face, above, has wane (bark) along edges; good face, below, is relatively clear.

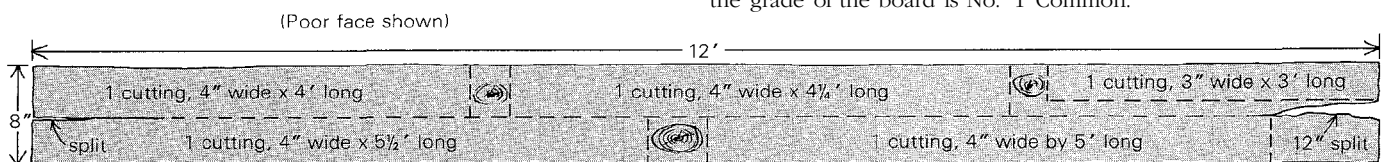
- 3 Totals the area of the clear cuttings.
 $1 \text{ cutting @ } 5'' \times 7' = 35 \text{ cutting units}$
 $1 \text{ cutting @ } 5'' \times 4' = 20 \text{ cutting units}$
 $\underline{55 \text{ cutting units}}$
 against $6'' \times 12' = 72 \text{ cutting units if the board were perfect}$.
- 4 Compares the available clear cuttings with the grade requirements given in the table.
Firsts: $11 \times \text{SM} = 11 \times 6 = 66 \text{ cutting units in 1 cutting}$.
Seconds: $10 \times \text{SM} = 10 \times 6 = 60 \text{ cutting units in 1 cutting}$.
1 Com.: $8 \times \text{SM} = 48 \text{ cutting units in 2 cuttings}$.
- 5 Assigns a grade. The board contains enough cutting units (55) in few enough cuttings (2) to be graded No. 1 Common. It falls short of meeting the requirements for Seconds because it lacks 5 cutting units and because 2 cuttings were necessary to obtain the units available. This grade was determined from the poor face of the board. If the good face could meet the grade of Seconds, the proper grade would become Select. Select is a special grade, generally used for parts or items that show on one face only. But if the good face of the board grades no higher than No. 1 Common, then the poor face determines its grade.



EXAMPLE 2: WALNUT BOARD

Board size: $2'' \times 8'' \times 12'$
 Surface measure (SM): $\frac{8'' \times 12'}{12} = 8 \text{ sq. ft.}$
 Available clear stock:
 $1 \text{ cutting } 4'' \times 4' = 16 \text{ cutting units}$
 $1 \text{ cutting } 4'' \times 4\frac{1}{4}' = 17 \text{ cutting units}$
 $1 \text{ cutting } 3'' \times 3' = 9 \text{ cutting units}$
 $1 \text{ cutting } 4'' \times 5\frac{1}{2}' = 22 \text{ cutting units}$
 $1 \text{ cutting } 4'' \times 5' = 20 \text{ cutting units}$
 Total: 5 cuttings with 84 cutting units

Grade requirements (from table):
Firsts: $11 \times \text{SM} = 11 \times 8 = 88 \text{ cutting units in 2 cuttings}$
Seconds: $10 \times \text{SM} = 10 \times 8 = 80 \text{ cutting units in 2 cuttings}$
1 Com.: $8 \times \text{SM} = 8 \times 8 = 64 \text{ cutting units in 3 cuttings}$
2 Com.: $6 \times \text{SM} = 6 \times 8 = 48 \text{ cutting units in 4 cuttings}$
 Modification for walnut: 1 Common standard, unlimited number of cuttings.
 Under standard rules (as for oak), this board would grade as excellent No. 2 Common, with 75 units in four cuttings. (Since only four cuttings are permitted for No. 2 Common, the smallest cutting, 9 cutting units, is not included in the total.) But because a modification to the rules allows an unlimited number of cuttings for walnut, the grade of the board is No. 1 Common.



(Boards are not drawn to scale)

simple. It is a matter of calculating the number of cutting units available and comparing the total to the number required for a given grade. A cutting unit is a portion of clear lumber one inch wide and one foot long. Thus the number of cutting units in each clear portion is determined by multiplying its width in inches by its length in feet. When calculating the total yield of clear material, only those cutting units making up the surface of the clear-face cuttings may be counted. There may be additional cutting units in the board, but in areas too small for furniture cuttings, and thus not available for grade computation. Within each grade there is some leeway because the rules describe the poorest pieces—thus there are both borderline and "good" boards. A good No. 2 Common would be just shy of the total cutting units it would need to qualify as a No. 1 Common. The table lists the requirements for determining standard grades.

As can be seen from the table and the two examples, hardwood grading can be detailed and quite exacting. Grading is a 100% inspection procedure, but in a given pile of lumber an experienced grader can accurately judge whether most boards contain the proper percentage of clear area in the allowable size and number of cuttings without using the complete method. However, for a borderline board he will go through all the necessary measurements and calculations, if the lumber value warrants the effort.

Grading and the woodworker

Although grading rules are of particular use to furniture manufacturers, they can also guide the cabinetmaker in selecting lumber. In sum, Firsts and Seconds are relatively clear boards of good widths and lengths. They yield on the average, 80% to 90% clear material, depending on cutting requirements, and the pieces will be good on both sides. Select boards are about 80% clear on one face and of good widths and lengths. They are often used for items that show only one side. No. 1 Common is probably the best all-around grade, considering both yield (about 65%) and price. This grade can include some long (over 4 ft.) cuttings. If most of your cabinet parts are 16 in. to 4 ft. long, consider the economy of No. 2 Common. Often the grade yield of 50% can be exceeded, especially if the parts are glued into assemblies.

A cabinetmaker who wants to use graded lumber should visit a lumber supplier and look over the available stock in the various grades to become familiar with the typical array of defects (and their spacing) that is permitted. Look for grade stamps on softwoods so you will know you are getting what you are paying for. But most important, try to associate the character and size of the cabinet (or parts) with the appearance of the lumber. Then select the grade that will permit you to cut out the parts with the least waste. Not all parts need to be blemish-free; in fact, defects more often than not add character and interest. The lower grades are less expensive, but figure the waste before buying on price alone. □

AUTHOR'S NOTE: Lumber-grading rules can be obtained from the following associations:

National Hardwood Lumber Assn., 332 S. Michigan Ave., Chicago, Ill. 60604 (*Rules for Measurement of Hardwood and Cypress Lumber*, \$1.00).

Northeastern Lumber Manufacturers Assn., 4 Fundy Rd., Falmouth, Maine 04105 (*Grading Rules for Northeastern Lumber*, \$2.00).

Western Wood Products Assn., 1500 Yeon Bldg., Portland, Ore. 97204 (*Grading Rules for Western Lumber*, no cost).