



Wood, Moisture & Warranties: A Technical Bulletin

Millwork, or lumber for interior finish use, should only be delivered to a jobsite after the building has been fully enclosed and weather tight, with HVAC systems fully operational, and humidity controlled within the range of 25-55%. If the relative humidity falls outside the range of 25-55%, the materials should be wrapped in plastic to limit air circulation around them. The key is to properly acclimate the materials without subjecting them to the extremes that cause degrade.

✓ Drywall “mud”, wet plaster, concrete, and all wet work should be fully cured.

✓ Lumber and wood products for interior use should be stored indoors, in the environment in which it will be installed, protected from extreme temperatures, humidity, or dryness.

✓ Exterior materials should be in sheltered storage, protected from drying heat in the winter and extreme humidity in the summer.

✓ Moldings and lumber items should be neatly stacked, in well-supported piles.

✓ Doors and millwork items should be evenly supported to prevent warpage.

✓ Do not store any woodwork in an unheated basement, on a recently poured concrete floor, or in a building with standing water on the floor.

✓ Keep all lumber & millwork products away from heat sources. Workshops heated with wood stoves create very dry environments, which can cause damage in a matter of hours.

✓ Material that is not tightly wrapped should have equal air flow on all surfaces. Stack glued panels with even thickness, clean, dry stickers in between each panel, and a cover sheet on stickers on top. Stickers should be vertically aligned for proper weight distribution.

✓ Solid wood tops, and other wide solid wood panels, must be installed so that the panel can expand and contract across its width with seasonal changes in moisture content. This can be accomplished with slotted screw holes, panel or tabletop clips, panel & frame construction, etc.

➔ **Interior and exterior materials should be finished as soon as possible.** Depending on the product and jobsite conditions, a delay of even a few days could result in damage.

➔ **Priming is not a finish.** It buys a few days time at best. (See p.3 for information about effectiveness of different finishes.)

➔ **Finish all six sides** of doors, wood tops, and glued panels. Inadequate finish on the tops and bottoms of doors can cause significant damage. Tops and bottoms should have two finish coats minimum.

➔ **Apply the same finish to all six sides.** Uneven finishing can cause warping. Doors with one painted and one clear finished face should have the same film thickness both faces.

➔ **Back Prime** trim, siding, paneling, or similar products applied to walls.

*Extremes in humidity, low and high, cause a multitude of problems with lumber and wood products every year. Problems are most apparent in the winter, when the extreme dryness of northern winters takes its toll, but the root cause of those problems often happen in the humid summer months. Seasonal dimensional change is integral to wood and requires proper storage, handling, and construction methods, which are the **responsibility of the purchaser.***

This bulletin is intended to assist with an understanding of the nature of wood and its proper handling and working. The topic is broad, and no brief paper could cover every situation.

**See the back page to reference further information
on specific products and wood technology.**

The following information and data is taken from:
 The Wood Handbook: Wood as an Engineering Material from the Forest Product Laboratory of the USDA.

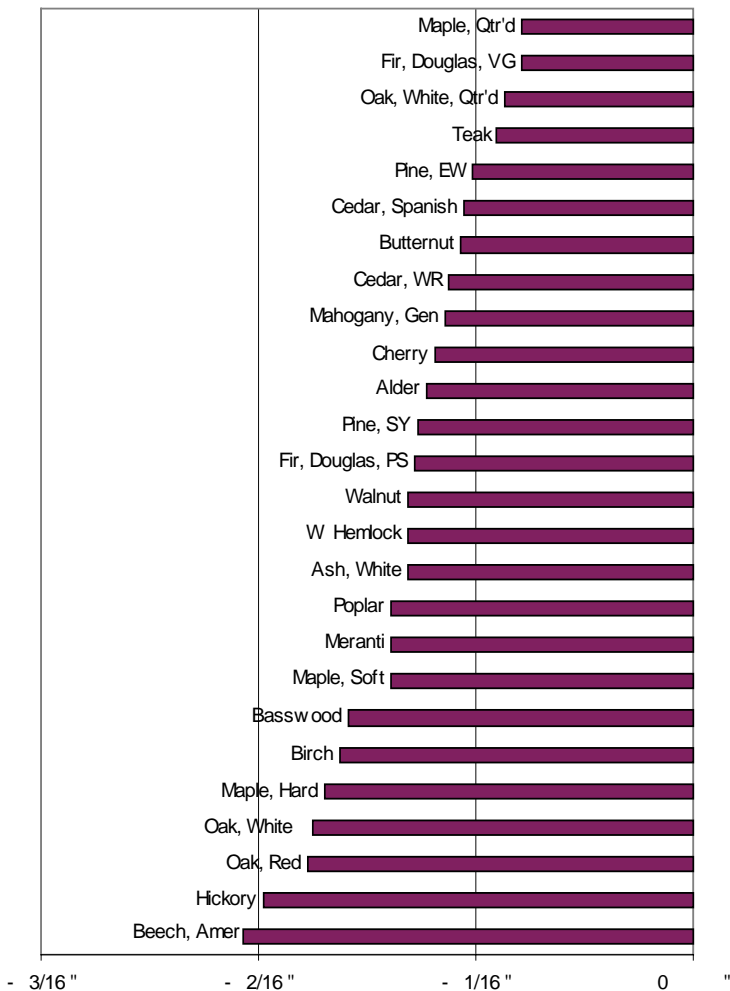
The principal source of problems with lumber & wood products is moisture, either an excess, or an extreme lack thereof. Wood's moisture content (MC) changes in reaction to the relative humidity (RH) of the surrounding air. As the MC changes, so do the width and thickness of a piece of wood. The higher the RH, the faster wood picks up moisture; the lower the RH, the quicker it dries. Given a stable temperature and RH, wood will reach a predictable Equilibrium Moisture Content (EMC). As an example, wood in a room with a stable environment of 70° and 40% RH would have an EMC of 7.7%.

Most lumber intended for interior use is dried to a target of 6-8% MC. Exterior wood is targeted 12-15%. The Architectural Woodwork Institute (AWI) recommends maintaining indoor RH levels within the range of 25-55%. This means that, at 70°, the range of EMC would be 5.4% to 10.1%, a pretty broad range. Best results are achieved when that range is tightened up to 35-45% with only temporary fluctuations below and above. Houses air conditioned in the summer and humidified in the winter will still range between 35-60% RH at the extremes. Proper finishing slows the rate of change so the extremes are not normally reached by the time the seasons change. Normal seasonal variation in EMC would probably be in the 2-3% range, in properly finished wood.

As wood picks up moisture it will expand, when it gives up moisture it shrinks. Proper construction accounts for these dimensional changes, allowing the wood to move. The chart in the next column gives an idea of the relative stability of various species by showing the amount of shrinkage for a 12" wide board with a drop in MC of 2-1/2%.

Wood subjected to extreme dryness will only re-absorb about 85% of the moisture that it had at any given RH when it was drying initially. Practically this means that flooring boards or mitre joints that have opened up from an extremely low RH, will probably not close up as tight when the humidity rises again.

Shrinkage in a 12" board with A change from 8-1/2 to 6% MC



Problems such as cupping, twisting, warping, splitting, and glue seam failure are often caused by a "rapid" change of moisture content. Wood that gives up moisture more on one face than another, will shrink more on that face; i.e. it will cup. Proper finishing slows down the process of moisture exchange, and can therefore *limit* its effects. **No finish can make a wood product completely impervious to the effects moisture changes in its environment.**

Temperature Fluctuations

Fluctuating temperatures can exacerbate dryness problems. A typical jobsite, or shop, will be 10-20 degrees colder overnight than during the day. **The same volume of water in the air results in a higher RH as the temperature drops.** The following example illustrates the effect.

	<u>Temp.</u>	<u>RH</u>	<u>EMC</u>
Day	75°	40%	7.6%
Night	60°	65%	<u>12.1%</u>

An unfinished, or partially finished, piece of wood kept in these conditions will soak up the moisture at night, and give it up rapidly during the day; a cycle that will damage the product quickly.

The bottom line to all of this mumbo-jumbo about EMC is that wood needs to be protected from relatively rapid changes in moisture content, and any changes that do happen need to happen evenly, having the same effect on all sides.

The number one method of protection is to get a *good* finish on it ASAP. If something will be stored unfinished for a few days, wrap it, not just cover, in plastic.

Finish Performance and The Myth of Primer

Primer is designed to provide good adhesion for finish coats, not as a moisture barrier. A customer of ours, with a house on the ocean, left his exterior wood doors only primed for a year, and wondered why they warped.

The following chart gives data from the USDA Wood Handbook Table 15-3. It has very good information as to the relative effectiveness of various finishes. When asked to prime, we generally apply one coat of oil base primer. You can see by the chart, that priming offers limited protection for a few days at best. ***Get some finish on it!***

The percentage values give the improved effectiveness over unfinished wood, *not* moisture content values.

Problems with Glued Stock

Some of the worst dryness problems occur in stock glued up for width and/or thickness. Stresses are created by each board trying to move and being restricted by the

		<u>Moisture excluding effectiveness (%)</u>		
		<u>Time in days</u>		
<u>Product</u>	<u>Coats</u>	<u>1</u>	<u>7</u>	<u>14</u>
Water	1	12%	0%	0%
Repellant	2	46	2	0
	3	78	27	11
Latex Ext	1	43%	6%	1%
Primer	2	66	14	2
Latex House	1	52%	12%	5%
Paint, flat	2	77	28	11
	3	84	39	16
Alkyd Ext	1	85%	46%	24%
Primer (oil)	2	93	70	49
Enamel (oil)	1	93%	69%	50%
Paint, flat	2	96	83	70
	3	97	86	80
	4	98	92	85
Urethane	1	55%	10%	2%
Varnish	2	83	43	23
	3	90	64	44
	4	91	68	51
Latex Stain	1	5%	0%	0%
solid color	2	38	4	0
	3	50	6	0
Oil-based	1	45%	7%	1%
Stain	2	84	48	26
solid color	3	90	64	42

Samples were painted all sides.
Data is relative to absorption of moisture. Desorption (drying) factors would be similar.

others to which it is glued. Problems include cupping and/or splitting, either on or off the glue seam.

Cupping or warpage occurs when one face dries out faster than the opposite face. It shrinks faster than the other one does.

Splitting generally occurs at the end grain of the glue-up because the exposed raw ends dry out & shrink faster than the middle. The only way for this to happen is for the seams, or the wood itself, to split, relieving the tension between the ends wanting to get smaller & the middle staying the same size.

Another common cause of splits in wood tops & wide panels is restrictive fastening. The wood will move. If a top is fastened down tight, with no provision for shrinkage, it will shrink by cracking. Use slotted screw holes or panel clips for fastening.

Further Information

Lumber and millwork need to be stored and installed in conformance with accepted procedures and manufacturer's instructions. New products, and new ways of using traditional products, demand that professionals and do-it-yourselfers alike follow recommendations. Warranty claims can be voided by not following industry recommended practices.

Visit the Resources section of copperbeech.com for further information on a variety of topics:

Product Information

Wood Doors

Architectural Columns

Butcher Block & Wood Tops

Hardwood Flooring

Cedar Siding

Wood & Composite Decking

Wood Technology & Generic Product Information

Measurement & Control of Humidity & Wood Moisture Content

Tool Resources

Important Information on:

Wood, Moisture & Warranties



413-582-1852
413-585-0288 F
www.amherstwoodworking.com



413-584-3003
800-532-9110

413-582-0164 F
www.copperbeech.com