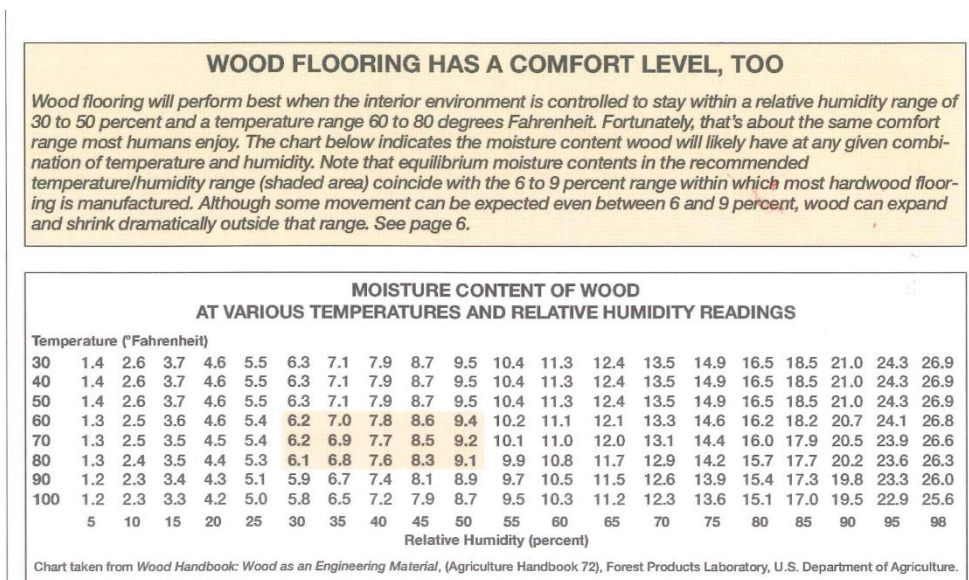


What a National Wood Flooring Inspector will be determining when asked to investigate a concern!

Acclimation----definition as follows

Acclimation is insuring that the hardwood, the plywood the concrete moisture readings are all within the requirements of the wood manufacturer.

1. Concrete must have a moisture content of 4.5% or less utilizing a tramex concrete encounter CME4 moisture meter. In approx. 1,000 feet take many readings throughout the project and look for inconsistencies. i.e. 6 readings 3%, 1 or 2 5%. Why is one area exceeding the average of all the others?
2. Or Relative Humidity, aka as RH, tested. Also known as in-suiti testing with readings of 75% relative humidity or less. 3 tests in the 1st 1,000 feet and 1 for every 1,000 thereafter.
3. PH testing must be accomplished
4. Plywood over concrete: moisture meter set for plywood must be less than 12% maximum if more find out why!
5. Hardwood is generally manufactured between 6% to 9% moisture content. Ideally this would be installed at 7% but if it falls lower or higher than 5% to 9% it needs more acclimation until it does.
6. Wood 2 1/4" wide **must** be within 4% or more acclimation is required.
7. Wood wider than 2 1/4" must be within 2% or more acclimation is required.
8. Every manufacturer may have different requirements but these are the minimums required by the NWFA.
9. Additionally to acclimate wood all wet work, installation of ceramic tile, painting etc. must be completed prior to acclimating the wood.
10. The building must be enclosed with the HVAC systems functioning.
11. The goal of acclimation is to insure the wood subfloor and the hardwood reaches Equilibrium Moisture Content, EMC, of the building it will be installed in.
12. If the RH is installed too high generally abnormal gaps may occur within the first year. If the RH is too low at the time of installation subsequent high levels of RH can cause the floor to cup and even buckle from the subfloor.
13. My suggestion if the homeowner or builder do not want to wait would be to have a meeting with the homeowner and builder and explain the consequences and document this meeting.



As stated in chart which

from the Wood Handbook and depicts how Relative Humidity affects the moisture content of wood. Temperature plays a minor role. As an inspector if I have mc readings of say 3.5% mc and I look down I see that it would take relative humidity readings of 15% for that to occur or if I had moisture content readings of 14.4% MC it would take relative humidity readings of 75% to have that occur.

the above was taken

Now we get into some real cool wood science stuff. How do we further verify the affect this has on wood floors.

Wood expands or shrinks depending on atmosphere it is exposed to.

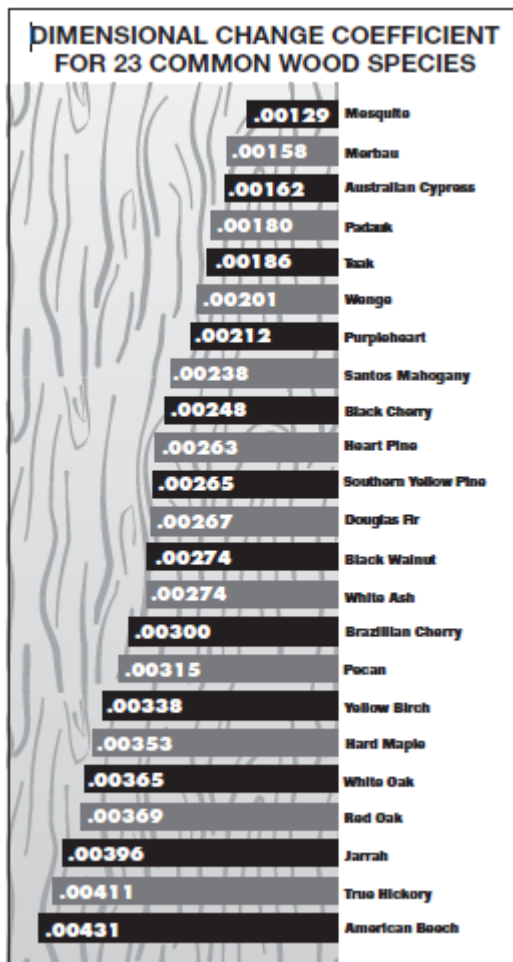
Wood scientists have a formula to determine this. Each species of wood has what is called the coefficient of change which determines precisely what it took to get where it is. The chart below depicts the more popular species.

The moisture map of the United States puts us in an area that has a moisture content average in the winter time of 5% and 9% in the summertime.

So that produces a 4% difference from 5% to 9%.

The formula goes like this:

$\% \text{ change} \times \text{coefficient of change} \times \text{board width} = \text{dimension in decimal. } 2 \frac{1}{4}'' \text{ wide}$



Source: Wood Species Used in Wood Flooring

Example red oak: $4 \times .00369 = .01476 \times 2.25 = .03321$ this represents the expect swell or shrinkage.

Now if the room were 20 feet wide that would amount to 107 boards $\times .03321 = 3'6''$ which could literally push a wall out. Generally at that point it would buckle up from the floor at the weakest point.

5 foot wide wood floor = $4 \times .00369 = .01476 \times 5 = .0738$ or $48 \times .0738 = 3'6''$.

The wider the board the bigger the gap in the case of shrinkage. So applying wood science if installed with too much moisture in the winter abnormal gaps would manifest itself in the winter. If installed with too little moisture the higher RH in the summer could cause the wood to buckle off the floor.

Complicated but applying wood science an inspector can figure out that the wood was not acclimated properly. The manufacturer will not accept a claim in this case.

Proper acclimation documented by moisture readings and measurements of the board width will prove you have properly acclimated the wood and some other cause is influencing gaps or buckling.

Cupping and buckling are always moisture related. Excessive moisture from the subfloor or high relative humidity in the house generally will prove to be the cause. Dry cupping is caused by excessively low relative humidity generally accompanied by face checking. When the top of the wood is excessively drier than the bottom the wood will cup. In no event should the MC at the top of the board and the MC at the

bottom of the board be more than 1%. Measurements of moisture content will determine the cause.

Testing not speculation and just looking at a wood concern is the only definitive way to determine cause.

Flat: The concrete or plywood subfloor must be flat, not level, to within a 1/8" in 6 feet or 3/16" in 10 feet no other determination is acceptable. Concrete must be flattened using self-leveling concrete and wood subfloors by shims.

Sound: Regarding wood subfloors there can be no movement also known as deflection as no manufacturer will consider this a manufacturing defect.

Industry Specifications:

For wood not meeting specifications for warping i.e. cupping, bowing, twist and crook it is the installer's responsibility to not use any boards that do not meet industry specifications. If he does it will be construed as acceptance and no matter how out of spec it may be, there will be no remedy from the manufacturer. Generally pieces not too out of spec can be cut in two and used or used in an inconspicuous area such as a closet. Most mfg.'s state they will reimburse for any faulty wood over 5% so set them aside and don't use them.

When nailing hardwood powerful round magnets will tell the inspector if it is nailed to the mfg.'s requirements. $\frac{3}{4}$ " thick $2\frac{1}{4}$ " wide require a fastener 1" to 3" of each end and 8" to 10" in between. $\frac{3}{4}$ " thick x 3" or wider 1" to 3" end and 6" to 8" in between. Subfloor over concrete hardened steel pins 1 $\frac{1}{4}$ " – 2 $\frac{1}{8}$ " 50% penetration spaced 1 per square foot or as recommended by the fastener mfg.

If gluing the wood down the proper trowel size and adhesive recommended must be followed. Installer must check from time to time and ascertain that the adhesive is adhering to the wood by lifting a board and seeing if it is transferring. Blue tape must be used to keep the wood from separating before the glue can setup enough to hold it in place.

The installer must also determine if the landscaping outside the house is graded 6" in 10' as water pooling against the concrete can cause cupping and buckling. Remember concrete is a ridged sponge. Water against it will be absorbed into the concrete and be a cause for failure.

This paper only deals with the most obvious causes of hardwood failure. It is important that the installer adheres to every part of the manufacturer's installation instructions or be considered at fault.

They are in every box, if not they will tell you to look them up on their website. This is the installer's responsibility. The homeowners is to maintain relative humidity between 30% to 50% and 60 degrees to 80 degrees temperature and under no circumstances close the house up without at least ventilation as this can have an adverse effect on their hardwood floors and no mfg. or anyone else will accept any responsibility should this occur. The owner must follow the manufacturer's maintenance instructions or the manufacturer will accept no responsibility for failures from improperly maintained hardwood floors.

Decker Consulting and Inspections can as an independent and certified NWFA inspector document moisture readings and other facets that can cause a failure. It only takes approximately \$4,000 worth of testing equipment and the training to use them.

Call me for a consultation.



Decker Consulting & Inspections

4800 N Stanton St
Suite 125
El Paso TX 79902

Jim Decker
License # CP235410

Website: www.decker-consulting-inspections.vpweb.com
Email: certifiedhardwoodinspector@gmail.com
NWFA CP Certified Wood Flooring Inspector 915-588-0266

The following pages will depict why moisture testing of concrete is so critical due to the fact that it is in contact with the ground. Attached pictures show what I see every day in commercial buildings. As we walk through most affected commercial installations you will find that RH moisture testing would have revealed that once covered they would be the trouble spots.



Figure 3-2. Adhesive oozing from joints (top) in recently-installed vinyl composition tile on a school floor. New tile (bottom) debonded due to moisture and high pH attack on new adhesive. (IMG16023, IMG16003)



Figure 3-1. Due to excessive moisture and a high pH in the concrete surface, the adhesive under this vinyl backed carpet tile has reemulsified and has lost most of its holding strength. (IMG16042)



Figure 3-4. Osmotic blistering in epoxy floor coating (photo courtesy of Peter Craig, Concrete Constructives).



Figure 3-8. In this residence, wood flooring was glued directly to a damp concrete floor slab; the wood absorbed moisture from the slab, expanded, and buckled (photo courtesy of George Donnelly, Testing and Inspections).