Wood Ceiling **Acclimatization Handbook**

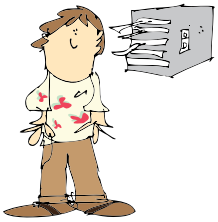
This packet includes the following documents:

- 9Wood Handbook: Wood Ceiling Acclimatization for Professionals
- 2016 N. American Arch. Woodwork Standards (by WI and AWMAC)

This packet is accompanied by the 9Wood Submittal Packet.

If you have any questions about any of the information in this packet, please contact your Project Coordinator.

WOOD CEILING ACCLIMATIZATION FOR PROFESSIONALS



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Contents

Introduction

The quality of your wood ceiling installation can be seriously compromised by improper climate control during or after installation.

This Wood Ceiling Acclimatization booklet has been written to help take some of the mystery and anxiety out of the topic. It's a bit technical—but no more so than a high school science project.

Wood is a remarkable material: versatile, organic, and resilient. The natural beauty of wood has made it an enduring architectural finish. Like all materials, it needs a certain level of understanding to make it work properly. This booklet is designed to promote better understanding on this critical topic, and to help you better understand acclimatization's impacts on your warranty options. It is written with the professional in mind—whether architect, general contractor or acoustical ceiling installer.

If it creates more questions than it answers, don't hesitate to give us a call at 888.767.9990. We can answer your questions and walk you through wood acclimatization.

Charles Coury
President
9Wood, Inc.

P.S. Be sure to take the quiz on page 23 after reading this booklet. The answer key is below. Rank yourself based on number of correct answers out of 9:

8-9 Wood Guild Master
6-8 Wood Guild Journeyman
4-5 Wood Guild Apprentice
0-3 Enroll again

1) a 2) b 3) b 4) c 5) a 6) b 7) a 8) c 9) c

Wood in Buildings
Wood is hygroscopic. This means moisture moves in and out of wood depending on the building's relative humidity. The key to a stable wood ceiling, one without undue movement, is a controlled building environment.

Wood Acclimatization
Wood ceiling acclimatization is the process of your wood ceiling reaching stability with the moisture content in the environment. The point at which this happens is called Equilibrium Moisture Content, or EMC.

Why Bother?
Wood is like a sponge. It even looks like a sponge under a microscope. It absorbs and gives off moisture constantly in response to the environment it lives in. Like a sponge it expands and contracts as it gains and loses moisture. With a sponge we don't care what size it is as long as it gets the job done. With finished wood ceilings we do care because there is a risk of warp, unsightly reveals, or delaminated edge banding.

Environment Parameters
For this purposes of this handbook and 9Wood, Inc.'s warranty, a controlled environment is defined as a Relative Humidity (RH) of 25–55% at temperatures between 60–80°F. An out-of-bounds environment can destroy the beauty and integrity of your wood ceiling.

EMC: Equilibrium Moisture Content. The point at which wood moisture reaches balance with respect to the moisture in the environment.

How Does Acclimatization Affect My Warranty?

9Wood includes a standard one-year warranty on all ceilings whose installations comply with the requirements listed in this booklet for a “Track A” install (see page 15 for details).

9Wood recognizes, however, that various circumstances can prevent a wood ceiling from being installed in a controlled environment. One of two issues usually drives this situation: either the schedule does not allow proper acclimatization, or the HVAC will not be functional enough to control the environment. In such cases, we endeavor to help you mitigate negative effects and offer some viable design solutions.

When you anticipate or discover a less than perfect environment, the strategies outlined in this handbook will greatly increase the chances of a successful installation. 9Wood cannot guaranty, however, that they will always and completely negate the effects of an improperly acclimatized ceiling.

Under such circumstances, there are two options. A project-specific “Assigned Risk Warranty” may be purchased from 9Wood to help manage the added risks associated with uncontrolled acclimatization. Alternately, the customer may decide to forgo warranties of any sort. This leaves all risk with the customer, but avoids the additional cost typically associated with an Assigned Risk Warranty.

Who is Responsible for Acclimatization?

9Wood, as manufacturer/supplier, is responsible to ship a wood product that is within acceptable tolerances for moisture content, size and quantity, wood grade and finish quality.

The **Acoustical Subcontractor** is responsible to assure the material is received, stored, acclimatized and installed in a controlled building environment. The subcontractor is the go-between that links 9Wood and the general contractor and is responsible to notify the GC and 9Wood if there is an environmental problem. How to measure acclimatization is discussed later in this booklet.

The **General Contractor** is responsible to provide an installation environment that is controlled and stable. This means that the building is enclosed, the HVAC is up and running and the environment is stabilized within industry standards. See also On-Site Solutions: When You Discover a Less Than Perfect Environment (page 20).

The **Architect** is responsible to ensure that the wood ceiling is designed and specified with the realities of the building environment in mind (both area climate and building HVAC). See also Design Solutions: When you Anticipate a Less Than Perfect Environment (page 12).

The **Owner** is responsible to ensure that the building environment is maintained throughout the life of the wood product.

These roles track Architectural Woodworking Institute's long-standing advisory entitled "Care & Storage: 1.4 Acknowledgments." AWI sets the industry quality standards for architectural millwork across North America. Please ask 9Wood for a copy or consult Architectural Woodworking Standards, page 46.

1.3.7.1 Abuse of cabinet doors and drawers, for example, may result in damage to them as well as to the cabinet parts to which they are joined.

1.4 **ACKNOWLEDGEMENTS**

1.4.1 **RESPONSIBILITY** for dimensional change problems in wood products resulting from:

2

1.4.1.1 Improper design rests with the design professional.

1.4.1.2 Improper relative humidity exposure during site storage and installation rests with the contractor.

1.4.1.3 Humidity extremes after occupancy rests with the owner.

1.5 **INDUSTRY PRACTICES**

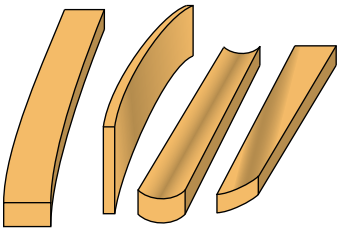
1.5.1 Raising the temperature in a building for a sustained period of time to eliminate the **OFF GASES** is unacceptable and will negatively affect the appearance and performance of architectural millwork.

1.5.1.1 Open joints, warped paneling/doors, and other defects caused by such are not to be considered a defect.

AWI ARCHITECTURAL WOODWORK INSTITUTE

Acclimatization & Equilibrium Moisture Content

Understanding this section is the key to understanding acclimatization. EMC is the moisture content at which the wood is neither gaining nor losing moisture. This is a dynamic balance and fluctuates with changes in relative humidity and temperature in the building. When EMC is not reached prior to installation, wood movement is likely as it seeks balance with the surrounding environment. Low atmospheric humidity typically causes greater problems with wood movement than high humidity. Reaching EMC is the key to acclimatization.



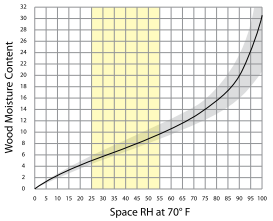
EMC & Warpage

A leading cause of warpage on construction sites is installing the wood prior to reaching EMC. Schedule is often the culprit. Another cause is an environment where humidity levels fall outside acceptable parameters. Rapid fluctuation (such as HVAC flushing) can also cause warpage. Transitory warp occurs when wood products recover their shape once reaching EMC (typical of engineered wood).

Measuring Equilibrium Moisture Content (EMC)

Three tools are needed to determine if the wood product has reached EMC:

1. A temp-humidity recorder to measure the space;
2. A moisture meter to measure the wood; and
3. A calibrated EMC chart (provided by 9Wood).



Monitoring the Environment

Monitoring the building's temperature and humidity is critical throughout the duration of a project. This data can be collected in several ways:

1. The General Contractor assumes responsibility for controlling the construction site and assuring it is acclimated within proper ranges prior to installation. GCs often monitor the space and provide temperature and RH readings.
2. Purchase a Temp-Humidity Gauge for less than $30.00 online and take your own readings. (See forms on page 26 and 27.)
3. Rent a Temp-Humidity Recorder from 9Wood for a $200 refundable fee (less shipping and handling). The digital data can be emailed back to 9Wood and evaluated with our software. (See Rental Form on page 25.)
4. Though expensive, a 9Wood technician can be sent to the job site to assist in monitoring and evaluation.

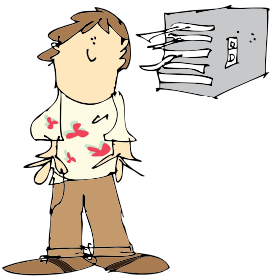
1 Test / 3 Tracks

There is one test—or measurement—of the environment:

- Test 1: Relative Humidity—is the building controlled or not?

There are three tracks—or responses—to this information:

- Track A: Proceed—controlled environment
- Track B: Hazard—uncontrolled environment
- Track C: Caution—exterior installation



Track A: Proceed
Activated HVAC
Normal Relative Humidity

Track B: Hazard
Inactive HVAC
Very Dry Relative Humidity

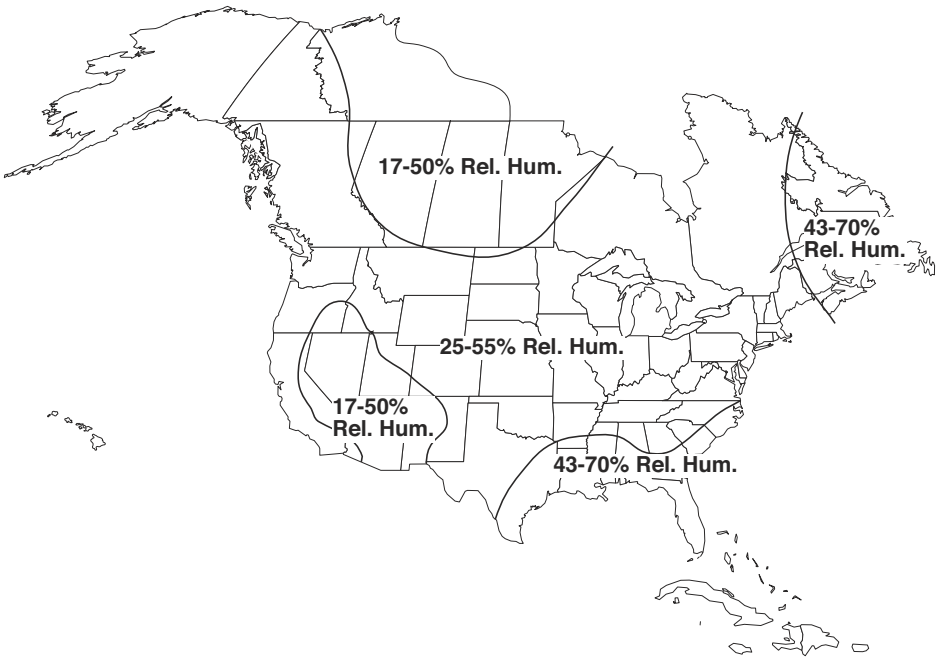
Track C: Caution
Uncontrolled Exterior
Variable Relative Humidity

Measuring the relative humidity is the best way to determine the appropriate track (see next section). Unfortunately, it is often too late in the project life cycle to make critical changes to the product design or suspension. Predicting the building's environment at installation, particularly if anticipating an uncontrolled interior, allows time to change to robust designs and installation techniques that mitigate problems that can arise from an uncontrolled environment.

With a little homework and discussions with the general contractor, a reasonable prediction of either a controlled or an uncontrolled building can be determined.

Location

Using the attached relative humidity map of North America, locate the building by % RH. Note areas with low or high Relative Humidity may require wood ceiling products and designs that are more robust than what are permissible within the standard 25–55% RH.



Some of these areas have additional micro-climates not show.
[USDA Forest Service, Agricultural Handbook No. 72]

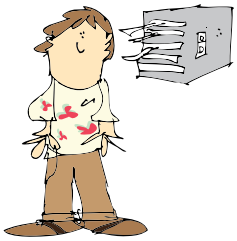
Other Climate Factors

Though location is often a primary factor in anticipating the appropriate track, there are other circumstances that affect the building's environment:

1. **Profile:** 9Wood provides humidity profiles for most locations in North America based on data from the National Oceanic and Atmospheric Administration (NOAA). This can help pinpoint the average % Relative Humidity for the building area.
2. **Schedule:** Determine the pace of the installation; is it fast tracked or conservative? Schedule can often drive an acclimatization process into dangerous territory by insisting on speed at the expense of proper acclimatization. To be forewarned is to be forearmed.
3. **Buttoned Up:** Determine, in concert with the general contractor, if the building will be "buttoned up" by the time of installation. All windows should be installed, wet work complete, and the HVAC operating and stabilized (building has "cured").
4. **HVAC Activation:** Determine if the schedule anticipates that the wood ceiling will be installed prior to HVAC activation. Wood ceilings can often appear flat during initial inspection and installation only to cup and warp following HVAC activation. This is because sudden uneven humidity between rooms and plenums can cause uneven moisture movement—resulting in warping or cupping. Reference Industry Practices (AWS 2009 Standards, 1.5.1 on page 46).
5. **Storage Conditions:** Determine where the wood crates will be stored during the acclimatization process. It is possible that the storage area has significantly different humidity levels than the installation area in the same building. In this case, installing straight from storage will not allow the wood ceiling to reach its true EMC in the installation space.
6. **Temporary Heating:** Temporary heaters can either add excessive moisture or create excessive dryness, depending on the heat source. They should be avoided as a preparation for your wood ceiling acclimatization. Also avoid localized heaters.

Anticipate the Track

After reviewing the geographical location, schedule, HVAC status and other factors, you should be able to anticipate the relative humidity of the building during installation—and consequently the correct track:



Track A: Proceed
If the relative humidity will fall within 25%–55%, then you may proceed.

Track B: Hazard
If there is reasonable concern that the relative humidity will fall outside 25%–55%, be aware of potential hazards. See page 12 for details.

Track C: Caution
If the ceiling will be installed in the exterior of the building, the relative humidity is still important and should be anticipated. Proceed with caution. See page 14 for details.

Design Solutions: When You Anticipate a Less Than Perfect Environment

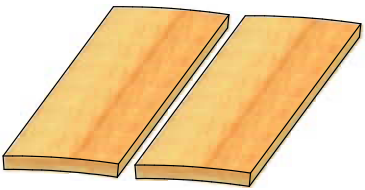
We call those situations a Hazard Track when a reasonable expectation exists that the building will fall outside standard humidity parameters. It is at this point that design steps should be taken to minimize the risk of unacceptable wood movement for your project.

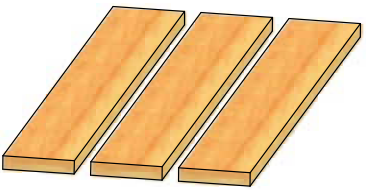
What design considerations can make a difference in an interior space that is on the hazard track? Below is a list of possible design solutions. Consult 9Wood's Technical Desk for help applying these general ideas to your specific project.

Hazard

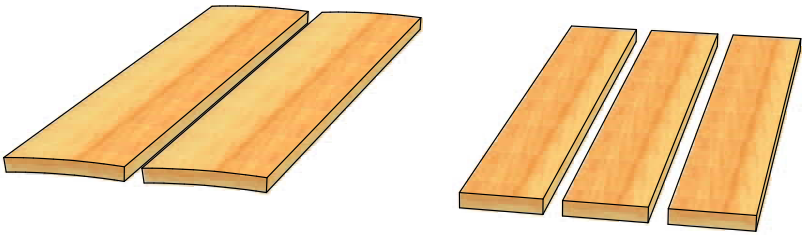
- **Specify Balanced Construction**
  Unbalanced construction of veneered products results in a surprising amount of warp. Symmetry in species, veneer grade and slice, even veneer thickness on either side of the panel's central plane is an important aspect of stable ceiling tiles. Specify (and accept the added cost) that all ceiling panels match the grade, slice and species of veneered products on both the face and the back.

- **Change Specification**
  Some wood products are more environmentally robust than others. For example, 3 ¼" linear members in a "Hazard" environment perform better than 6" wide members. Specify direct-attached products instead of clip suspended products, open reveal linear planks instead of closed-reveal, etc. Consult 9Wood for alternate environmentally robust specs in the product type desired.





- **Change Suspension Systems**
  A general rule of thumb is that the more accessible the wood ceiling attachment system, the more susceptible to wood movement it is. Consult 9Wood for suspension options that perform better in uncontrolled conditions (and especially with low humidity).
- **Enlarge the Reveals**
  Many of the visual difficulties associated with wood movement involve compromised reveals. The wood may shrink and open up the reveals. Or the wood may swell and close the reveals. One simple solution is to enlarge the size of the reveals to assure a larger “forgiveness” for wood expansion and contraction.



- **Purchase More Attic Stock**
  Because wood is made up of natural cell structures, predicting which panel or board will move is impossible. One solution is to procure extra attic stock to change out those panels which are truly warped or compromised visually.

Though there is **no substitute for a controlled environment**, the above suggestions can help mitigate the risks. Remember that the architect is responsible to ensure that the wood ceiling is designed and specified with the realities of the building environment — both during construction and maintenance — in mind.

When You Anticipate an Exterior Environment

We call those situations a Caution Track in which we know that the wood ceiling will be installed in an exterior soffit. Design steps should be taken to minimize the risk of unacceptable wood movement for your project.

What considerations can make a difference in an exterior soffit that is on the caution track? Below is a list of possible design solutions. Consult 9Wood's Technical Desk for help applying these general ideas to your specific project.

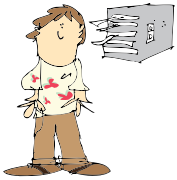
Caution

- **Control the Wood Species and Cuts**
  Certain woods are more resilient than others to exterior weathering. Douglas fir, cedar, and teak will handle exterior applications better than many other species. The cut of wood is also important. Avoid flat sawn woods. Vertical grain or quarter sawn woods are more stable.
- **Use Exterior-Grade Finishes**
  Not all finishes are created equal. Only those finishes designed specifically to handle exterior environments should be specified.
- **Soffits with Non-Corrosive Fasteners**
  Suspended Wood Ceilings for an exterior condition assume soffited construction. Still, it is wise to assure that sufficient structure to support wind load as well as non-corrosive fasteners are used.
- **Create Realistic Joints Between Panels**
  A 1" joint between abutting planks or panels can significantly reduce the visual impact of wood movement.

The above suggestions can help mitigate the risks in an exterior soffited condition. Remember that the architect is responsible to ensure that the wood ceiling is designed and specified with the realities of the exterior environment in mind.v

Phase 2 — Confirming the Track

Once the building is up and enclosed and measurements are possible, it's time to confirm the track you anticipated earlier in Phase 1.



Track A
The relative humidity does fall within 25%–55%.

Track B
The relative humidity does not fall within 25%–55%.

Track C
The ceiling is installed in the exterior of a building.

The next section will walk you through how to take measurements and determine the EMC (Equilibrium Moisture Content) of your wood ceiling. Please reference the charts and graphs on pages 26–28 as you read this section.

The Key Test: Relative Humidity

There is one key test to measure the building's environment: **relative humidity**. Relative humidity (RH) determines which track you should follow. As discussed, it can be anticipated. Better yet, it can be measured. Ideally you should start measuring the building a couple of weeks prior to installation. **You must perform this measurement for at least three days before installation of your wood ceiling.**

Tools

Data loggers are digital devices used to record temperature and relative humidity over a period of time. Often general contractors use data loggers. They can be purchased, or 9Wood will rent them to you. For rental information and forms see page 25.

How to Measure Relative Humidity

To know the fluctuation of the relative humidity in the building space, measurements need to be taken over a period of at least three days (minimum). Leave the data logger in the install space. It will take measurements automatically.

Average Relative Humidity

Next, calculate the average temperature and RH from the daily readings recorded on the chart (taken over a period of days). Use the attached 9Wood Relative Humidity Measurement Form on page 26:

Project Name:	
Date of HVAC Activation:	1/15/20XX

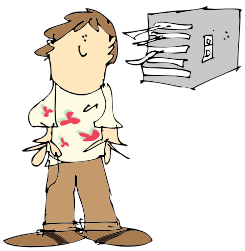
Building Relative Humidity: Area A

	Time	Interior Temp F°	Interior %RH	Exterior Temp F°	Exterior %RH
On-Site -2 Weeks	8:30 am	65	43	85	55
On-Site -1 Week	9:00 am	70	45	70	45
On-Site -3 Days	8:30 am	75	47	80	50
On-Site	8:00 am	70	45	72	45
Average	8:30 am	70	45	77	50

Relative Humidity Measurement Form, page 26

Building Environment Is Controlled Within Acceptable RH Parameters

If you've found that the relative humidity is between 25% and 55% then the space is ready for staging your wood ceiling. Remember that before installing the wood ceiling it must first reach Equilibrium Moisture Content (EMC): the point at which the wood is neither gaining nor losing moisture. In other words, the wood has a stable amount of moisture which is balanced with the surrounding air. Getting to EMC is the key to acclimatization.



Wood Moisture Content and EMC

The moisture content of the wood must be measured to find out if it has reached EMC. We recommend a pin-style moisture meter for this. Some units come with an extra set of longer pins recommended for acquiring readings on veneer overlay products. Pin style meters send out an electrical charge and measure the current between the pins to determine the moisture content. Moisture meters require calibration using the species calibration chart which comes with the meter. Make sure you've selected the correct species or engineered wood (e.g. the wood core not the veneer).

Measuring with the Pin-Style Moisture Meter

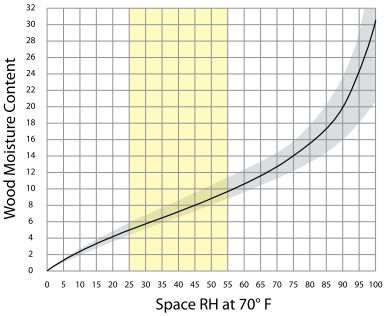
Once the calibration setting is determined and selected on the moisture meter the next step is to take readings of the wood. Moisture content readings (%MC) should be taken from 3 to 5 different panels or planks. Since the pins of the moisture meter make small holes in the surface of the wood, take measurements only from non-visible surfaces. Stab the wood 3-4 times and log the average recording as shown below.

	Species Calibration Used: 3			Wood Moisture Content (%)						
	Temp F°	% RH	Time	Pnl 1	Pnl 2	Pnl 3	Pnl 4	Pnl 5	Pnl 6	Average
Day 1	70	50%	8:30 am	12	10	12	11	12	13	12
Day 2	70	45%	9:00 am	11	10	11	10	11	12	11
Day 3	71	46%	8:30 am	10	9	10	9	10	10	10
Day 4	70	44%	8:30 am	8	8	9	8	9	8	8
Day 5	69	45%	9:00 am	8	8	8	8	8	9	8

Wood Moisture Content Measurement Form, page 27

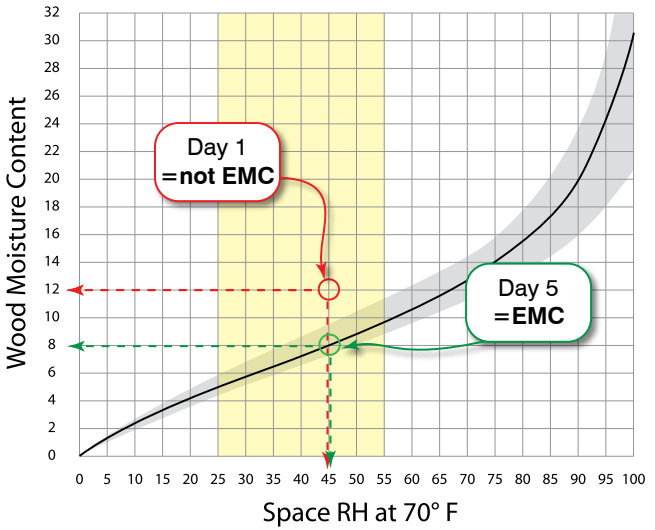
Finding EMC

This is probably the most important page in this booklet. Why? The EMC chart. It tells the story of the wood ceiling's Equilibrium Moisture Content (EMC) based on the relative humidity and temperature of the space where it is to be installed. Temperature affects %RH, but affects EMC very little, so it is estimated at 70°F. The solid dark center line represents white spruce. This is a fair approximation for most common species. Some engineered woods require a calibrated EMC chart, which will be provided by 9Wood. The "Magic Grey Zone" around this line is the safety area. You can find a copy of this chart on page 28.



EMC Chart, page 28

An example: Before and after delivery, the building's humidity readings stabilized at 45% relative humidity in the install location. On day 1 the wood gave readings of 12% using the calibrated moisture meter. Days 2 & 3 showed movement. Then on days 4 & 5 the wood moisture readings stopped moving, stabilizing at an average moisture content of 8%. This is the EMC of wood at a relative humidity of 45%, as shown by the graph. The wood has reached EMC and is ready to install!



Uncontrolled Building Environment

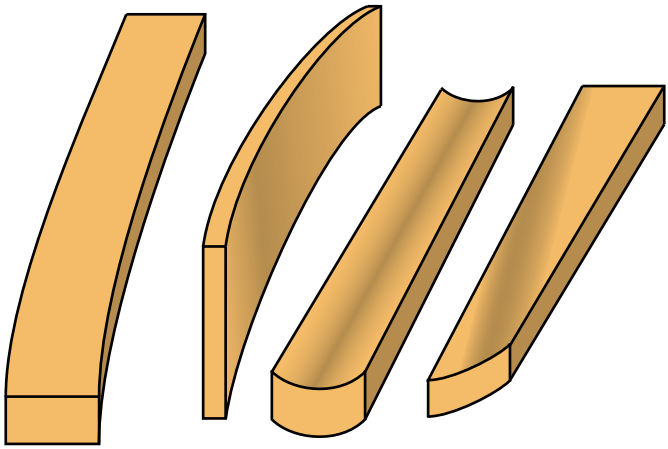
When the building is confirmed to have relative humidity that falls outside 25%–55%, then the project is on a Hazard Track. Managing the Hazard Track also means taking extra care when the HVAC system is turned on. A fast activation can cause wood to warp due to a rapid release of moisture that causes uneven internal stress to build inside the wood.

Whether the environment is within or outside of limits, wood must be allowed to acclimatize. First, take off the lid and sides of the crates. A rule of thumb is 72 hours minimum to reach EMC. But the key is reaching EMC, not the time that has elapsed.

Risk: Unacceptable Wood Movement

Equilibrium Moisture Content: As noted earlier, EMC is the moisture content at which the wood is neither gaining nor losing moisture. This dynamic balance fluctuates with changes in relative humidity.

Warpage: Low humidity is a leading cause of warpage on construction sites. This is made worse by installing the wood prior to the product reaching EMC. Schedule can often drive an acclimatization process into dangerous waters by insisting on speed at the expense of acclimatization. It should be noted that when it comes to suspended ceiling panels, whether metal or wood tiles, all tend to pillow slightly. AWI tolerance for flatness is 0.36”/ft ~ ¼” on diagonal of a 4’x4’ wood panel. This industry standard should also be taken into considerations during design.



The four types of warpage: crook, bow, cup and twist

On-Site Solutions: When You Discover a Less Than Perfect Environment

If your measurements recorded on the forms on pages 26–28 fall outside acceptable parameters described above, steps to control the risk of unacceptable wood movement should be taken:

Hazard

- **Revisit the Design Solutions Proposed Earlier in This Booklet**
  Despite the late schedule, it may still be wise to incorporate some of these features prior to installation.
- **Apply Extra Stiffener Bars**
  In an uncontrolled environment wood ceiling products can be reinforced with mechanical restraints. This is not a guarantee that wood movement will be completely controlled, but can make a significant difference in the amount of movement. The advantage of this option is that a change order for extra restraints can be applied later in the project, or even on the job site itself.
- **Limit Critical Lighting**
  Harsh, natural light or up-lights streaming across a ceiling pose challenges for all types of ceilings in the best of conditions, whether wood or metal. If the wood is subject to movement due to an uncontrolled space, critical lighting may make the ceiling look worse. By limiting, if possible, critical lighting, the visual impact of this movement can be lessened.
- **Achieve the Most Stable Equilibrium Moisture Content Possible**
  Assure the wood ceiling reaches true EMC with the interior space prior to installation. This is CRITICAL. In low humidity situations, reaching EMC may take longer than 3 days. The wood ceiling requires good ventilation during the EMC process. Obviously, the greater the temperature and humidity flux in the building, the more the wood will continue to move.

Though there is no substitute for a controlled environment or a robust design, the above suggestions can help mitigate the risks on-site. Remember, the general contractor is responsible to provide an environment that is controlled and stable. They must be notified by the acoustical subcontractor if there is a problem with the space.

Wood Ceiling is Installed in the Exterior of a Building

The key to a stable exterior wood ceiling is using acceptable wood species and keeping the ceiling from the elements (sunlight, rain, wind). Typically ceilings are adequately protected in a soffited condition.

Managing the Caution Track also means taking care to insure that the soffit condition keeps the wood system protected, using exterior grade finishes and securing the ceiling system with adequate mechanical fasteners. This is a Caution Track because a lack of care on the part of the Installers or General Contractor can result in unnecessary problems with warping, cracking and discoloration.

Risk: Unacceptable Warping, Cracking and Discoloration

- **Warpage**
  Lack of sufficient fasteners and inadequate expansion/contraction joints can cause exterior wood applications to warp, cup, bow or twist.
- **Cracking**
  Extremes in moisture and UV exposure cause cracking (technically called “checking) in exterior wood ceilings.
- **Discoloration**
  Discoloration in exterior wood ceilings typically has three possible causes: Direct UV exposure that discolors the wood and finish, moisture retention that “clouds” underneath the finish, and the use of corrosive fasteners that streak the wood.

On-Site Solutions When you Discover a Less Than Perfect Exterior Situation

If your measurements recorded on the forms on pages 26–28 of the local climate or specific building environment reveal a harsh exterior climate, steps to control the risk of unacceptable wood movement should be taken:

Caution

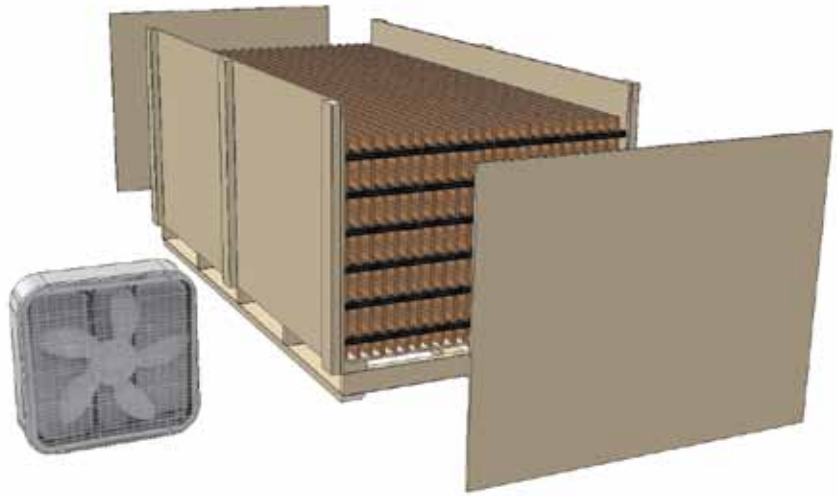
- **Use Non-corrosive Fasteners**
  Stainless steel or galvanized fasteners should always be used when installing exterior wood ceilings.
- **Add More Mechanical Fasteners**
  Placing mechanical fasteners at robust intervals (e.g., at least 12” oc) and especially at end of a plank will help reduce wood warpage.
- **Place Realistic Joints Between Panels**
  For example, a 1” joint between abutting planks or panels can significantly reduce warpage.

Though there is no substitute for a robust design in an exterior condition, using correct soffit protection and secure suspension, the above suggestions can help mitigate on-site the risks of improper warpage.

Crate Handling for Best On-Site Acclimatization

The goal of crate handling is to help the newly arrived wood ceiling reach a moisture balance with the building's environment as efficiently as possible. A classic technique is to open the crates to the surrounding air. This needs to be done carefully:

- ☐ Receive (sign for) crates at project job-site (directly from trucking company or from temporary warehouse storage).
- ☐ Place crates at job-site in FINAL environmental conditions. Be careful of storage rooms, which may or may not share the RH of the installation space.
- ☐ Remove lid and open both ends of each crate.
- ☐ (Optional) Place fans in vicinity of crate—perpendicular only (as shown below). Do not blow air directly on wood as this may create "transitory warp" in the product.
- ☐ (Optional) For accelerated acclimatization in certain products, uncrating and re-stacking is an option (Continuous Linears, Acoustic Planks, 2x2/2x4/4x4 Tiles). This process requires CAREFUL sticker alignment when stacking. Consult a 9Wood project manager.
- ☐ Allow material to reach EMC with final building environmental condition. Time is a rule of thumb only (i.e. 72 hours). The key is knowing when the on-site wood ceiling has reached EMC with a stable building environment.



Take this quiz to test your professional knowledge of wood acclimatization. Circle the correct letter — answer key is on page 3.

1) EMC stands for
   a) Equilibrium Moisture Content
   b) Equilibrium Moisture Constant
   c) Equilibrium Moisture Consent

2) EMC means
   a) The axis along a board at which moisture is balanced on both sides.
   b) The point at which wood is neither absorbing nor desorbing moisture.
   c) The technique in which veneers are assembled in a balanced construction.

3) Wood acclimatization means
   a) The moment at which wood reaches moisture balance with its surroundings.
   b) The process in which wood reaches moisture balance with its surroundings.
   c) The study of how wood reaches moisture balance with its surroundings.

4) Materials which absorbs and desorbs moisture are called
   a) Hyperscopic
   b) Hydroscopic
   c) Hygroscopic

5) Tools needed to determine if wood has reached EMC are
   a) Wood Moisture Meter, Relative Humidity/Temperature gauge, EMC Chart
   b) Wood Moisture Meter, Relative Humidity gauge, EMC Chart
   c) Wood Moisture Meter, Relative Humidity/Temperature gauge

6) Relative humidity (RH) is
   a) The amount of moisture in the air, expressed as a percentage of the amount of water the air can hold at 70°F degrees.
   b) The amount of moisture in the air, expressed as a percentage of the maximum amount that the air could hold at a given temperature.
   c) The amount of moisture in the air, expressed as a percentage of the amount of water the air can hold.

7) Wood moisture means
   a) The amount of water stored within wood in a given period of time.
   b) The amount of water released into the surrounding environment.
   c) The amount of moisture contained in wood following kiln drying.

8) Warpage means
   a) Veneers that have delaminated.
   b) Wood that has moved unacceptably.
   c) Wood that has cupped or twisted.

9) Track B (Hazard) is 9Wood's term relating to building situations where
   a) The building is not within: RH below 35%.
   b) The building is not within: RH below 15% or over 80%
   c) The building is not within: RH below 25% or over 55%.

- Understanding Wood: A Craftsman Guide to Wood Technology, R Bruce Hoadley, Taunton Press, Newtown, CT, 2000.
- Architectural Woodwork Standards (www.awinet.org)
- CISCA Wood Ceilings Technical Guidelines, Chapter 4 & 5 and Glossary.
- Oregon State University, Oregon Wood Innovation Center, http://owic.oregonstate.edu
- Tech Support at 888.767.9990
- Tech Articles at www.9wood.com
- Lignomat USA LTD (www.lignomat.com) – source for wood moisture meters

Glossary of Terms

- Acclimatization: the process in which wood reaches EMC with the surrounding environment.
- Architectural Woodworking Institute (AWI): an organization that defines woodworking standards developed by architects and millworkers.
- Equilibrium Moisture Content (EMC): the point at which wood is neither absorbing nor desorbing moisture.
- Hygroscopic: Describes a material that absorbs and desorbs moisture.
- Moisture Meter: a tool for measuring wood moisture (usually by %). Typically they require calibration to the material (species) being measured.
- Relative Humidity (RH): the amount of moisture in the air, expressed as a percentage of the maximum amount of water the air could hold at a given temperature.
- RH/Temp Gauge: a tool for measuring relative humidity and temperature.
- Species Calibration Chart: Moisture meters require calibration for specific wood species and building materials to record correct moisture percentages. These come with moisture meters.
- Track A (Proceed): 9Wood's Track for when the building climate is within standards: a relative humidity between 25%–55%.
- Track B (Hazard): 9Wood's Track for when the building climate is not within standards: a relative humidity outside 25%–55%.
- Track C (Caution): 9Wood's Track for the exterior of a building.
- Transitory Warp: Temporary warp which recovers back to normal after reaching EMC; occurs mostly with engineered wood products.
- Warpage: the unwanted movement of wood, of which there are 4 main types: Cup, Bow, Twist, and Crook (Kink is restricted Crook).
- Wood Moisture: the amount of water stored within wood in a period of time.

Relative Humidity Measurement Form

Project Name:	
Date of HVAC Activation:	

Building Relative Humidity: Area A

	Time	Interior Temp F°	Interior %RH	Exterior Temp F°	Exterior %RH
On-Site -2 Weeks					
On-Site -1 Week					
On-Site -3 Days					
On-Site					
Average					

Building Relative Humidity: Area B

	Time	Interior Temp F°	Interior %RH	Exterior Temp F°	Exterior %RH
On-Site -2 Weeks					
On-Site -1 Week					
On-Site -3 Days					
On-Site					
Average					

Building Relative Humidity: Area C

	Time	Interior Temp F°	Interior %RH	Exterior Temp F°	Exterior %RH
On-Site -2 Weeks					
On-Site -1 Week					
On-Site -3 Days					
On-Site					
Average					

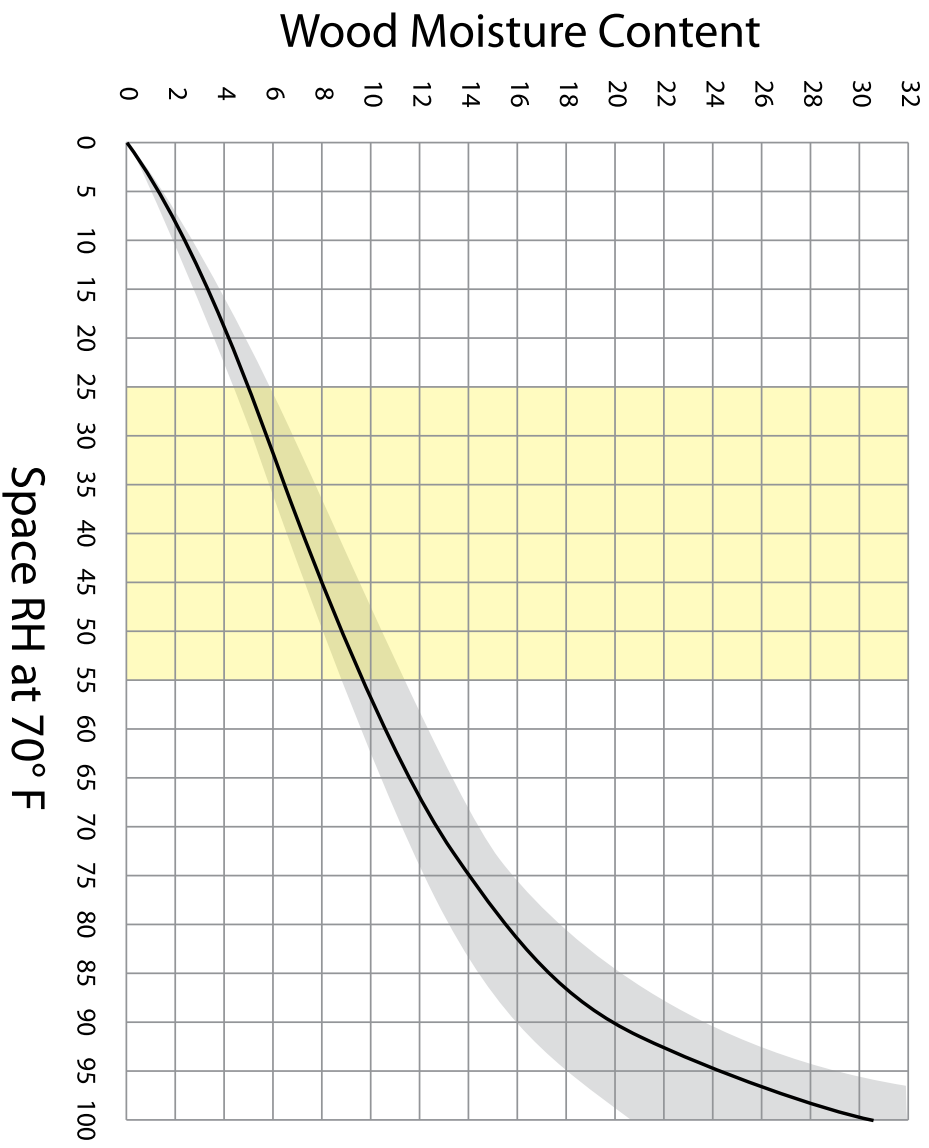
Wood Moisture Content Measurement Form

Project Name:	
Date of HVAC Activation:	

	Species Calibration Used:			Wood Moisture Content (%)						
	Temp F°	% RH	Time	Pnl 1	Pnl 2	Pnl 3	Pnl 4	Pnl 5	Pnl 6	Average
Day 1										
Day 2										
Day 3										
Day 4										
Day 5										

Name:	

EMC Chart


Wood Moisture Content
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32
Space RH at 70° F
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

Forms / Charts:

- ☐ Relative Humidity Measurement form (p. 26)
- ☐ Moisture Content Measurement form (p. 27)
- ☐ EMC chart (p. 28)
- ☐ Humidity Profile of the building location

Tools:

- ☐ RH Data Logger or temp/RH gauge
- ☐ Wood Moisture Meter with Species Calibration Chart
- ☐ Computer with Internet/e-mail access

Steps:

- ☐ Step 1: **Anticipate Track**
  - ☐ Determine Building Zone on RH Map
  - ☐ Determine Area Humidity Profile
  - ☐ Anticipate construction schedule for Installation
  - ☐ Anticipate degree of building button-up at Installation
  - ☐ Anticipate HVAC activation at Installation
  - ☐ Determine Storage Conditions
- ☐ Make Design Adjustments as needed

- ☐ Step 2: **Confirm Track**—Measure RH% of space in anticipation of wood arrival
  - ☐ Leave temp/RH gauge on-site to measure relative humidity
    - ☐ Measure 2 Weeks prior to wood on-site (use RH form on page 26)
    - ☐ Measure 1 week prior
    - ☐ Measure 3 days prior
    - ☐ Measure once wood is on-site

- ☐ Step 3: **Stage Material**—Wood on-site measurements
  - ☐ Stage material
  - ☐ Remove crate sides and allow airflow
  - ☐ Select panels/members at random to measure (6+)
  - ☐ Measure wood moisture content selected at random (plus Temp/RH) using the moisture content form on pages 27.
    - ☐ Day 1
    - ☐ Day 2
    - ☐ Day 3
    - ☐ Day 4
    - ☐ Day 5
    - ☐ Day 6

- ☐ Step 4: **Achieve EMC—**Determine if wood has reached EMC using the EMC chart on page 28.
  - ☐ (Optional) e-mail data to 9Wood for EMC validation

- ☐ Step 5: **Install**—(once at stable EMC)

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