Before plunking down your hard-earned cash on hardwood lumber, read this primer on what to look for, what to ask for — and what to avoid.

By Udo Schmidt

There are many sources for quality lumber and each of the following has its pros and cons.

SAWMILL: a good choice for buying lumber and most likely the cheapest place. Lumber at the sawmill is green. That means it is freshly cut or air-dried at best. Before use in most projects, it will have to dry to the proper moisture content.

Sawmill lumber is probably not sorted by grades. As the log is sawn, the lumber is piled into a stack wherein the quality is not uniform. The quality of the log determines the proportions of good and poor lumber in a given stack, so it is advisable to look at every board before purchasing a pile of log-run lumber.

WHOLESALE YARD: a good place to purchase large amounts of lumber. Unless you are in the market for a truckload (roughly 12,000 board feet of kiln-dried oak), the wholesale yard is out of your league.

DISTRIBUTION YARD: where most of the lumber used in woodshops is purchased. Some companies will sell from 100 board feet to multiple truckloads. They carry a wide selection of species and grades,

HARDWOOD LUMBER: A BUYER’S GUIDE

Buying hardwood lumber is not as straightforward as buying a finishing product or hardware. That’s because wood is a natural product; no two trees are alike and no two boards are alike, even when they come from the same tree. Each woodworker also has a different idea what the lumber for his or her project should look like; the woodturner will want different wood than the cabinetmaker. From forest to woodshop, here are some factors to consider.
sometimes including exotic woods. The larger yards maintain a fleet of trucks and can deliver the lumber to your place. Distribution yards also offer planing and straight-line ripping services. Unless you are looking for a special wood, the distribution yard is probably your best source for lumber.

**RETAIL YARD OR STORE:** where you can find a wide variety of woods in smaller amounts. Unlike distribution yards, retail stores let you select the boards you want. Therefore, expect to pay a lot more money for the lumber you buy there.

There are many other sources of lumber, including companies that sell salvaged or recycled lumber. You can also luck into the occasional purchase of good lumber from an individual. But in most cases, the distribution yard and the retail store are the best bets.

### Measurement

Most lumber sold at sawmills and lumberyards is measured by volume in board feet (sometimes abbreviated bf or bdft). A piece of wood 1” wide, 1’ long and 1” thick would measure exactly 1 board foot. Of course, lumber does not normally come in these dimensions, so we have to apply a formula: (width in inches x length in feet) / (12 x thickness in inches). For example, take a board 6” wide, 10’ long and 1½” thick and apply the formula:

\[6 \times 10/12 \times 1.5 = 7.5\text{ board feet}\]

On the other hand, some specialty items and milled stock are sold in linear feet, a pricing system based only on the length of the board. Our example board at $1/linear foot would cost $10.

Lumber thickness is sometimes expressed in quarters. Lumber that is 1” thick is called 4/4 (four-quarter), 1½” is 6/4 (six-quarter) and 2”-thick stock is 8/4 (eight-quarter). Remembering this can help you determine the total volume in board feet.

Hardwood lumber is customarily measured and graded before kiln drying. The price for a board foot of lumber is based on a green measurement. That means that a 6” board might only be 5¼” wide. The amount of shrinkage during kiln drying depends on the species and the final moisture content.

### Grading

Lumber quality is a wide-open topic, and many experts have different opinions on what is acceptable and what is not. Often, what is a defect to one woodworker is “authentic” or “artistic” to another.

Most lumber sold in the U.S. is based on the grading rules published by the National Hardwood Lumber Association, which was founded in 1898 to standardize the inspection of hardwood lumber. Unfortunately, the rules are written for volume shipments of lumber (usually truckloads) and the grades they establish were never intended to be used for retail sales. Widely established in the wood industry, the rules and resultant grades might be confusing to the layman.

Lumber grades are based on a clear face cutting of a board. According to the rules, the minimum size of pieces that can be cut from a board depends on its grade. The larger a board is, the greater its surface measure (SM) and the more cuttings can be taken from it according to the grading rules.

For instance, in the best grade, FAS (firsts and seconds), the maximum number of cuttings allowed is SM/4. In a given board 8” wide and 12’ long, the surface measure is 8 and therefore two cuttings (or graded pieces) are allowed. Also, the FAS grade requires a minimum cutting size not less than 4” x 5’ or 3” x 7’ for each piece, and a yield of at least 83 1/3% clear cuttings. In other words, the 8” x 12’ board can be cut (crosscut or ripped) into two pieces to obtain 83 1/3% clear wood from the entire board. The FAS board minimum size is 8” wide and 8’ long.

Of course, the higher the grade, the stricter the requirements. The lowest grades can be cut an unlimited number of times and might only require a yield of 25%.

There are a number of other rules for grading, but these basics can help you begin to picture how the grading process works.

### Kiln drying

Lumber grades are a good way to start assessing quality, but they only tell the buyer how much usable lumber he can expect from a certain grade, not the overall quality of wood. For instance, lumber is measured and graded when it is green, so any kiln-drying defects are handed down to the buyer. The woodworker should be more concerned about these defects than whether a board meets grading requirements.

When lumber dries, it shrinks. Actually, it starts at a moisture content around 30 percent, which is called the fiber saturation point (FSP), and dries from the outside in. That means that part of a drying board — the shell — goes below the FSP and begins to shrink while the inside — the core — is still saturated. The different moisture contents and shrinking portions of
a board produce tension and compression between shell and core that can cause many drying defects, like splits and checks.

Another kind of drying defect is caused by the different shrinking properties of wood — tangential, radial and longitudinal — which are all present in a given board. Unfortunately, due to this natural drying process, some defects like light cupping, short end splits and small twists should be accepted on hard-to-dry species. Good lumber stacking and kiln drying can keep these defects to a minimum.

Lumber companies, like any other business, are geared for maximum production. Increased production (accelerated kiln drying) also increases drying defects. It might take some time and patience to find a supplier who delivers a consistent quality of kiln-dried lumber. Another problem is that kiln-drying defects are not covered by NHLA rules, which primarily deal with the measurement and grading of lumber before kiln drying.

### Services

Many lumber companies offer additional services like planing and straight line ripping. The extra charges for this service are minimal compared to the work saved by the woodworker who has no heavy machinery. A few points, however, should be considered before the purchasing the services.

The term used in lumber yards for planing is S2S, which means “surfaced on two sides.” Buying lumber already surfaced is a tremendous time-saver for the woodworker with just a small planer. The extra charges range from 5 to 10 cents per board foot. It is advisable not to have the lumber planed to the final thickness. The planers used for surfacing are very fast and not intended for a smooth finish; they merely bring the lumber to a uniform thickness. The woodworker can take the resurfaced lumber to the smooth finish and final thickness by just taking \( \frac{1}{32} \)” off each side of the board. That means surfaced

### Common Lumber Defects

- **Twist**, also called wind, is a common natural drying defect occurring mostly in lumber where the grain direction changes. It can cause problems such as tearout.
- **Cupped** boards usually have two planes (radial and tangential) in their cross sections and continue to cup during the seasonal swelling and shrinking periods, even after they are jointed flat.
- Boards that are heavily **crooked** are a good indication of reaction wood and should be avoided if possible in any solid wood projects.
- **End splits** are the result of kiln drying the wood too quickly or leaving the ends of the lumber stack unprotected during air drying. In any case, it is better to rip the board into smaller strips — next to the split — instead of crosscutting close to the end split. Some splits continue further into the wood than is visible, and can open up during seasonal swelling and shrinking.
- Boards with clearly visible **surface checks** usually indicate other defects or problems such as severe casehardening, honeycomb or wet wood. Any board with surface checks should be closely inspected.
- **Wavy** boards are the result of poorly handled lumber and bad lumber stacks. They do not affect a single board, but the whole stack.
Bells and whistles?

How about liquid crystals and lasers?

lumber should be about 1/16” thicker than the final thickness required for the project.

E1S means “edged on one side.” In other words, the boards are ripped on one side with a straight line rip saw, which gives the customer one straight side on each board. Here again, this can be a time-saver for some woodworkers for the extra charge of 5 to 10 cents per BDFT. Straight line ripping, however, can cost a lot of wood. The average loss ranges from 5 to 10 percent. Unless the woodworker requires long stock, which is difficult to square up on a small jointer, it is cheaper not to have the lumber ripped straight.

the journey

Many people may ask: Why do I have to pay $3 or $4 a BDFT for wood that grows in my backyard? The following example shows a typical journey from tree to usable lumber. (Prices in this example are not meant to reflect market conditions.)

The process begins with loggers, who buy standing timber from private landowners or bid on forest service tracts for logging. The logs, of various species and grades, are sorted and sold to veneer mills, processing plants (for particle board), and paper mills. Good quality sawlogs are sold to the sawmill. Prime red oak logs are sold for $600 per 1,000 board feet.

The sawmill yields 50 percent FAS, 30 percent No. 1 Common and 20 percent No. 2 Common and less. The FAS is sold to wholesale lumberyards for $900 per 1,000 board feet, and the No 1 Common for $600 per 1,000 board feet. The No. 2 Common lumber is sold to flooring plants, and the lower grades to pallet manufacturers.

At the wholesale lumberyard, the FAS and No. 1 Common are separated and kiln dried. The distribution yard buys one truckload of FAS red oak lumber kiln dried for $1,450

Drying Stress in Lumber

Green lumber has two moisture zones, the outer shell and the inner core (A).

As the lumber dries, the outer shell dries below the fiber saturation point and wants to shrink; since the inner core is still above fiber saturation point, the surface cannot shrink, and surface checks develop (B). When the surface checks are too deep, they will remain after the shell and core shrinks evenly together. (C) These inner checks are also called honeycomb. Properly dried lumber will shrink evenly across all planes with few defects (D). There remains, however, a small moisture gradient between the shell and the core.

If the moisture gradient is too big, the lumber cannot be used immediately. The moisture content will equalize over the course of weeks or even months.
Fatal Lumber Defects

There are three kinds of lumber defects which need to be discussed in detail and should not be accepted by any woodworker because they render lumber useless and make it dangerous to machine.

**Casehardening** is a difference in moisture content in a given board between the shell and the core. As lumber dries from the outside in, the shell and the core will go through tension and compression stages. If a certain moisture gradient between shell and core is maintained during the drying phase, the lumber will dry to its final moisture content without problems. However, if the moisture content between the shell and the core is too great, the lumber is casehardened. That means there is a tension from the core to the shell of a board. Commercial kiln operations are very familiar with this problem and try to compensate by steaming the kiln load at the end of a drying cycle.

If the casehardening is too severe, the steaming or conditioning of the lumber will not relieve the stress in the board. This will cause serious problems for the woodworker.

Unfortunately, most lumber companies do not consider stress in lumber a defect. Another problem with this defect is that it is not detected until the lumber is processed. A good indication of stress is when a board is ripped. If the two ends coming out of the saw pull to each other to the point where they bind the saw blade then the board is severely casehardened. If the board is cut, the two halves will never stay straight. Even with careful jointing and ripping, it is almost impossible to get straight stock out of severely casehardened lumber.

**Ring shake** or ring failure occurs in a living tree. The rings actually separate, causing severe splits. This problem is hard to detect in green lumber when it’s measured and graded. The kiln drying will separate the fibers or rings, and the shake sometimes becomes clearly visible—and sometimes not.

When the kiln-dried lumber is not re-inspected, shaky boards are left in a lumber stack and shipped to the customer. Ring-shake boards are extremely dangerous to machine, especially on rotary cutters such as shapers, routers and lathes.

**Honeycomb** is another defect associated with kiln drying. Like casehardening, honeycomb can develop during air drying under certain conditions but it is rather rare. Basically two conditions cause honeycomb. First, when surface checks are very deep the surface or shell will close when conditioning, and the interior checks remain. Secondly, if the moisture gradient between shell and core becomes too great (like in casehardening) during drying, the tension and compression stage between the shell and core will tear the wood fiber apart, leaving honeycomb.

Severely honeycombed stock is considered cull and should not be used in any project. Honeycomb is acknowledged as a major kiln drying defect, and the woodworker should have no problems returning the damaged lumber to the lumber company in exchange for defect-free stock.

---

per 1,000 board feet.

At the distribution yard, the woodworker can buy the required minimum for $1,850 per 1,000 board feet. It will cost about 15 cents per board foot to have the lumber surfaced and edged, for a total of $2 per board foot.

Wholesalers and distribution yards sell the FAS red oak lumber to retailers. Some retail stores sort through the lumber and surface it on all four sides. This makes the lumber uniform in thickness and width. Here is where the woodworker can buy, for example, a 1” x 6’ x 8’ red oak board. The price jumped to $1.80 per linear foot ($3.60 per board foot).

This example shows five middle-men handling the lumber, between a tree and the woodworker. Needless to say, each of these five middle-men has to support his business and wants to make a profit. From logging to sawing, to kiln drying to sorting and planing, it is easy why the price of quality lumber is high.

— Udo Schmidt is a contributing editor to Woodcraft Magazine.
FREE YEAR!

2 YEARS for $29.99!

go to woodcraftmagazine.com and click SUBSCRIBE

-or-

Complete the form below and mail in an envelope addressed to:

WOODCRAFT MAGAZINE
PO BOX 7020
PARKERSBURG WV 26102-9916

□ Payment Enclosed  □ Bill Me

Name

Address

City

State               Zip

Country

E-mail

Send in now to get

2 Years for $29.99!

or go to woodcraftmagazine.com and click SUBSCRIBE

By providing my e-mail address, I am indicating I’d like to receive information about my subscription and other offers from Woodcraft Magazine via e-mail.

Outside of the U.S and Canada add $30 for postage.
Foreign orders must be prepaid. Payment in U.S. Funds only.