How to Determine Moisture Content at the Time of Manufacturing

There has been great controversy and discussion regarding how to determine the moisture content of solid hardwood at the time of manufacturing. Science has proven it is possible to determine individual board movement using the dimensional change coefficient - whether it would be expansion or contraction. Throughout the remainder of this article I will disclose the process of determination. The first point we must understand is in order to make such calculations we need to obtain absolute values to insert into the dimensional change coefficient formula.

The Process

The first step is data collection of the values needed to insert into the formula. For the best results and the most accurate information you need to obtain four (4) individual sets of input values.

The following procedure is for one set of data collection.

**Step 1.** Mark out a sample area on the floor using blue tape and obtain an overall board width measurement of either a set of 10 or 20 planks depending on size. Flooring width 3-1/4” and under collect a 20 board width (i.e. 3-1/4” x 20 = 65”) and everything over 3-1/4” collect a 10 plank width measurement.

**Step 2.** Obtain individual plank width measurements using a digital micrometer for the 10 or 20 plank measurement depending on size. Measure and record each width on the downloadable field form attached at the end of this document.

**Step 3.** Next obtain individual gap size of the same planks you measured for plank width. Using a feelers gauge or Starrett Taper gauge, measure each gap width and record each measurement on the field form.

**Step 4.** Record temperature and relative humidity using two (2) quality hygrometers and record each on the field form.

**Step 5.** Obtain moisture content measurements of same planks that were measured for plank and gap width. Take two moisture content readings for each plank, one set of MC
with an invasive (pin) style meter and the second measurement using a non-invasive (pinless) meter. Record both readings on the field form and continue this process for the amount of planks you in your sample area. Both meters should have the ability to be set for specie correction or specific gravity adjustment.

**Step 6.** Total each column and obtain an average value for each board width, gap width, temperature, relative humidity and moisture content. Record totals and averages on the field form.

**Step 7.** For the most accurate results, repeat this process in 3 additional locations figuring a total of 4 measurement sets per 1,000 square feet of flooring.

This whole data collection process should take approximately 20 to 30 minutes per set.

**Determining Values**

Before proceeding to enter the recorded values into the dimensional change formula, one must understand what type of values you have.

**Absolute Value:** That is the absolute number from zero whether it is positive or negative.

**Relative Error:** Expresses the “relative size of error” of the measurement in relation to the actual measurement itself.

**Absolute Error:** That is simply the amount of physical error in the measurement.

Here are some facts to consider before one can make a final determination of moisture content at time of manufacturer.

**Moisture Meters:** Depending on the brand and quality of meter you are using the +/- accuracy maybe up to 5% on some inexpensive meters. The next question is when was the last time the meter has been calibrated against equipment that is certified traceable to NIST (National Institute of Standards and Technology)? Therefore the results obtained could only be listed as absolute error.

The moisture meter must have the ability to have specie or specific gravity correction. With today’s market being flooded with imported species, it is important to know what the appropriate setting would be for the meter. For example, one of the hottest flooring trends today is Acacia, which is extremely beautiful, but what many people don’t realize there are 1,400 sub-species worldwide and specific gravity ranging from 25 to 70 making it nearly impossible to set the meter
accurately. Next concern is operator error and the meter programmed to the wrong temperature, specie, specific gravity, pin type or depth will provide inaccurate results. Therefore the results obtained could be listed as absolute error.

**Plank Width:** Manufacturers typically have a +/- allowance of .005 to .010” width allowance. Therefore a 3” wide plain sawn Red Oak plank may range from 2.99” or 3.010” or anywhere in between. When these two (2) planks are installed next to each other they may have a gap the width of a credit card and still comply with manufacturer’s specifications.

**Moisture Content at Time of Milling:** Most manufacturers comply with the industry standards of 6 to 9% moisture content. This could mean 6% in one plank 9% in another or it could mean 6% to 9% in the same plank if grain structure is tighter or a knot involved. Many manufacturers will produce flooring 6 to 8 or even 12 months in advance and place in controlled storage until an order has been placed. If a 3” Red Oak plank dries from 8% to 7% reaching the equilibrium moisture content with its surroundings, the dimensional change would be .011”. Now combine this with the +/- width allowance, this plank could measure 2.979” at the time of install. This same principle would apply if planks were shipped to coastal regions and one could see a 1 to 2% gain in moisture making the plank width oversized by .021”. This is where proper acclimatization plays important role to the success of the flooring project. Therefore the results we obtain could be listed as relative error.

**Installation Methods:** Staples vs. cleats which is better? Which lays a tighter floor? Many professionals have their preference, but in many cases it comes down the goal the installer is trying to achieve. During summer months the installer may want a tighter floor and winter months want a looser installation. If a tightly laid floor gains 3% moisture, the floor could cup and/or go into compression set reducing the original plank width of the flooring and hence, providing a false negative. Another case is where the installer uses washer rows to build spacing into the flooring system to allow flooring to expand. This too will provide wider over all width measurements providing a false negative. Or yet, an installer may have to straighten out a long run by shaving a 1/16” off 8 planks, reducing overall width measurements by 1/2” and providing a false negative. Therefore the results obtained can only be listed as relative error.

**Conclusion:** With all the possible inconsistencies in data collection and the variables mentioned earlier, one does not have absolute values to determine MC at time of manufacture, we only have averages of relative error. Let’s look at how we obtain a relative error value.

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\frac{\text{Measured Value} - \text{Actual Value}}{\text{Actual Value}} = \text{Relative Error}
\]

Let’s figure you obtained 6% moisture meter reading on a plank, yet through oven dry testing the same plank was actually 5% moisture content. The calculation would be as follows:
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\frac{6\% - 5\%}{5\%} = \frac{1}{5} = 0.20 \times 100 = 20\% = \text{Relative Error}
\]

The only way to obtain moisture content “absolute value” would be to oven dry each of the planks you previously recorded on the field form. Without absolute values it is impossible to determine what the actual moisture content was at the time of manufacturing. A manufacturer does random oven dry testing of their lumber to obtain an actual range in moisture content that can range from 6% to 9% with an allowance of 5% reading up to 12% MC. With that said, a manufacturer cannot provide an absolute moisture content unless they oven dry each piece of lumber. However, it is possible to determine what the average moisture content range was during the time of installation.

With the test results (averages) you obtained and documented on the field form one can use this formula to determine the average moisture content range at the time of installation.

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a \div (b \times c) + d = e
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- \(a\) = AVERAGE gap at time of testing
- \(b\) = Coefficient rate of change (i.e. Red Oak .00369)
- \(c\) = AVERAGE Plank width at time of testing
- \(d\) = AVERAGE Moisture content at time of testing
- \(e\) = AVERAGE Moisture content at time of installation

To make it easier to calculate the moisture content at the time of installation you can download a calculator app specially developed and is available on iTunes for $9.99. Go to iTunes app store and download “Woodtek” or visit www.woodtek.biz.

To download the free field form click here.