Seasoned Wood: What You Need to Know

Air-drying and kiln-drying both yield top-quality lumber

by William W. Rice

s a consultant and wood technologist, I'm frequently asked whether air-dried or kiln-dried wood is best for making furniture. The answer is short and simple: It doesn't really make any difference, as long as the wood has been seasoned properly. Both methods produce good cabinet-grade material that is difficult, if not impossible, to tell apart. Properly dried wood is just that—properly dried wood.

Many furnituremakers have a preference regarding air-dried or kiln-dried lumber. Their opinions probably are a result of what kind of lumber is available to them and what they're used to working. And it's true there are some subtle differences between airdried and kiln-dried lumber. But the way lumber is handled during the drying process and how it is stored before use have much more to do with its overall quality.

The basics of wood and moisture

Unless it's standing dead wood, lumber is water-laden when it's cut. Good drying, or seasoning, regulates the rate of moisture loss so that shrinkage is controlled. Checks, splits and twist occur when this process is rapid and uncontrolled.

To understand wood seasoning, you need to know a little about the terminology of drying. The amount of water in a piece of wood is expressed as a ratio of water to the weight of the wood when it's perfectly dry. This percentage is called the wood's moisture content (MC). A freshly cut log contains a lot of water. In some species, the MC exceeds 100%, meaning that the water trapped in a piece of wood weighs more than the wood itself.

Wood should have an MC of between 6% and 8% before it is used, unless you make green-wood furniture. Both air-drying and



These red oak logs, being cut in Connecticut, will go to either a dry kiln or a drying shed. With care, beautiful lumber will result from either journey.

A moisture meter eliminates guesswork, whether you dry your own wood or buy it at a lumberyard.



kiln-drying accomplish that. Even after it has dried, wood responds to surrounding temperature and humidity. Wood gives up moisture when the air is dry and absorbs moisture when it's humid. Eventually, wood comes into balance with its environment when it is no longer absorbing or giving up any water. That's its equilibrium moisture content (EMC). Keep in mind that all wood, whether it has been air-dried or kiln-dried, responds in the same way to changes in humidity. An accurate way to check the MC, whether wood has reached equilibrium or not, is with a moisture meter (see the photo at right).

Kilns are faster than air-drying

Air-drying uses natural atmospheric conditions to evaporate the moisture from the wood. On average, wood left outside under

cover will stabilize at 15% to 20% MC. Careful, uniform stickering and protecting the stack from rain and direct sunlight minimize checks, splits and warp (see the photo at right on p. 70). Circulating air through the stack and supporting it at least 15 in. off the ground will prevent stain and decay.

How long it takes to bring wood to 15% to 20% MC depends on the species, thickness and weather. For example, 1-in.-thick white pine stacked outside between April and September takes about four weeks to dry to 20% MC. Pine boards 2 in. thick will take six to eight months in reasonably good weather. Red oak boards, 1 in. thick, stacked in the summer will dry to 20% MC in about eight weeks, and 2-in. red oak may take 1½ to two years.

A kiln controls the temperature, humidity and air flow, bringing the lumber to a uniform MC (see the top left photo on p. 70). This



Kilns season wood quickly and uniformly. Commercial kilns are capable of seasoning large quantities of wood.

Careful stickering, stacking and storage (right) yield highquality lumber. Air-drying is well-suited for small shops with a ready supply of native trees.

Properly stored wood (below) achieves equilibrium with the shop environment.



Checks, splits and twist occur when the drying process is rapid and uncontrolled.



environment prevents checks, splits and discoloration. Kiln temperatures range from 110° to 200°F and relative humidity ranges from 25% to nearly 100%. Drying times are much shorter when using a kiln. For example, 1-in.-thick pine dries from 120% MC to about 8% in 11 days, 2-in.-thick pine takes four weeks, 1-in.-thick red oak dries to about 8% in about a month, and 2-in.-thick red oak takes about three months.

If possible, control temperature and humidity

Old-time cabinetmakers stored their air-dried lumber in the shop, often in an overhead loft. Today's woodworker also should store dry lumber indoors. Ideally, lumber that will be made into furniture and cabinets should be stored where the temperature is between 68° and 70° and the relative humidity about 42%. These conditions will allow kiln-dried material to maintain an MC of about 8%. Additionally, this temperature range and humidity level will allow stock that's been air-dried to 20% MC or less to come into equilibrium at about 8% MC in eight to 10 weeks.

Wood should be stacked on a level surface. Air-dried stock will

equalize in MC faster when separated by uniformly placed stickers, which keep the stock flat as air gently circulates over the pieces. Do not store lumber on or close to a basement furnace or room heater because the humidity will be too low, causing excessive drying. The result will be shrinking and cracking.

Drying conditions affect wood's color

Air-dried lumber often has a grayish color from sunlight and oxidation. This easily can be surfaced off, leaving the wood bright. Kiln-dried green wood will maintain its bright color if the kiln temperature is kept below 160°.

When a species with natural sugars, such as maple or birch, must be kept as white as possible, kiln temperatures should not exceed 130° (except for a short period at 160° to relieve drying stress). When the sapwood in these woods looks dark, it is probably because kiln temperatures were above 170° for several days, which caramelized the sugars in the wood

Both air- and kiln-drying can cause a chemical gray stain in hard maple. Brown stain in white pine often begins in the air-drying stage, though invisible at that point. The stain is exposed when kiln-dried at temperatures above 130°. If maintaining color is of prime importance, properly controlled kiln-drying is the best method.

Check moisture before bending or gluing

For steam-bending wood, the method of drying prior to steaming is unimportant. Steam the wood at about 25% MC to make the material easier to bend and less likely to crack or buckle.

Cold-bending wood (as practiced by green-wood chairmakers, for example) requires less force if the stock is green. But 25% MC stock is better because wood that dry can still be bent yet can be pulled from the bending form much sooner than green wood.

Stock that will be used for glue-laminating requires that the wood be dried to the MC recommended by the glue manufacturer, generally between 6% and 12%. Kiln-drying is more likely to produce both the low MC and uniformity of moisture distribution this technique requires.

When gluing up boards, either face to face in a fiat lamination or as a wide panel, make sure all pieces have roughly the same MC. That will help the panel stay flat with its gluelines intact when put into service. At most, the difference in MC between individual pieces should be no more than two percentage points. It's also a good idea to make panels from lumber that is free of casehardening, a type of residual drying stress. Casehardening is not something that can be cured in your woodshop. But you can check for the problem (see the drawing at right).

Differences in finishing and workability

Some finishing materials, such as preservative stains and latex paints, are more tolerant of higher moisture, making them better suited to air-dried lumber. Lacquers and acrylics perform best if the wood has been dried to 6% to 8% MC. A special finishing problem occurs in species containing pitch (as in white pine and spruce). This natural material will bleed through most finishes if it's not set or crystallized. Setting pitch is done by subjecting the wood to a temperature of at least 165° for about 24 hours and should be done during the last stage of kiln-drying.

The drier the wood, the harder and stiffer it becomes, so air-dried stock can be worked somewhat more easily with hand tools than wood that has been kiln-dried to a lower MC. The ease of cutting air- or kiln-dried wood with power tools is, for practical purposes,

A shop test for casehardening

Casehardening, drying stress left in lumber after it has been kiln-dried, can affect the quality of glued-up panels. To check for the condition in stock up to 1½ in. thick, take a 1-in. sample off the end of a board, and cut out the center to create two prongs. For thicker material, create three prongs with a sawkerf at the middle of the sample. Prong movement, which occurs immediately, indicates casehardening.



the same. However, surface quality is dependent on MC. Wood machines best between 6% and 12% MC. Above 15% MC, wood fibers tend to spring back after the knife passes, leaving a fuzzy surface. Stock dried below 5% MC becomes brittle, and grain tearout may occur when planing the wood.

Relocating cabinetry and furniture

Moisture content should match the humidity of the place where the piece of furniture will be used. With the wood air-dried to 15% MC, a cabinet made in a shop located on the sea coast that is then shipped to Tucson, Ariz., is very likely to develop cracks and loose joints. Conversely, a cabinet made in Tucson with wood air-dried to 6% to 8% MC would behave fine in the heated coastal home in the winter, but drawers and doors would swell and stick in the humid summer atmosphere.

Dr. William W. Rice is a drying consultant and retired professor of wood technology at the University of Massachusetts. He lives in Amherst, Mass.