

*Madison, Wisc.*

## VENEER CUTTING AND DRYING PROPERTIES

TANOAK

Tanoak or white bark oak (Lithocarpus densiflorus (Hook. & Arn.) Rehd.) is the most abundant hardwood species found in the coast ranges of California and southwest Oregon (12). <sup>1</sup> The tree occurs from sea level to 5,000 feet (5). On favorable sites, forest-grown tanoak trees have clear, straight boles for considerable heights. Mature trees are 70 to 90 feet tall and 2 to 4 feet in diameter (11).

The wood is hard, heavy, and strong (1). The strength of tanoak is nearly equal to that of the best true oaks (Quercus spp.) (9). The heartwood is light brown tinged with red, and its formation is believed to be due to fungal infection. On the logs cut at the Forest Products Laboratory, the heartwood zone was small and generally confined to the portion of the log that normally is left in the core of rotary-cut bolts (table 1). The sapwood, which may be several inches thick, is light reddish-brown when freshly cut (1). The color darkens with age.

The bark of tanoak is rich in tannin, and in past years the chief user of the species has been the leather tanning industry. Its other uses are for fuel, mine timbers, and occasionally furniture. The sapwood has been found easy to treat with preservatives (11).

The wood works easily with tools, but because of its hardness and heaviness it dulls tools more rapidly and requires a greater amount of machining power than do lighter and softer hardwoods (2).

The lumber is difficult to dry and may surface check, end check, collapse, and warp. Kiln-drying schedules for tanoak have been published by the Forest Products Laboratory (14).

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<sup>1</sup>Underlined numbers in parentheses refer to literature cited at the end of this report.

## Description of Logs Tested

Rotary veneer cutting and slicing tests were made on three lots of tanoak logs from Humboldt and Sonoma Counties, California.<sup>2</sup> Many logs were eccentric in shape. The logs from the 1947 shipment contained little bark when received at the Laboratory. These logs had deep end checks, and all were badly surface checked. Table 1 provides a more complete description of all test logs.

Based on the test logs described in this report, the main defects to be avoided in the selection of tanoak veneer logs are knots, shake, end and surface checks, tension wood (10), and pathological heartwood.

## Preparing Bolts, Flitches for Veneer Cutting

Nineteen bolts for rotary cutting were sawed from the logs of the 1946 (13) and 1947 shipments. Two bolts, two flitches for flat-slicing, and four flitches for quarter-slicing were sawed from the 1956 shipment of logs. All bolts were about 4 feet long. The flitches were about 6-1/2 feet long.

One bolt was cut at room temperature. The other bolts were heated in hot water at various temperatures from 120° to 210° F. Veneer of good quality was cut from bolts heated at 150° F. Heart checks, end checks, and ring shakes tended to open excessively in bolts that were heated higher than 160° F.

The flitches were heated in hot water at 180° F. without incurring any defects. Veneer of good quality was sliced from the flitches.

The approximate heating times required for conditioning 8-foot tanoak bolts of various diameters in water at 160° F. to insure a temperature of 140° F. at a core diameter of 6 inches are as follows (4):

<u>Log diameter</u> (In.)	<u>Heating time</u> (Hr.)
12	12
24	54
30	81

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<sup>2</sup>The logs were obtained through the cooperation of the Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif., and the Simpson Logging Company.

The approximate heating times required for conditioning 8-foot flitches of various end dimensions in water at 180° F. to insure a temperature of 160° F. at the flitch center are as follows (4):

Average end dimension of flitch	Heating time
(In.)	(Hr.)
6	5
12	19
16	33

The data in these tabulations are based on an assumed starting temperature of 70° F. If the wood is colder, additional heating time is required.

### Veneer Cutting

#### Rotary Cutting

The lathe settings listed in table 2 were satisfactory for cutting veneer of good quality. The heartwood and sapwood cut equally well with these settings.

Most of the veneer was smooth and uniform in thickness. The knife checks were shallow in 1/16 inch and thinner veneer, but fairly deep knife checks appeared in the 1/8-inch-thick veneer.

The surface and end checks in the bolts from the 1947 shipment caused the veneer to split severely. The knots cut smoothly but often nicked the lathe knife. Veneer containing tension wood (10) was often slightly fuzzy.

#### Slicing

The slicer settings presented in table 3 were suitable in most cases for cutting veneer of good quality. Many sheets of veneer contained both sapwood and heartwood.

The quarter-sliced veneer was smooth. Some of the 1/8-inch veneer, however, had fairly deep knife checks. The quarter-sliced veneer also had fairly prominent ray "flecks."

The flat-sliced veneer 1/20 inch thick was usually smooth enough for use as face veneer. Flat-sliced veneer 1/8 inch thick was moderately rough in half of each sheet.

In general, smooth veneer was cut when the angle between the ground face of the slicer knife and the wood rays was less than 90° (7). Rough veneer was cut when this angle was greater than 90°. Veneer containing tension wood was often slightly fuzzy.

### Veneer Drying

The schedules used to dry the veneer in a mechanical roller-conveyor type of veneer dryer are shown in table 4. Most of the veneer was sapwood and dried satisfactorily. In general, heartwood veneer up to 1/16 inch thick dried satisfactorily in a roller-conveyor dryer. The sapwood and heartwood dried at about the same rate, but the heartwood 1/8 inch thick often checked and collapsed. As a result of these drying problems, most of the tanoak heartwood 1/8 inch or thicker cut at the Laboratory was not suitable for use as face veneer.

Dried veneer up to 1/16 inch thick was often slightly buckled, but not enough so to prevent its use.

Splits present in the green veneer often widened and lengthened during drying, but new splits did not develop. Most of the knots were intergrown and stayed in the veneer after it was dried. Upon being heated, the wood darkened, especially in areas of short grain.

Surface checks developed adjacent to the rays when some of the flat-sliced and rotary-cut veneer was dried. The checking was present in about the same degree as in dried veneer of the true oaks.

Tension wood (10) caused buckling in some of the veneer during drying. Areas containing the gelatinous fibers associated with tension wood were usually darker than the typical wood, but most of the fuzziness present in the green veneer disappeared after the wood was dry.

Tangential shrinkage was high, averaging about 13.6 percent of the green dimensions, when the veneer was dried to a moisture content of 2 to 8 percent. Radial shrinkage averaged about 6.9 percent of the green dimensions.

One-eighth-inch sapwood veneer, both rotary-cut and flat-sliced, was satisfactorily press-dried for use as flooring (6).

### Veneer Yields

Good yields of face-grade veneers were obtained from some of the bolts that were rotary cut and from the flitches that were flat sliced. Much veneer was degraded by surface and end checks that occurred in the logs. Some degrade was caused by collapse that occurred during drying. Other causes of veneer degrade were knots, holes and stains caused by ambrosia beetles, decay, fungus stain, and tension wood.

### Stains

Many of the bolts and flitches had stains associated with decay. On one log, dark stains were present around the ambrosia-beetle holes.

The wet veneer developed a blue-black stain upon contact with iron or steel. The stain, however, was easily removed by swabbing the wood with oxalic acid (3). Complete removal of the acid with hot water was necessary to prevent a pink stain from appearing where the acid had been applied.

The veneer sometimes turned a darker brown during drying. Tanoak face veneers occasionally darkened during hot pressing of the plywood. These discolorations can be kept to a minimum by using moderate drying temperatures and cold pressing the plywood.

### Gluing

Plywood panels of good quality were made with 1/20-, 1/16-, and 1/8-inch tanoak faces and backs. Cores and crossbands consisted of tanoak

or yellow-poplar. Hot-pressed panels were made with a liquid phenolic glue, a phenolic film glue, and with an extended urea glue. On the other hand, a straight urea glue and a casein glue were used in making cold-pressed panels.

Tanoak does not present unusual gluing problems (8), and good joints can be expected with any of the conventional woodworking glues used with good control of gluing conditions.

### Interior Plywood Exposure Test

Some three-ply panels were made with 1/16-inch rotary-cut face veneers and 1/8-inch rotary-cut cores. Several panels were hot pressed with a urea glue, while the others were cold pressed with a casein glue. All were finished with two coats of sealer and one coat of wax. These panels were exposed for 1 month in a room at 80° F. and 30 percent relative humidity, followed by a month in a room at 80° F. and 80 percent relative humidity. The cycle was repeated four times. After this exposure, most of the panels were free of face checks or grain raising. A few panels had inconspicuous hairline checks.

### Tanoak Veneer and Plywood Flooring

Tanoak veneer 1/8 inch thick was press-dried (6) and installed over a concrete office floor at the Laboratory. After several months of use, this floor is still in good condition.

Plywood flooring blocks faced with 1/8-inch rotary-cut tanoak veneer have been in service at the Laboratory since 1948, and have shown excellent wearing properties.

The veneer flooring and the faces of the plywood flooring blocks were of sapwood. The 1/8-inch heartwood was not suitable for faces because of defects that occurred during drying.

### Finishing

The plywood made with thin tanoak face veneers needed little sanding. The press-dried flooring strips made from 1/8-inch veneer required

moderate sanding to remove the roughness caused by slicing or by irregular shrinking in thickness during drying of the veneer.

Some of the panels were finished with a clear lacquer to a uniform gloss, while other panels were covered with two coats of sealer and then waxed. The press-dried flooring strips were finished with filler, two coats of floor seal, and wax.

Tanoak is a diffuse-porous wood, and has pores smaller than those in the true oaks. The pores in tanoak, however, are larger than those in birch, and consequently the wood should be filled if a continuous smooth film finish is desired.

#### Appearance and Potential Use of the Veneer

Tanoak has the necessary properties for use as face veneer when it is cut 1/16 inch or thinner. It has attractive color, and some of the sliced veneer has good figure. Rotary-cut tanoak veneer is somewhat similar in appearance to rift-cut white oak. Sapwood veneer 1/8 inch thick appears suitable for use as veneer strip flooring or for plywood block flooring. Small quantities of tanoak veneer have been cut commercially for face veneers. The species is probably best adapted to rotary veneer cutting.

Literature Cited

- (1) Brown, H. P., Panshin, A. J., and Forsaith, C. C.  
1949. Text Book of Wood Technology, Vol. 1, McGraw-Hill Book Co., Inc., N. Y.
- (2) Davis, Edward M.  
1947. Machining of Madrone, California Laurel, Tanbark Oak, and Chinquapin. Forest Products Laboratory Report No. R1727.
- (3) Downs, L. E.  
1950. Bleaching Wood. Forest Products Laboratory Report No. 1705.
- (4) Fleischer, H. O.  
1959. Heating Rates for Logs, Bolts, and Flitches To Be Cut into Veneer. Forest Products Laboratory Report No. 2149.
- (5) Harlow, William M., and Harrar, Ellwood S.  
1941. Textbook of Dendrology, 2nd Ed., McGraw-Hill Book Co., Inc. N. Y.
- (6) Heebink, Bruce G.  
1952. Veneer Flooring. Journal of the Forest Products Research Society, Vol. 2, No. 3.
- (7) Lutz, John F.  
1956. Effect of Wood Structure Orientation on Smoothness of Knife-Cut Veneers. Forest Products Journal, Vol. VI (11).
- (8) Olson, W. Z.  
1955. Gluing Characteristics of Chinquapin, Tanoak, California Laurel, Madrone. Forest Products Laboratory Report No. 2030.
- (9) Paul, Benson H., Dohr, Alfred W., and Drow, John T.  
1955. Specific Gravity, Shrinkage, and Strength of Tanoak. Forest Products Laboratory Report No. 2041.
- (10) Pillow, Maxon Y.  
1953. Effects of Tension Wood in Hardwood Lumber and Veneer, Forest Products Laboratory Report No. R1943.

- (11) Randall, C. A.  
1956. Strength and Related Properties of Tanoak. Journal of Forestry 54 (7).
- (12) Roy, D. F.  
1957. Silvical Characteristics of Tanoak, Forest Service, California Forest and Range Experiment Station, Tech. Paper No. 22.
- (13) Schowalter, W. E.  
1946. Exploratory Tests in the Rotary Cutting of Veneer From Certain California Hardwoods. Forest Products Laboratory Report WP-66.
- (14) Torgeson, O. W.  
1956. Kiln-Drying Schedules for 1-Inch Laurel, Madrone, Tanoak, and Chinquapin. Forest Products Laboratory Report No. 1684.



Table 2.--Lathe settings used to cut tanoak veneer

Veneer thickness	Knife angle	Knife bevel	Nosebar settings	Nosebar bevel
			Vertical	Horizontal
<u>In.</u>	<u>Deg.-Min.</u>	<u>Deg.</u>	<u>In.</u>	<u>In.</u>
1/24 (0.042)	90 - 45	21	0.012	0.037
				15
1/20 (0.050)	90 - 45	21	.012	.045
				15
1/16 (0.063)	90 - 35	21	.015	.050
				15
1/8 (0.125)	90 - 0	21	.028	.115
				15

Table 3.--Slicer settings used to cut tanoak veneer

Veneer thickness	Knife angle	Knife bevel	Nosebar settings	Nosebar bevel
			Vertical	Horizontal
<u>In.</u>	<u>Deg.-Min.</u>	<u>Deg.</u>	<u>In.</u>	<u>In.</u>
1/20 (0.050)	90 - 30	22	0.030	0.045
				12
1/8 (0.125)	90 - 20	22	.030	.115
				12

Table 4.--Veneer drying schedules used and shrinkage values determined for tanoak veneer

Veneer thickness	Veneer dryer temperature	Drying time	Average shrinkage values		Average moisture content
			Radial	Tangential	
<u>In.</u>	<u>°F.</u>	<u>Min.</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>
1/24	250	7	.....	7.7	2
1/20	250	13	7.3	13.5	6
1/16	250	15	.....	12.5	8
1/8	250	30	8.1	13.7	8
	320	15	5.8	18.6	8