

Hardwood Lumber and Veneer Series



White Oak

FNR-292-W

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White oak is truly the all American wood. Dense, strong, durable, and from a long-lived tree, it welcomed the settlers to the east coast. It was used for durable bottom logs in cabins, ships, and most importantly for wagons. As a major component of wagon wheels and other high-strength parts, it carried the settlers even further west and supplied both the North and South with the means to transport artillery and other heavy items used in the Civil War. As the country continued to develop, the last of the old growth timber was sawed into quartered and rift white oak. It was used for the Arts and Crafts movement and Mission Style furniture and to decorate railroad passenger cars. Quartered and rift oak was an important point of contention in the creation of the National Hardwood Lumber Association (NHLA). Today, white oak remains a valuable timber species for both decorative and industrial applications. The time honored phrase, "solid as the oak is our own USA" surely refers to this species.

"White Oak" is a term used in the lumber trade that refers to a category of lumber that may contain as many as eight different eastern species of trees. Several additional, mostly non-commercial species, are found in the west.

The multiple species that comprise the white oak lumber category grow in various locations throughout the eastern United States (see Table 1). The first species listed in the table is the preferred one and constitutes three quarters of all the white oak lumber produced. It ranges from the great plains east except the gulf coastal plains and the far northeastern



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White oak tree and Dan Cassens

states. Trees with particularly large plates of flaky bark are some-times referred to as forked-leaf white oak. There are other white oak species, only about one-half of which are significant in the lumber trade. Bur oak is common in both bottomlands and in prairie regions. Its wood is usually a darker brown in color and the wood grain sometimes has a scalloped

appearance. Chinkapin oak can produce good quality lumber, but it is irregular in occurrence. The wood may have a very light greenish tint. Several other species can be developed into saw-log size material, but the yield of high-grade lumber may be less than the more preferred species.

Wood Color and Texture

White oak wood color can vary from a very light straw color, which is currently preferred, to a brown color. The wood can also be mottled with gray. Occasionally, slow growth old trees will produce boards with a pink color, very similar to red oak.

White oak lumber has a very characteristic showy, coarse grain pattern just somewhat more subdued than red oak. White oak is ring porous, which means that in the spring of the year it produces very large diameter pores that are visible to the naked eye. At some point during the growing season, it abruptly begins to produce very small diameter, thick-walled pores. The result is alternating layers of coarse and fine textured wood. The pores of the heartwood are also filled with tyloses making the wood impermeable. On a freshly cut surface, the tyloses in the pores will glisten as light reflects off their surface.

All of the oaks have very large wood rays. In fact, these rays are the largest of any North American commercial lumber species. When oak is flat sawn, only the ends of the rays are exposed, and they are relatively inconspicuous in comparison to the large pores. When the lumber is quarter sawn, the boards are cut on a radius from the pith, or very center of the tree, to the bark. The saw is cutting parallel to the large wood rays, and a very characteristic splotchy pattern results. The rays may average 1¼ inches tall. Rift cut oak results when the rays are intersected at a 45° angle. In this situation, the ends of the rays appear somewhat larger than in flat sawn lumber; but more importantly, the wood appears pencil stripped as the alternating large earlywood pores run parallel to the small dense latewood pores. The industry prefers to sell quartered and rift cut oak together. Quartered and rift oak was commonly used in Mission Style furniture and during the Arts and Crafts period. The appearance is strictly different than that of flat-sawn oak.

Workability

White oak is rated as one of the very best woods for planing, shaping, turning, and boring. It is a hard wood but tends to cut clean without tearing or fuzzing.

Strength

At 12 percent moisture content, white oak will weigh about 47 pounds per cubic foot making it the heaviest lumber species next to hickory. With the exception of bur oak, which is somewhat weaker, it is one of our strongest species.

White oak has excellent mechanical or strength properties. These properties can vary somewhat by species. Considering failure in bending (MOR) and shear strength, the values for true white oak are considerably higher than Douglas fir or loblolly pine. In bending, or MOE, the three species are about equal. However, the wood of white oak is much heavier and harder to nail than that of Douglas fir and southern pine.

Steam Bending

In a U.S. Forest Products Laboratory study, white oak is rated one of the very best woods for bending.

Drying

White oak lumber is difficult to dry, and a mild kiln schedule must be used. Freshly cut lumber can surface check within a day or less when exposed to the hot summer sun or when air drying proceeds too rapidly. Later in the drying process, internal checks, or honeycomb, can develop if the process proceeds too rapidly. Honeycomb usually occurs in the dry kiln, but it can occur on the air drying yard as well. Commercial producers are aware of these drying problems and follow procedures to avoid them.

Shrinkage

As one of our heaviest woods, white oak also has the highest shrinkage next to hickory. However, once properly dried and placed in a stable environment, the wood should have little movement.

Decay Resistance

Depending on species, white oaks are rated as resistant or very resistant to moderately resistant to decay. True white oak and bur oak are considered durable, and the wood has had specific applications because of this attribute.

Table 1. Scientific and common names, range, and preferred sites for white oak species growing in the eastern United States

| Common and Scientific Names | Range | Site | Comments |
|--|--|--------------------------------|---|
| White oak <i>Quercus alba</i> L. | States bordering the west side of the Mississippi River and then east and S. Canada | Uplands | Premier species |
| Bur oak <i>Q. macrocarpa</i> Mickx. | E. great Plains and E. to Appalachians except southeastern United States, also in S. Canada | Uplands and bottomlands | Acceptable species but wood is dark colored |
| Overcup oak <i>Q. lyrata</i> Walt. | Lower Mississippi and Ohio River bottoms, portions of Atlantic and Gulf coastal states | Bottomlands | Poor species |
| Post oak <i>Q. stellata</i> Wangenh. | Southern portions of eastern and central states and south and then southwest into Texas, Oklahoma, and S.E. Kansas | Dry uplands | Poor species |
| Swamp chestnut oak <i>Q. michauxii</i> Nutt. | Lower Mississippi and Ohio River bottoms and east and south of Appalachian Mountains | Well drained bottomlands | Good southern species |
| Chestnut oak <i>Q. prinus</i> L. | Northeastern states south to Alabama and Georgia west to southern tip of Illinois | Dry uplands sites | Usually poor |
| Swamp white oak <i>Q. bicolor</i> Willd. | Northern half of eastern United States | Stream banks and swamp margins | Usually poor |
| Chinkapin <i>Q. muehlenbergii</i> Engelm | Eastern United States except Atlantic coast and most of the immediate gulf coastal plains | Uplands and bottomlands | Quality depends on site |

Commercial Use, Grading, and Value

White oak closely parallels red oak in most characteristics but has some additional attributes. White oak constitutes about 15 percent of the lumber cut. Together with red oak, these two species groups account for 48 percent of all hardwood lumber produced.

White oak is preferred for interior decorative applications ranging from furniture (especially church furniture), cabinets, millwork, and caskets to hardwood flooring. It is also a very dense strong wood making it a favorite for industrial applications such as railroad ties; mine timbers; pallets; blocking; industrial, agricultural, and truck flooring; and others. As a naturally durable wood, it is also used where this attribute is important. Examples include fence posts, fence boards, sill plates, trailer beds, mine timbers, and railroad ties. Old time uses for white oak include wagon wheels and bottom logs on cabins where rain water splash and subsequent decay create problems.

White oak is the one hardwood species group produced in large quantities of naturally durable lower grade material, which could be used for some construction purposes. There is also a separate price schedule in the Appalachian region where worm

holes are not considered a defect (WHND). The material is low cost and often specified where the strength and durability of oak is needed but a defect free appearance is not required.

Tyloses block the vessels in white oak to any liquid movement making the wood impenetrable to preservatives. Therefore, one unique use of white oak is for tight cooperage such as whiskey barrels and wine casks. Red oak, which normally lacks or has limited tyloses, is not used for tight cooperage, but treats well with liquid preservatives.

White oak lumber when sold as flat-sawn stock is graded standard with the exception that some mineral stain is allowed; but when excessive, it will reduce a board one grade only. When quarter sawn, the minimum board width is reduced from 6 to 5 inches wide.

White oak, in the wholesale market, is usually priced somewhat less than red oak but still considered a valuable species. Veneer quality logs and lumber are commonly exported to Europe as a substitute for European white oak.

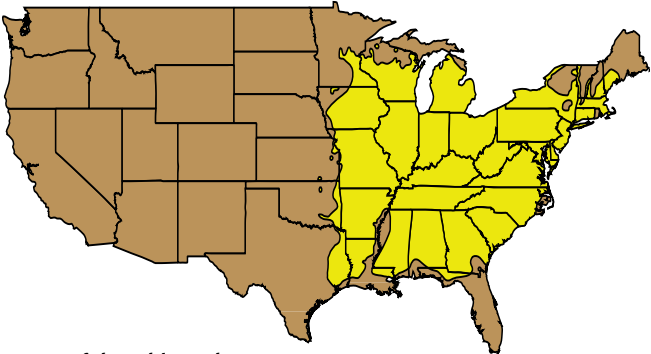
Quarter- and rift-sawn white oak is a specialty item and commands a substantial premium compared to standard lumber.

Hardwood Lumber – White Oak

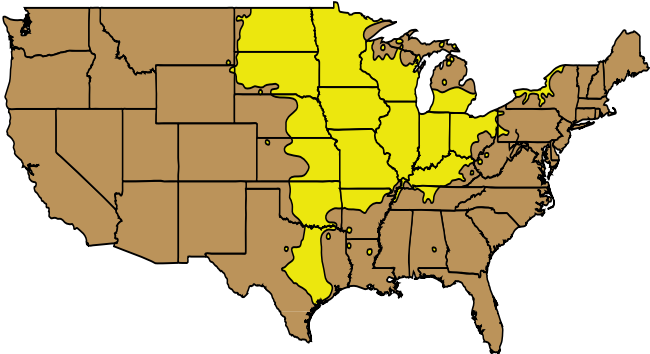


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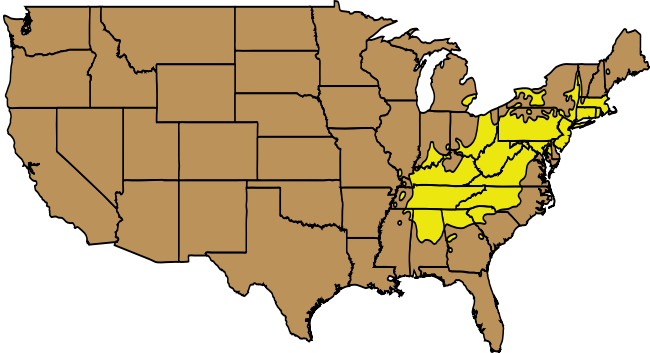
Quartered white oak flooring



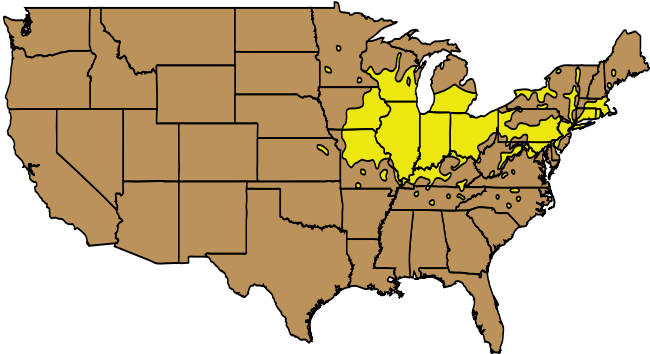
Range of the white oak



Range of the bur oak



Range of the chestnut oak



Range of the swamp white oak



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White oak is very similar to red oak but usually much lighter in color. However, in some older slow-growth trees the boards can have a pinkish color, and they are difficult to separate by sight from red oak. The pores in white oak heartwood are totally packed with tyloses. Upon close examination of well-machined sawn faces or end grain, the tyloses will sometimes glisten in the light. The grain pattern in white oak is somewhat more muted than in red oak due to a typically slower growth rate and the pores being filled with tyloses in white oak.

Board 1 represents a wide perfectly flawless flat sawn sample of white oak. The growth rings are easily discernable as “U” or “V” shaped lines. Board 2 shows a very strong ray fleck, and it is called quartered white oak. The growth rings can be seen as parallel lines running from top to bottom of the board. In rift oak, the growth rings appear as parallel lines running along the length of the piece and no

ray fleck is evident. The left one-third of Board 1 is typical of rift white oak. For a detailed explanation of flat sawn, quartered and rift oak, see the “Wood Color and Texture” section on page 2.

Boards 3 and 4 are more typical of average sawn white oak lumber. Board 3 shows white sapwood along both edges of the piece. Board 4 is dark and mixed in color. It also shows mostly small tight or pin knots. Pin knots or clusters of pin knots are common in white oak.

Board 5 shows a large round grub hole toward the top of the piece and an oblong scar also from grub damage along with numerous knots. Some mineral stain or discoloration occurs around the grub holes. Older and stressed trees are subject to bore damage. Lumber from these trees can have small bore damage called pin and shot holes, but these are not shown here. Several deep cracks are also evident.