
White Oak (Quercus Alba) Solid Wood – Technical Material Specification for Machining & Fabrication

1.0 Material Overview & Common Uses

White Oak (Quercus Alba) is a dense, closed-grain hardwood native to eastern North America, prized for its strength, durability, and natural resistance to moisture and decay. It is a ring-porous wood with prominent medullary rays, yielding a distinctive flake pattern when quarter-sawn.

Common industrial applications include: heavy timber framing, boatbuilding (keels and ribs), whiskey barrel staves, flooring (solid and engineered), fine furniture, cabinetry, architectural millwork, and tool handles. Its high impact resistance and ability to hold fasteners make it a preferred material for structural joinery.

2.0 Core Technical Properties & Sizing

- Average dried density: 755 kg/m³ (47 lb/ft³) at 12% moisture content (MC).
- Janka hardness: 6,000 N (1,350 lbf) – rated as very hard.
- Modulus of rupture (MOR): 104.8 MPa (15,200 psi) at 12% MC.
- Modulus of elasticity (MOE): 12.3 GPa (1.78 million psi).
- Crushing strength parallel to grain: 51.7 MPa (7,500 psi).
- Radial shrinkage: 4.4% (green to oven-dry). Tangential shrinkage: 8.9%. Volumetric shrinkage: 13.7%.
- Standard rough lumber dimensions: 4/4, 6/4, 8/4, 12/4 thicknesses; widths 3" to 12" random; lengths 6' to 16' random.
- Moisture content tolerance for machining: 6–9% MC (kiln-dried). Reject if MC exceeds 10% or is below 5%.
- Flatness tolerance: 1/8" over 4' length for surfaced lumber. Twist or bow exceeding 1/4" over 8' is rejectable.

3.0 Processing, Machinability & Application

White Oak machines well with sharp tooling but is abrasive due to its high silica content (up to 0.5%). Carbide-tipped (CT) or polycrystalline diamond (PCD) tooling is recommended for production runs. Dull tooling causes burning and tear-out, especially on interlocked grain.

- Routing: Use 3/4" shank carbide bits at 12,000–18,000 RPM with a feed rate of 100–150 IPM. Climb cutting reduces tear-out on cross-grain passes.
- Sawing: Use 24–30 tooth carbide-tipped rip blades for ripping; 60–80 tooth ATB (alternate top bevel) blades for crosscutting. Feed speed: 30–50 FPM for 4/4 stock.
- Planing: Maximum cut depth 1/16" per pass. Feed rate 15–25 FPM. Use helical carbide cutterheads to minimize grain tear-out on figured stock.
- Sanding: Start with 80-grit, progress to 180-grit. Do not skip more than one grit step. White Oak dust is carcinogenic – use HEPA vacuum extraction.
- Gluing: Use Type I or Type II polyurethane or PVA adhesives. Clamp pressure: 100–150 psi. Open assembly time: 10–15 minutes at 21°C. Cure time: 24 hours at 20°C.

- Fastening: Pre-drill for screws (pilot hole 75% of screw shank diameter). Nail holding strength: 1,200 N per 8d nail (withdrawal).
- Steam bending: White Oak bends well. Steam at 100°C for 1 hour per 25mm thickness. Bend radius minimum 50x thickness. Allow to cool in form for 24 hours.

4.0 Common Defects & Quality Control

- Reject if moisture content exceeds 10% or is below 5% (measured with pin-type meter at 3 points per board).
- Reject if surface checks (cracks) exceed 1/16" width or extend more than 1/4 of board thickness.
- Reject if wane (bark edge) is present on more than 1/3 of board width or length.
- Reject if warp (bow, crook, twist, cup) exceeds 1/4" over 8' length for surfaced lumber.
- Reject if knot diameter exceeds 1/2" on edge-glued panels or 1" on structural members (unless specified as character grade).
- Reject if mineral stain or fungal discoloration covers more than 20% of board face (unless specified as rustic grade).
- Reject if insect damage (pinholes, galleries) is visible on more than 2% of board surface.
- Reject if planer snipe exceeds 1/16" depth over 6" from board end.
- Reject if glue line failure occurs in laminated stock (delamination visible under 10x magnification).

5.0 Storage, Handling & WHMIS Guidelines

- Store in a climate-controlled environment at 18–24°C and 35–50% relative humidity. Do not store near HVAC vents or exterior walls.
- Allow material to acclimate for minimum 72 hours in the machining environment before processing.
- Stack lumber flat on 3/4" stickers spaced 24" apart. Do not stack more than 4 feet high without rack support.
- Shelf life: Indefinite when stored at stable MC (6–9%). FIFO protocol recommended to avoid dust accumulation on older stock.
- WHMIS 2015: Wood dust (CAS 7440-44-0) is classified as a carcinogen (IARC Group 1). Use local exhaust ventilation (LEV) capturing at source.
- Mandatory PPE: N95 or P100 respirator during sanding, cutting, or any dust-generating operation. Safety glasses with side shields. Hearing protection above 85 dBA.
- Do not use compressed air to clean surfaces – use HEPA vacuum or wet sweeping. Combustible dust hazard: maintain dust concentration below 0.5 oz/ft³.
- First aid: For eye contact, flush with water for 15 minutes. For skin irritation, wash with soap and water. Seek medical attention if respiratory symptoms develop.

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