REDWOOD
Technical Data Sheet

Dimensional Stability

Redwood has the least volumetric shrinkage of any commercial domestic wood; therefore, it can be subjected to considerably more change in moisture before it has the same change in dimensions as other commercial species. This means that projects manufactured with redwood will be much less subject to open joints, warping, cupping, splitting, and other defects associated with dimensional change.

Shrinkage Values

Table 1 provides relative shrinkage values for a number of common domestic softwoods. These values are shown on a relative basis taking the values for old-growth redwood as 100%. Values over 100 indicate shrinkage greater than that for old-growth redwood.

Table 1. Average relative shrinkage values for common domestic softwoods

Species	Shrinkage from green to oven-dry condition based on dimensions when green		
	Radial	Tangential	Volumetric
Redwood, old-growth	100	100	100
Redwood, second-growth	85	111	103
Western Red Cedar	92	114	100
White fir	127	159	144
Baldcypress	146	141	154
Ponderosa pine	150	141	143
Douglas-fir (coastal)	185	173	182
Southern pine (loblolly)	185	168	181
Western hemlock	162	177	182

Understanding Wood Shrinkage

Water exists in green (unseasoned) wood in two conditions: as free water in the cell cavities and as bound water in the cell walls. When wood contains just enough water to saturate the cell walls, it is said to be at the fiber saturation point (FSP). Water in excess of this amount cannot be absorbed by the cell walls, and, therefore, is free water in the cell cavities. Removal of the free water from the cell cavities has no apparent effect on the properties of wood except to reduce its weight, but as soon as any of the bound water in the cell walls is removed, wood begins to shrink. Since the free water is the first to be removed, shrinkage does not begin until the FSP is reached.

The FSP for wood varies from about 22% to 30% moisture content. For redwood, FSP can be taken as approximately 22%. Dimensional change does not occur until moisture content reductions from the green, or unseasoned, condition go below this value and the cell walls begin to give up bound water. Then redwood begins to shrink in all directions, although not uniformly. Generally speaking, the shrinkage is about twice as great across the flat grain face (tangential shrinkage) as it is across the vertical grain face (radial shrinkage). Longitudinal shrinkage is normally so small that it is generally not considered significant.

All woods contain quantities of chemical extractives in addition to the cellulose and lignin components. Redwood is rich in extractives which, combined with redwood's cellular structure, are responsible for its low shrinkage. In properly dried wood there is little appreciable difference between sapwood and heartwood with respect to dimensional change. Sapwood, however, may be more susceptible than heartwood to changes in atmospheric humidity; therefore, its dimensions may change more quickly than those of heartwood.

Humboldt™

Installation

Ideally, wood products should be manufactured and installed at the moisture content to which they will equilibrate in use. This moisture content is referred to as the equilibrium moisture content or EMC. Table 2 provides recommended moisture content values for various wood items at the time of installation.

Table 2. Recommended moisture content values for various wood products at time of installation*

	Recommended moisture content (%) for areas in the United States					
	Most areas of the United States		Dry southwestern area		Damp, warm coastal area	
Use of wood	Average**	Individual pieces	Average**	Individual pieces	Average**	Individual pieces
Interior: woodwork, flooring, furniture, wood trim	8	6—10	6	4—9	11	8—13
Exterior: siding, wood trim, sheathing, laminated timbers	12	9—14	9	7—12	12	9—14

*Source: USDA Forest Products Laboratory General Technical Report FPL-GTR-190, *Wood Handbook: Wood as an Engineering Material* (Table 13—2)

**To obtain a realistic average, test at least 10% of each item. If the quantity of a given item is small, make several tests. For example, in an ordinary dwelling containing 60 floor joists, at least six tests should be made on joists selected at random.

Redwood Shrinkage

Redwood general purpose grades are available green (unseasoned) or S-Dry (19% or less moisture content). Redwood architectural grades are available green, S-Dry, or Kiln Dried in accordance with the Redwood Inspection Service (RIS), *Standard Specifications for Grades of California Redwood Lumber*.

The change in dimension within the moisture content limits of 6—14%, as defined in the USDA Forest Products Laboratory General Technical Report FPL-GTR-190, *Wood Handbook: Wood as an Engineering Material*, can be estimated by using dimensional change coefficients as follows:

$$\Delta D = D_I[C_T(M_F - M_I)]$$

where: ΔD= change in dimension

D_I = initial dimensions in units of length

C_T = dimensional change coefficient tangential direction (for radial direction, use C_R)

M_F = final moisture content (%)

M_I = initial moisture content (%)

Dimensional change coefficients for redwood:

	C_R (radial)	C_T (tangential)
old-growth	.00120	.00205
second-growth	.00101	.00229

Because lumber products rarely are perfectly flat grain (tangential) or vertical grain (radial), this calculation will usually overestimate tangential skrinkage and underestimate radial shrinkage.

For approximate dimensional changes associated with moisture content changes greater than 6—14%, or when one moisture content value is outside those limits, refer to the *Wood Handbook: Wood as an Engineering Material.*

A general rule of thumb is that redwood will shrink or swell approximately 0.7% in width for each 4% reduction or increase in moisture content below FSP.