WOODSENSE

When it comes to wood, getting a grip on the terminology starts with a thorough understanding of wood's properties.

By Udo Schmidt

IS IT HARDWOOD, HEARTWOOD OR JUST HARD WOOD?

Whether woodworking is a favorite pastime or a challenging business, one thing we can all do without is the confusing terminology surrounding the core material we use: the wood itself. As woodworkers, it is important to understand the materials we work with even if most of the time it doesn't matter if we use evergreen or hardwood for a project. Some projects demand certain characteristics from wood, and in those cases it's essential to know which woods have which characteristics.

hardwood

The terms "hardwood" and "softwood" can be misleading, since hardwoods are not always hard and softwoods are not always soft. In fact, the world's lightest and heaviest woods are both considered hardwoods even though it takes 45 cu. ft. of the lightest wood to equal just a single cubic foot of the heaviest wood.

Scientifically, hardwoods belong to the group *angiosperms* which means "covered seeds," while softwoods belong to the *gymnosperms*, which means "naked seeds." In other words, the real difference between hardwood and softwood is the way the tree reproduces, not the actual hardness of the wood. Other terms used are evergreen for softwoods and deciduous for hardwoods. Although conifer is a classification in *gymnosperms*, and most are needle-leaf evergreens, some of them aren't –

PHOTOS: UDO SCHMIDT

OAK IS WIDELY USED, *especially for cabinetry. Available oak boards are mostly heartwood; visible sapwood is generally cut out or stained to match the heartwood.*

in spite of the name – green forever. The bald cypress is a good example; this tree sheds its needles like other deciduous trees, hence its name "bald." (The bald cypress is a true odd duck; see sidebar "Master of Confusion" on page 73.) But the live oak – a tree with very hard wood – is considered an evergreen because it replaces its leaves gradually. Another interesting species is ginkgo biloba, the same tree the herb comes from. Classified as a gymnosperm or softwood, this Asian native tree is deciduous and has broad leaves that change to a yellow color in the fall.

Microscopically, softwoods have a simpler cell structure than hardwoods; 90 percent of softwood cells are of a single cell type. These cells are *longitudinal tracheas* and function for support and water transport. The other 10 percent of softwood cells consist of *ray parenchyma*, which serve as food storage.

Hardwood fibers, meanwhile, are three to eight times smaller than softwood cells. The cells, which conduct water in hardwoods, are called vessels. These cells are seen as pores in cross sections and are highly distinguished in certain species like oak. Wood primarily consists of thick-walled support cells called fibers. Like softwoods, hardwoods have parenchyma cells. They are also food storage cells and live in the sapwood portion of the tree.

heartwood

In a living tree, the heartwood is for support and doesn't conduct water or store food. In contrast, sapwood contains both living and dead cells, and transports water and nutrients from the roots to the leaves. The thickness of the sapwood varies greatly among species, from only ½" in black locust up to 6" in hickory and maple. After several years of growth, the cells become inactive and increase extractive content like resins, gums and tannins and become heartwood. Heartwood is usually darker in color than sapwood because of this higher level of extractives, which also make the heartwoods of some species highly resistant to decay. Meanwhile, all sapwood has very little resistance to decay.

In woodworking, the color difference between sapwood and heartwood can be used to create contrast. For example, it often gives hickory character. However, if a uniform color is desired, as with cherry, the sapwood portion of the tree needs to be cut out, or stained or dyed to match the rest of the wood.

Special consideration is necessary if boards containing both heartwood and sapwood are used in cabinetmaking. The sapwood part will absorb and give off moisture faster than the heartwood, making these pieces more susceptible to warping.

HICKORY IS COMMONLY USED *with a mix of sapwood and heartwood boards.*

Heart pine is a wood traded with very little clarification of what it actually is. According to the Southern Pine Inspection Bureau, true heart-pine boards are cut from the slash pine (*Pinus elliottii*) and the longleaf pine (*Pinus palustris*). As the name implies, the face side of the boards should be all heartwood, showing only the reddish color without the lighter sapwood. New lumber is traded as *new heart pine*. *Antique heart pine* is reclaimed from old buildings or salvaged from river or lake bottoms. This wood is usually very dense and heavy due to its very

TRUE HEART PINE *should not have any sapwood, but the patina of this old wood makes it popular for flooring and millwork. Most people like the contrast between the reddish heartwood and the much lighter sapwood.*

slow growth – it's virgin timber – but is not necessarily all heartwood or cut from the abovementioned species.

hard wood

The density – or hardness – of wood is measured by its mass per unit of volume. Specific gravity is the ratio of a material's density to that of water, and is an abstract number of independent units. The mass of water is 1000kg/m^3, which is one kilogram per cubic meter or 62.43 lbs. per cubic foot. Specific gravity is a good indicator of a species' properties for mechanical engineering, its drying properties, and its weight. When drying wood, the maximum water a species can hold is calculated based on specific gravity, and unusual properties of wood can be detected by measuring the specific gravity. For instance, reaction wood can have 40 percent higher density values than normal growth wood and juvenile wood has a lower density than mature wood.

It is interesting to note that wood substance has a higher specific gravity than water. The actual substance which wood is composed of, the cell walls, has a specific gravity of 1.5, independent of species. However, due to cell cavities, pores and other openings in the wood's structure, a species-specific gravity will drop below that point. That also means that the heaviest and densest cannot have a specific gravity above 1.5. South African ironwood, a member of the olive family, has been recorded with a specific gravity of 1.49 and according to the *Guinness Book of World Records*, is considered the world's heaviest wood. One board foot of this wood weighs more than 7½ lbs., compared to red oak, which has an average weight of 3½ lbs. per board foot at 12 percent moisture content. The world's lightest wood, *Aeschynomene hisidia*, ironically is classified as a hardwood and weighs only 2 lbs. per cu. ft., or just a little more than 2½ oz. per board foot. On a more domestic level, live oak is one of the heavier woods of the commercial species in North America with an average specific gravity of .81, while western red cedar is one of the lighter woods with a specific gravity of .31.

The specific gravity of wood varies with moisture content because wood is hygroscopic, meaning that it absorbs or loses water depending on the surrounding temperature and humidity conditions. With a change of moisture content below the fiber-saturation point, wood will also change dimensions by either swelling or shrinking. Because of the different dimensions at various levels of moisture content, the specific gravity is determined at a precise moisture content. For engineering and general woodwork, the specific gravity of a species is given at a moisture content of 12 percent.

Growth rings can indicate valuable information to the woodworker. The quality of wood is the relationship between earlywood and latewood. In softwoods, slow-growing trees have smaller-spaced growth rings and a higher proportion of denser latewood. This makes slow-growing softwood more stable and dense. It is also heavier due to a higher number of thick-walled latewood cells. Ring-porous hardwoods, such as the slow-growing oaks, have a greater amount of large-pore earlywood. This makes their wood less dense and softer, but like the softwood, more stable and easier to work. Fast-growing hardwood trees have a larger concentration of latewood, with its thick-walled cells, making the wood heavier, denser and, obviously, harder.

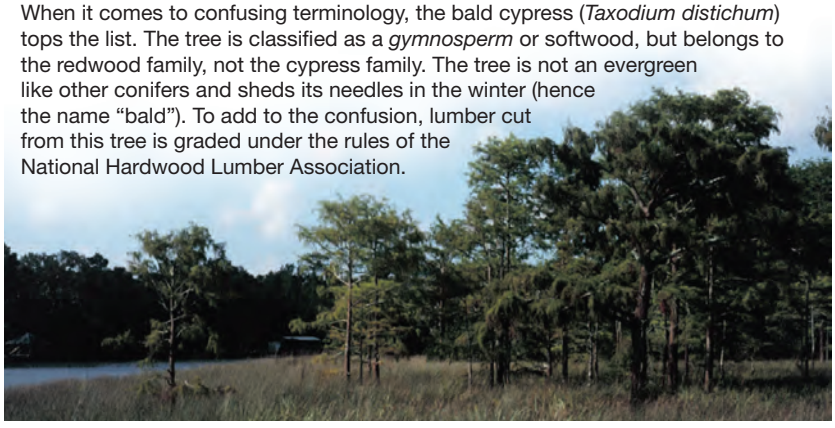
THE STORIES TOLD *by growth rings can be valuable to the woodworker and his craft.*

This is the reason virgin timber is so highly valued. In the virgin forest, trees struggled for light, nutrients and water, making them grow slowly. It was not uncommon for these trees to have 30-50 growth rings per inch.

Lumber cut from virgin logs is extremely stable. The softwoods are hard and dense and the hardwoods are soft with finely grained wood of unsurpassed quality. Virgin timber today only exists in national parks and forests, and is not subject to logging. Fortunately, virgin lumber is becoming available again through salvage companies. These companies specialize in salvage operations to recover wood from old buildings or the sunken barges and rafts from river and lake beds.

Bald cypress – Master of confusion

When it comes to confusing terminology, the bald cypress (*Taxodium distichum*) tops the list. The tree is classified as a *gymnosperm* or softwood, but belongs to the redwood family, not the cypress family. The tree is not an evergreen like other conifers and sheds its needles in the winter (hence the name "bald"). To add to the confusion, lumber cut from this tree is graded under the rules of the National Hardwood Lumber Association.

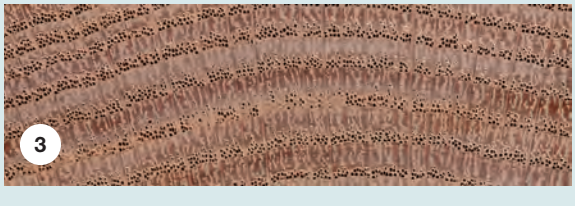


... and furthermore

SOFTWOOD

Softwoods consist mostly of one-cell structures, the tracheids. At the beginning of the growing season cells have to transport a lot of water and nutrients, so the cells formed have thin walls with large cavities. These cells are called *earlywood* or *springwood*. As the growing season continues, less water is needed and the cells form with thicker walls and smaller cavities. These cells are called *latewood*. Because of the higher density, latewood has a darker color than earlywood **(Fig. 1)**. The transition from earlywood to latewood can be gradual or abrupt, but the change from the end of one growing season to the beginning of the next is clearly visible. One growing season is made up of one band of earlywood and one band of latewood. Under normal conditions, a growing season is from spring to summer or early fall. It is possible for a tree to have multiple growth rings or skip a growth ring altogether. But usually, we can say that one growth ring represents one year of tree life.

HARDWOOD



Hardwoods are separated into "ring-porous" and "diffuse-porous". Ring-porous wood, such as oak, begins the growing season with a ring of large-cavity cells for water and nutrient conduction. Latewood cells are much smaller and distinguished from the earlywood cells, forming – like in the softwoods – a growth ring with a band of earlywood and a band of latewood. Most hardwoods are diffuse-porous, however. If the pores are evenly distributed and relatively the same size, as in yellow birch, distinguishing growth rings is difficult. Other species like cherry produce an extra ring of pores in the earlywood, or a line of terminal parenchyma cells, like in yellow poplar, clearly forming the transition from one growing season to the next. Tropical woods are interesting in that they grow in a climate without seasons. For them, a growing season isn't relevant to a single year, even though some subtropical species like Brazilian cherry **(Fig. 2)**, a diffuse-porous species, show distinguished growth rings brought on by the regularly occurring rainy seasons. Ring-porous hardwood like oak **(Fig. 3)**, a slow-growing tree, has a greater amount of large-pore earlywood.

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