# Red Oak (Quercus Rubra) Solid Wood – Machining & Fabrication Specification

## 1.0 Material Overview & Common Uses

Red Oak (Quercus Rubra) is a dense, ring-porous hardwood native to eastern North America, widely used in Canadian furniture, cabinetry, flooring, millwork, and architectural joinery. It is prized for its prominent grain pattern, high strength-to-weight ratio, and excellent machinability when properly dried. This specification covers kiln-dried, surfaced (S4S) solid lumber for industrial fabrication.

## 2.0 Core Technical Properties & Sizing

- Average density at 12% moisture content: 0.75 g/cm³ (47 lb/ft³)
- Janka hardness: 1290 lbf (tangential), 1360 lbf (radial)
- Modulus of rupture (MOR): 99 MPa (14,300 psi)
- Modulus of elasticity (MOE): 12.3 GPa (1.78 million psi)
- Standard moisture content range: 6% to 9% for interior applications; 9% to 12% for exterior millwork
- Standard surfaced dimensions: 4/4 (1 inch nominal, 0.75 inch net), 6/4 (1.5 inch nominal, 1.25 inch net), 8/4 (2 inch nominal, 1.75 inch net)
- Width tolerance after surfacing: ±1/32 inch (0.8 mm) for stock under 6 inches wide; ±1/16 inch (1.6 mm) for wider stock
- Length tolerance: ±1/8 inch (3.2 mm) for random-length bundles; custom cut lengths ±1/16 inch (1.6 mm)
- Tangential shrinkage (green to 6% MC): 8.6%
- Radial shrinkage (green to 6% MC): 4.0%

## 3.0 Processing, Machinability & Application

Red Oak machines well with sharp carbide tooling. Its open grain can cause tear-out on planing and shaping if feed rates are too aggressive. Pre-drilling is recommended for nailing and screwing to prevent splitting. Glue joints require clean, freshly machined surfaces and adequate clamp pressure.

- Ripping: Use a 24-tooth carbide-tipped rip blade at 3,600–4,200 RPM; feed rate 15–25 ft/min for 4/4 stock
- Crosscutting: 60-tooth combination blade at 3,600–4,200 RPM; feed rate 10–15 ft/min
- Planing: Carbide knives with 20-degree bevel; depth of cut 1/32 inch (0.8 mm) per pass; feed rate 15–20 ft/min
- Shaping: Use 3-wing carbide cutters; feed rate 8–12 ft/min; climb cut to reduce tear-out on figured grain
- Sanding: Start with 80-grit, progress to 120-grit, then 150-grit for final finish; avoid 180-grit or finer as it can burnish the surface and reduce stain absorption
- Gluing: Use Type I or Type II PVA (polyvinyl acetate) adhesive; open time 5–10 minutes at 70°F; clamp pressure 100–150 psi; cure time 24 hours at 70°F
- Fastening: Pre-drill for screws (pilot hole diameter 75% of screw shank); use 8d or 10d finish nails for face nailing

- Finishing: Accepts oil-based stains, water-based stains, and clear lacquers; open grain may require grain filler for a smooth finish

## 4.0 Common Defects & Quality Control

- Reject if moisture content exceeds 9% for interior applications or 12% for exterior applications (measured with pin-type moisture meter at 3 points per board)
- Reject if bow exceeds 1/8 inch over 8 feet of length
- Reject if crook exceeds 1/16 inch over 8 feet of length
- Reject if cup exceeds 1/16 inch over 4 inches of width
- Reject if twist exceeds 1/8 inch over 8 feet of length
- Reject if surface checks (cracks) exceed 1/16 inch in width or 1 inch in length
- Reject if knots are loose, open, or exceed 1 inch in diameter for clear grade; sound tight knots up to 1.5 inch diameter acceptable for #1 common grade
- Reject if wane (missing wood at edge) exceeds 1/8 inch in depth or 1/4 of board width
- Reject if stain (blue stain, mineral stain) covers more than 10% of board surface for clear grade
- Reject if insect damage (pinholes, grub holes) exceeds 3 holes per linear foot
- Reject if planer snipe exceeds 1/32 inch in depth over the first 6 inches of board end

## 5.0 Storage, Handling & WHMIS Guidelines

- Store in a climate-controlled environment at 60–75°F and 35–50% relative humidity to maintain target moisture content
- Stack lumber flat on 3/4-inch stickers spaced 16 inches apart, aligned vertically to prevent warping
- Allow 2 inches of air circulation between stacks; keep stacks at least 6 inches off the floor
- Shelf life: Indefinite when stored at stable conditions; acclimate to shop environment for 48–72 hours before machining
- FIFO protocol: Rotate stock by date of receipt; mark each bundle with receipt date and moisture content
- WHMIS classification: Wood dust (CAS 9004-34-6) is classified as a hazardous substance under WHMIS 2015; hardwood dust is a Group 1 carcinogen (IARC)
- Mandatory PPE during machining: NIOSH-approved N95 or P100 respirator, safety glasses, hearing protection (ANSI S3.19), and cut-resistant gloves (ANSI A2 or higher) for handling rough lumber
- Engineering controls: Use local exhaust ventilation (LEV) with dust collection system rated for fine wood dust (minimum 1 micron filtration); maintain air velocity of 400 ft/min at capture hood
- First aid: For eye contact, flush with water for 15 minutes; for skin contact, wash with soap and water; for inhalation, move to fresh air and seek medical attention if symptoms persist
- Spill procedure: Sweep or vacuum dust (do not use compressed air); dispose in sealed containers labeled 'Wood Dust – Combustible'
- Fire safety: Wood dust is a combustible dust hazard; maintain dust accumulation below 1/32 inch (0.8 mm) on surfaces; use Class D fire extinguishers for metal fires, but for wood dust use Class A extinguishers or water