

Wood Movement & Gaps

How much boards shrink and swell, what moisture to build at, and how big to leave the gap.

01 How much wood moves

SPECIES	TANGENTIAL % (GREEN TO OVENDRY)	RADIAL %	T/R	PER 12 IN WIDTH PER 1% MC	VERDICT
PT southern pine (loblolly)	7.4	4.8	1.5	0.030 in (about 1/32)	Moderate; wet PT is the real problem
Western red cedar	5.0	2.4	2.1	0.020 in	Very stable
Redwood	4.7	2.4	2.0	0.019 in	Very stable
Douglas fir (coast)	7.6	4.8	1.6	0.030 in (about 1/32)	Moderate
SPF (white spruce)	8.2	4.7	1.7	0.033 in	Moderate to high
White oak	10.5	5.6	1.9	0.042 in (about 3/64)	High; design for it
Red oak	8.6	4.0	2.2	0.034 in	High; cups easily
Hard maple	9.9	4.8	2.1	0.040 in	High
Cherry / walnut / poplar	7.1 / 7.8 / 8.2	3.7 / 5.5 / 4.6	1.9 / 1.4 / 1.8	0.028 / 0.031 / 0.033 in	Moderate, all three

Math: movement per 1% MC = tangential % / 30 (straight-line from ~30% fiber saturation to 0). Loblolly 7.4 / 30 = 0.247% x 12 in = 0.030 in per foot of width. Tangential = flatsawn; radial = quartersawn. Length moves 0.1 to 0.2% total. Plywood ~0.3%; MDF and composite move with heat, not moisture. (FPL Wood Handbook, Table 4-3.)

02 Target moisture content

SITUATION	TARGET MC	BASIS
Indoor, heated (winter)	6 to 8%	70F at 30% RH = 6.2%
Indoor, humid or basement	9 to 12%	50% RH = 9.2%; 65% RH = 12%
Covered porch	12% (9 to 14)	FPL exterior target
Outdoor exposed, Midwest	12 to 15%	Detroit 12.3 to 15.1
Outdoor exposed, humid South	12 to 14%	Atlanta 12.0 to 14.2
Outdoor exposed, dry West	5 to 11%	Phoenix 4.6 to 9.5; Denver 9.4 to 11
Fresh PT off the rack	50 to 80%+	Above fiber saturation; will shrink a lot
KD framing / KDAT	19% max / 12 to 19%	Framing averages 15%

Build at the MC of the place it will live. Pin meter: read a fresh cut, not the face.

04 Build for movement

- Width moves, length does not: 0.1 to 0.2% along the grain vs. 5 to 10% across it.
- Attach tops with Z-clips, buttons, or elongated holes; fix the center, float the edges. Figure-8s under 18 in only.
- Breadboard ends: glue the center tenon only; elongate the outer pin holes.
- Do not glue cross-grain wider than 3 to 4 in; past that, screws in slots.
- Quartersawn moves a bit less than half of flatsawn.

06 Symptom to cause

SYMPTOM	CAUSE, THEN FIX
Cupping	Bark face goes concave as it dries. Seal both faces alike; the wetter side is the high side.
Checking, end splits	End grain dries first. Seal end grain; buy long, trim later.
Joints open in winter	Heated air drops wood to ~6% MC. Build at 6 to 8%; float panels.
Tabletop cracked at screws	Round holes, nowhere to move. Elongated holes or clips; fix center, float edges.
Deck boards buckled or gapped 1/2 in	Dry boards laid tight, or wet PT gapped 1/4 in then shrank. Match the gap to the moisture.

The rest of the shop-wall charts are free at rogueengineer.com/guides. Built for the same projects as the **Outdoor Table + 4x4 Bench plans**.

Reference values compiled from manufacturer and industry sources and checked 2026-09; your lumber, hardware, and local code govern. Free for personal use; please share the link, not the file. © Rogue Engineer LLC.

03 Gaps and clearances

PART	GAP	WHY
Deck boards, wet PT (30% +)	Butt tight, or 1/16 in	5.5 in board loses ~1/4 in drying to 13%
Deck boards, dry PT / KDAT	1/8 in	Only 1/16 to 3/32 in left to shrink
Deck boards, cedar or redwood (KD)	1/8 to 3/16 in	Low movement; gap is for drainage
Deck boards, composite (Trex)	3/16 in sides; 1/8 in ends	Thermal, not moisture; 3/16 ends under 40F
Tabletop or bench slats, outdoor	1/4 to 3/8 in	Drainage plus ~1/8 in seasonal swing
Planter side boards	Tight if wet; 1/16 in if dry	Soil side stays wet and swells; use a liner
Floating panel in a frame	1/16 to 5/32 in per side	12 in oak panel moves ~3/16 in

5.5 in wet SYP, 30% to 13% = 5.5 x 0.00247 x 17 = 0.23 in. Never glue a floating panel.

05 Worked examples

- Formula: width change = width x (tangential % / 3000) x MC change. Loblolly factor 0.00247.
- 36 in flatsawn PT pine top, 19% to 12%: 36 x 0.00247 x 7 = 0.62 in (5/8).
- Same top installed wet: only the drop below 30% counts. 36 x 0.00247 x 18 = 1.6 in.
- 24 in cedar bench seat outdoors, Detroit, 12 to 15%: 24 x 0.00167 x 3 = 0.12 in.
- 36 in flatsawn white oak top indoors, 6% to 10%: 36 x 0.0035 x 4 = 0.50 in.

Be safe and happy building.

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