



## Quercus spp.

**Family: Fagaceae**

### **Oak**

Worldwide, the oaks (*Quercus* spp.) consist of 275 to 500 species that can be separated into three groups based on their microanatomy: the live or evergreen oak group, the red oak group (*Erythrobalanus*), and the white oak group (*Leucobalanus*). Species within each group look alike microscopically. The word *quercus* is the classical Latin name of oaks, said to be derived from Celtic fine and tree.

The commercial North American species are as follows:

#### **Red Oak Group (*Erythrobalanus*)**

*Quercus coccinea*-bastard oak, black oak, buck oak, red oak, **scarlet oak**, Spanish oak, spotted oak

*Quercus falcata*-American red oak, bottomland red oak, **cherrybark oak**, Elliott oak, red oak, Spanish oak, **southern red oak**, swamp red oak, swamp spanish oak, turkeyfoot oak, water oak

*Quercus kelloggii*-black oak, **California black oak**, Kellogg oak, mountain black oak

*Quercus laurifolia*-Darlington oak, diamond-leaf oak, **laurel oak**, laurel-leaf oak, swamp laurel oak, water oak, obtusa oak

*Quercus nigra*-American red oak, blackjack, pin oak, possum oak, punk oak, red oak, spotted oak, **water oak**

*Quercus nuttallii*-**nuttall oak**, pin oak, red oak, red river oak, striped oak

*Quercus palustris*-**pin oak**, red oak, Spanish oak, Spanish swamp oak, Spanish water oak, swamp oak, swamp Spanish oak, water oak

*Quercus phellos*-black oak, laurel oak, peach oak, pin oak, red oak, swamp willow oak, water oak, **willow oak**, willow swamp oak

*Quercus rubra*-American red oak, black oak, buck oak, Canadian red oak, common red oak, gray oak, eastern red oak, leopard oak, Maine red oak, mountain red oak, **northern red oak**, red oak, Spanish oak, spotted oak, southern red oak, swamp red oak, water oak, West Virginia soft red oak

*Quercus shumardii*-American red oak, Schneck oak, Schneck red oak, **shumard oak**, Shumard red oak, southern red oak, spotted bark, spotted oak, swamp red oak, Texas oak, Texas red oak

*Quercus velutina*-American red oak, blackjack, **black oak**, dyer oak, jack oak, quercitron, quercitron oak, redbush, red oak, smoothbark oak, spotted oak, tanbark oak, yellowbark, yellow oak, yellowbark oak

### **White Oak Group (*Leucobalanus*)**

*Quercus alba*-American white oak, Arizona oak, Arizona white oak, forked-leaf white oak, Louisiana white oak, mantua oak, ridge white oak, stave oak, true white oak, West Virginia soft white oak, **white oak**

*Quercus bicolor*-blue oak, cherry oak, curly swamp oak, swamp oak, **swamp white oak**, white oak

*Quercus garryana*-Brewer oak, Garry oak, Oregon oak, **Oregon white oak**, Pacific post oak, Pacific white oak, post oak, prairie oak, shin oak, western oak, western white oak, white oak

*Quercus lyrata*-American white oak, **overcup oak**, swamp post oak, swamp white oak, water white oak

*Quercus macrocarpa*-blue oak, **bur oak**, burr oak, mossycup oak, mossy-overcup oak, overcup oak, scrub oak, white oak, white mossycup oak, white overcup oak

*Quercus michauxii*-American white oak, basket oak, cow oak, swamp oak, **swamp chestnut oak**

*Quercus muehlenbergii*-chestnut oak, **chinkapin oak**, chinquapin oak, dwarf chestnut oak, dwarf chinkapin, pin oak, rock oak, rock chestnut oak, running white oak, scrub oak, shrub oak, white oak, yellow oak, yellow chestnut oak

*Quercus prinus*-American white oak, basket oak, **chestnut oak**, chestnut rock oak, chestnut swamp oak, cow oak, mountain oak, rock oak, rock chestnut, rock chestnut oak, swamp oak, tanbark oak, white oak, white chestnut oak

*Quercus stellata*-American post oak, barren white oak, bastard oak, bastard white oak, box oak, box white oak, brash oak, Delta post oak, Durand oak, iron oak, pin oak **post oak**, ridge oak, rough oak, rough white oak, southern oak, turkey oak, white box oak, white oak

### **Live Oak Group**

*Quercus virginiana*-dwarf live oak, encino, **live oak**, rolfs oak, scrub live oak, Virginia live oak, Virginia oak

Distribution

Widely distributed throughout the United States.

The Tree

Oaks can reach a height of 125 ft (38 m), with large diameters.

## The Wood

### General

The sapwood of oak is white to very light brown, while the heartwood is light to dark brown in the white oak group and reddish brown in the red oak group. Oak wood has a coarse texture; it is heavy, straight-grained, hard, tough, very stiff, and strong. Fast-grown oak, with wide rings, is stronger and heavier than slow-grown oak.

### Mechanical Properties (2-inch standard)

	Specific gravity	MOE X10 <sup>6</sup> lbf/in <sup>2</sup>	MOR lbf/in <sup>2</sup>	Compression		WML <sup>a</sup> in-lbf/in <sup>3</sup>	Hardness lbf	Shear lbf/in <sup>2</sup>
				Parallel lbf/in <sup>2</sup>	Perpendicular lbf/in <sup>2</sup>			
<b>Red Oak Group</b>								
<b><i>Quercus coccinea</i> (scarlet oak)</b>								
Green	0.60	1.48	10,400	4,090	830	15.0	1,200	1,410
Dry	0.67	1.91	17,400	8,330	1,120	20.5	1,400	1,890
<b><i>Quercus falcata</i> (southern red oak)</b>								
Green	0.71	1.14	6,900	3,030	550	8.0	860	930
Dry	0.52	1.49	10,900	6,090	870	9.4	1,060	1,390
<b><i>Quercus falcata</i> var. <i>pagodifolia</i> (cherrybark oak)</b>								
Green	0.61	1.79	10,800	4,620	760	14.7	1,240	1,320
Dry	0.68	2.28	18,100	8,740	1,250	18.3	1,480	2,000
<b><i>Quercus laurifolia</i> (laurel oak)</b>								
Green	0.56	1.39	7,900	3,170	570	11.2	1,000	1,180
Dry	0.63	1.69	12,600	6,980	1,060	11.8	1,210	1,830
<b><i>Quercus nigra</i> (water oak)</b>								
Green	0.56	1.55	8,900	3,740	620	11.1	1,010	1,180
Dry	0.63	2.02	15,400	6,770	1,020	11.8	1,210	2,020
<b><i>Quercus palustris</i> (pin oak)</b>								
Green	0.58	1.32	8,300	3,680	720	14.0	1,070	1,290
Dry	0.63	1.73	14,000	6,820	1,020	14.800	1,510	2,080
<b><i>Quercus phellos</i> (willow oak)</b>								
Green	0.56	1.29	7,400	3,000	610	8.8	980	1,180
Dry	0.69	1.90	14,500	7,040	1,130	14.6	1,460	1,650
<b><i>Quercus rubra</i> (northern red oak)</b>								
Green	0.56	1.35	8,300	3,440	610	13.2	1,000	1,210

Dry	0.63	1.82	14,300	6,760	1,010	14.5	1,290	1,780
<b><i>Quercus velutina</i> ( black oak)</b>								
Green	0.56	1.18	8,200	3,470	710	12.2	1,060	1,200
Dry	0.61	1.64	13,900	6,520	930	13.7	1,210	1,910

**Mechanical Properties-continued**

	Specific Gravity	MOE X10 <sup>6</sup> lbf/in <sup>2</sup>	MOR lbf/in <sup>2</sup>	Compression		WML <sup>a</sup> in-lbf/in <sup>3</sup>	Hardness lbf	Shear lbf/in <sup>2</sup>
				Parallel lbf/in <sup>2</sup>	Perpendicular lbf/in <sup>2</sup>			
<b>White Oak Group</b>								
<b><i>Quercus alba</i> (white oak)</b>								
Green	0.60	1.25	8,300	3,560	670	11.6	1,060	1,250
Dry	0.68	1.78	15,200	7,440	1,070	13.7	1,210	1,910
<b><i>Quercus bicolor</i> (swamp white oak)</b>								
Green	0.64	1.59	9,900	4,360	760	14.5	1,160	1,300
Dry	0.72	2.05	17,700	8,600	1,190	14.8	1,360	2,000
<b><i>Quercus garryana</i> (Oregon white oak)</b>								
Green	0.64	–	–	–	–	–	–	–
Dry	0.72	–	–	–	–	–	–	–
<b><i>Quercus lyrata</i> (overcup oak)</b>								
Green	0.57	1.15	8,000	3,370	540	12.6	960	1,320
Dry	0.63	1.42	12,600	6,200	810	15.7	1,190	2,000
<b><i>Quercus macrocarpa</i> (bur oak)</b>								
Green	0.58	0.88	7,200	3,290	680	10.7	1,110	1,350
Dry	0.64	1.03	10,300	6,060	1,200	9.8	1,370	1,820
<b><i>Quercus michauxii</i> (swamp chestnut oak)</b>								
Green	0.60	1.35	8,500	3,540	570	12.8	1,110	1,260
Dry	0.67	1.77	13,900	7,270	1,110	12.0	1,240	1,990
<b><i>Quercus prinus</i> (chestnut oak)</b>								
Green	0.57	1.37	8,000	3,520	530	9.4	890	1,210
Dry	0.66	1.59	13,300	6,830	840	11.0	1,130	1,490
<b><i>Quercus stellata</i> (post oak)</b>								
Green	0.60	1.09	8,100	3,480	860	11.0	1,130	1,280
Dry	0.67	1.51	13,200	6,600	1,430	13.2	1,360	1,840
<b>Live Oak Group</b>								
<b><i>Quercus virginiana</i> ( live oak)</b>								
Green	0.80	1.58	11,900	5,430	2,040	12.3	–	2,210

Dry            0.88            1.98            18,400            8,900            2,840            18.9            –            2,660

<sup>a</sup>WML = Work to maximum load.

Reference (59, 98).

### Drying and Shrinkage

Type of shrinkage	Percentage of shrinkage (green to final moisture content)		
	0% MC	6% MC	20% MC
<b>Red Oak Group</b>			
<b><i>Quercus coccinea</i> (scarlet oak)</b>			
Tangential	10.8	7.8	3.2
Radial	4.4	3.7	1.5
Volumetric	14.7	11.0	4.6
<b><i>Quercus falcata</i> (southern red oak)</b>			
Tangential	11.3	–	–
Radial	4.7	–	–
Volumetric	16.1	–	–
<b><i>Quercus falcata</i> var. <i>pagodifolia</i> (cherrybark oak)</b>			
Tangential	10.6	–	–
Radial	5.5	–	–
Volumetric	16.1	–	–
<b><i>Quercus laurifolia</i> (laurel oak)</b>			
Tangential	9.9	–	–
Radial	4.0	–	–
Volumetric	19.0	–	–
<b><i>Quercus nigra</i> (water oak)</b>			
Tangential	9.8	7.4	3.1
Radial	4.4	3.4	1.4
Volumetric	16.1	13.1	5.5
<b><i>Quercus palustris</i> (pin oak)</b>			
Tangential	9.5	7.6	3.2
Radial	4.3	3.4	1.4
Volumetric	14.5	11.6	4.8
<b><i>Quercus phellos</i> (willow oak)</b>			

Tangential	9.6	–	–
Radial	5.0	–	–
Volumetric	18.9	–	–
<b><i>Quercus rubra</i> (northern red oak)</b>			
Tangential	8.6	6.6	2.7
Radial	4.0	3.2	1.3
Volumetric	13.7	10.8	4.7
<b><i>Quercus velutina</i> ( black oak)</b>			
Tangential	11.1	7.8	3.2
Radial	4.4	3.6	1.5
Volumetric	15.1	11.4	4.7

Drying and Shrinkage-continued

Type of shrinkage	Percentage of shrinkage (green to final moisture content)		
	0% MC	6% MC	20% MC
<b>White Oak Group</b>			
<b><i>Quercus alba</i> (white oak)</b>			
Tangential	10.5	7.2	3.0
Radial	5.6	4.2	1.8
Volumetric	16.3	12.6	5.3
<b><i>Quercus bicolor</i> (swamp white oak)</b>			
Tangential	–	–	–
Radial	–	–	–
Volumetric	–	–	–
<b><i>Quercus garryana</i> (Oregon white oak)</b>			
Tangential	–	–	–
Radial	–	–	–
Volumetric	–	–	–
<b><i>Quercus lyrata</i> (overcup oak)</b>			
Tangential	12.7	–	–
Radial	5.3	–	–
Volumetric	16.0	–	–
<b><i>Quercus macrocarpa</i> (bur oak)</b>			

Tangential	8.8	7.0	2.9
Radial	4.4	3.5	1.5
Volumetric	12.7	10.2	4.2

***Quercus michauxii* (swamp chestnut oak)**

Tangential	10.8	8.6	3.6
Radial	5.2	4.2	1.7
Volumetric	16.4	13.1	5.5

***Quercus prinus* (chestnut oak)**

Tangential	10.8	7.8	3.2
Radial	5.3	4.4	1.8
Volumetric	16.4	13.4	5.6

***Quercus stellata* (post oak)**

Tangential	9.8	7.8	3.3
Radial	5.4	4.3	1.8
Volumetric	16.2	13.0	5.4

**Live Oak Group**

***Quercus virginiana* ( live oak)**

Tangential	9.5	7.6	3.2
Radial	6.6	5.3	2.2
Volumetric	14.7	13.0	5.4

References: 0% MC (98),  
6% and 20% MC (90).

**Kiln Drying Schedules<sup>a</sup>**

Condition	Stock				
	4/4, 5/4, 6/4	8/4	10/4	12/4	16/4
	<b>Western oaks<sup>b</sup></b>				
Standard	T3-B1	T3-B1	–	–	–
	<b>Upland red oaks<sup>c</sup></b>				
Standard	T4-D2	T3-D1	T3-C1	T3-C1	
	<b>Lowland red oaks<sup>d</sup></b>				
Standard	T2-C1	Table 113	–	–	–
	<b>Upland white oaks<sup>e</sup></b>				
Standard	T4-C2	T3-C1	T3-B1	T3-B1	–
	<b>Lowland white oaks<sup>f</sup></b>				
Standard	T2-C1	Table 113	–	–	–

<sup>a</sup>References (6, 86).

<sup>b</sup> California black, Oregon white, canyon live.

<sup>c</sup>Black, blackjack, cherrybark, northern pin, northern red, scarlet, Shumard, southern red, turkey, water.

<sup>d</sup>Cherrybark, laurel, nuttall, pin, Shumard, water, willow.

<sup>e</sup>Blue, bur, chestnut, chinkapin, Emory, Gambel, Mexican blue, post, white.

<sup>f</sup>Bur, live, overcup, swamp chestnut, swamp white, white.

**Working Properties:** Oak wood has good working properties. It machines and glues well and holds fasteners extremely well. It tends to split when nailed, unless predrilled. Oak finishes well, but shrinks considerably.

**Durability:** The oaks are rated with respect to resistance to heartwood decay as follows (98):

Very resistant--bur oak, chestnut oak, Gambel oak, Oregon oak, post oak and white oak

Moderately resistant--swamp chestnut oak

Slightly to nonresistant--black oak and red oak

**Preservation:** The heartwood of the white oak group is resistant to impregnation with preservatives, whereas that of the red oak group is more easily penetrated.

**Uses:** Ships, railroad crossties, timber bridges, tannin dyes, fuel wood, hardwood dimensions and flooring, furniture, veneer, plywood, barrels, kegs and casks (white oak group), truck and trailer beds, mining timbers, containers, pallets, caskets, boxes, paneling.

**Toxicity:** May cause allergic bronchial asthma, rhinitis, and dermatitis (40, 64, 105).

#### Additional Reading and References Cited (in parentheses)

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