

SONORA FLOORS

Installation Guidelines

INTRODUCTION

When buying flooring, in order to protect your investment, it is extremely important that you understand this information prior to beginning, since improper installation can void all manufacturing warranties.

These installation guidelines should be strictly followed. If one of the following recommendations is not followed, the floor and installation may fail.

These instructions are for the qualified, experienced hardwood flooring installer. For more details on the basics of installing hardwood flooring, please contact the National Wood Flooring Association at 800-422-4556, or visit www.nwfa.org.

ORDER ENOUGH PRODUCT

As a natural product, hardwood flooring can have boards that are defects that occur during the manufacturing process or naturally as a characteristic of the wood species. Accepted industry standards allow for up to 5% defective product (either natural or manufacturing related) based on the original hardwood flooring purchased. At least 5% - 8% additional flooring product should be ordered above actual square footage to allow for cutting, grading and culling of the material. For #2, #3, or Rustic grades, order an extra 10% - 12%.

MANUFACTURER HAS NO CONTROL WHERE FLOORING IS STORED

Once the end user receives the product, the manufacturer and seller have no control over where the product was stored, or if it was placed in a damp area, or on a concrete substrate that was giving off moisture vapors. Do not store in the garage or outside. This is the precise reason that all manufacturers and industry installation guidelines insist that the installer and end user must properly acclimate the wood flooring to bring it to within 2% of the wood sub floor or concrete substrate. In addition, the installer must check the moisture content of the boards to make sure they are not too dry or too wet and that the sub floor is not producing excessive moisture. This is not the responsibility of the manufacturer or the seller. It is clearly one of the installer.

PRE-INSTALLATION & JOBSITE CONDITIONS

It is the installer/owners responsibility to check and ensure that the job site is environmentally and structurally acceptable prior to the installation of Sonora Floors.

NORMAL LIVING CONDITIONS

The job site must be climate controlled "normal living conditions" for at least one week before

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any wood flooring is delivered.

The National Wood Flooring Association states that wood floors perform best when the home's environment is within “normal living conditions”:

- Relative humidity is between 40% to 50% (preferably 45% to 50%).
- Temperature is from 60° F to 80° F (preferably 68° F to 72° F).
- Thermostat fan switch is left “ON” to provide a constant flow of air across the floor.

ACCLIMATION OF SOLID WOOD FLOORING

Acclimation is not a “length of time measurement”, it is a function of making sure the moisture content of the floor boards to be installed are within a 2% range of the sub floor’s moisture content.

Stack boxes in an alternating cross manner, at least 4” off the sub floor, to allow air circulation. Open box ends and any plastic wrap. If possible, spread out individual boards in the rooms to be installed. Leave them sitting for at least one week. This will allow boards to acclimate to the “normal living conditions” that will be experienced when the job is finished and occupied.

ACCLIMATION OF ENGINEERED FLOORING

Because engineered floor boards are much more stable, Sonora recommends the following:

- Store on the job site
- For 72 hours
- At “normal living conditions” as described above
- Leave boards in sealed cartons until installation

FAILURE TO CONDUCT MOISTURE TESTING IS THE NUMBER ONE INSTALLER ERROR

The installer must conduct mandatory moisture testing of wood floor boards and sub floors. Use a pin type moisture meter on boards and wood sub floors. Concrete substrates require “special” concrete meters or calcium chloride testing. Planks (3” or wider) boards must have a moisture content that is within 2% of the moisture content in the sub floor. Strip (2 1/4”) boards must be within 4%.

CONCRETE SUBSTRATES – ONLY FOR ENGINEERED FLOORING – CALCIUM CHLORIDE TEST

Moisture transfer must not exceed 3 lbs/1000 square feet with this test. One test must be performed every 250 square feet. These test kits can be found at installation supply firms, online at www.taylortools.com, or by calling (888) 216-TEST (8378).

TRAMEX CONCRETE MOISTURE ENCOUNTER METER

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Moisture readings using this meter should not exceed 4.5 on the upper scale.

www.tramexltd.com

MOISTURE BARRIER SYSTEMS

The following moisture barrier systems are recommended. They carry a warranty from their manufacturer:

- Bostik – MVP4
 - www.bostik-us.com
 - Technical Services 800-523-6530

Please remember that your warranty against moisture vapor transmission comes from the manufacturer of the sealer. Sonora does not warranty products we do not manufacture.

INSTALLER MUST CHECK CRAWL SPACE

The National Wood Flooring Association installation guidelines states, in Section 1, Chapter 1, Page 1, "Acceptable Job Site Conditions", that the installer/retailer is responsible for checking to see if the job site conditions are acceptable for a wood floor installation. These checks should be done long before the installer arrives on the job site to start the installation. In this case, a quick inspection when the job estimated would have revealed that the crawl space was unacceptable, and therefore the job site was not ready for a wood flooring installation. Current guidelines for crawl spaces are: "There must be a minimum of 18" from the ground to the underneath side of joists, they must be dry (no apparent or standing water) and must be covered 100 percent by a vapor retarder of 6-mil black polyethylene that is overlapped 6" and lapped up the walls 6". Crawl spaces also should have 1.5 percent of open venting per 1,000 square feet (92.90 square meters) of floor area, and the venting should be properly located to foster cross ventilation. In addition to these guidelines, installers must check and follow local building codes.

CONCRETE SUBSTRATE MUST BE LEVEL

It is the installer's responsibility to make sure the concrete substrate is flat within 1/8" in 6' and 3/16" in 10 feet. If it is not, then the high points must be ground down and the low valleys filled with leveling compound. Furthermore, the concrete substrate must be free of all contaminants, i.e. paint, varnish, kerosene from heaters, dry wall paste, crayon marks, grit, soil, and other foreign chemicals and substances. Once they proceed to install the floor, they are assuring all of the parties involved that the concrete substrate has been inspected, is level, free of all contaminants, and is acceptable, resulting in a properly installed floor.

WOOD SUBFLOOR MUST BE LEVEL

In the Chapter 4 of The National Wood Flooring Association's Installation Guidelines (Wood Subfloor Guidelines), it states that wood subfloors must be flat, clean, dry, structurally sound, free of squeaks, and free of protruding fasteners. For installations using mechanical fasteners of 1

1/2" and longer, the subfloor should be flat to within 1/4" in 10', or 3/16" in 6'. For glue down installations, and installations using mechanical fasteners of less than 1 1/2", the subfloor

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should be flat to within 3/16" in 10', or 1/8" in 6'. If peaks or valleys in the subfloor exceed the tolerances specified above, sand down the high spots and fill the low spots with a leveling compound or other material approved for use under wood flooring. However, it is the builder's or general contractor's responsibility to provide the wood flooring contractor with a subfloor that is within the tolerances listed above. If there is movement or squeaks in the subfloor, refasten the subfloor to the joists in problem areas. Protruding fasteners are easily remedied by driving those fasteners deeper into the subfloor.

DRY LAY FLOOR FIRST

You should expect variations in color tones, shade, grain, and character marks in your wood flooring. Meet with your installer. Have them open the boxes and pull boards at random from many different cartons. Then ask them to dry lay and arrange planks to suit your personal taste. Now is the time to let the installer know what you like and dislike *before* they install the first board.

HOME OWNER – END USER RESPONSIBILITY

Your presence during the installation is crucial. Approximately 40% of installation failures and/or customer dissatisfaction are due to installer error. If you choose not to be present, you forgo the ability and right to participate in the board selection process. In doing so, you have left it up to the installer's judgment for arranging floor boards according to natural variations such as color, grain, and length. Neither the wood flooring manufacturer nor the seller can be held responsible for any unpleasant surprise resulting from the installer's lack of qualifications or poor judgment. *Once installed, you and the installer own the floor.* The responsibility to resolve any dispute is between you and your installer. This has long been an industry accepted rule.

NEW CONSTRUCTION OR REMODELING

BUILDER AND INSTALLER CHECKLIST

The National Wood Flooring Association states, in their technical publication, A-100 Water and Wood, page 14, and Sonora states that laying the floor should be the LAST STEP in your project.

Even BEFORE the wood flooring is delivered, make sure that:

- A) The house is closed or sealed in with all doors and windows installed.
- B) Plaster, paint, and plywood sub floors and/or concrete substrates are thoroughly dry.
- C) All plumbing or wet trades must be completely finished.
- D) The foundation is dry and the basement is well ventilated.
- E) The floor in the crawl space (if it has one) is completely covered, overlapped, and lapped up the wall six inches by a 6-8 mil black polyurethane plastic film.
- F) The heating or ventilation system is working properly and that the conditions inside your room(s) where the wood flooring installation is to take place have been kept at an approximate temperature of 68° F (20° C), and a relative humidity of between 40% and 50% for at least one week prior to the acclimation of the wood flooring to its normal climatic environment that it is to perform in.

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G) Solid wood flooring is acclimated for minimum of at least one week prior to its installation (the wood manufacturer's installation guidelines do supersede). Furthermore, the room's temperature and relative humidity must be kept at the recommended levels shown above, with a constant flow of air across the floor, during and after the installation until the end user moves into the rooms and/or house and controls the climatic conditions to their preference.

A failure to make sure that EVERY ONE of these industry proven steps are meticulously followed can result in splits, cracks, cupping, buckling, board delamination, finish flaking, blisters, bubbles, face checks, and peeling, or other major problems with the wood flooring.

DO NOT INSTALL TOO EARLY

Sonora Floors and the National Wood Flooring Association agree that “pre-finished” wood floors are defined as a factory-finished product requiring installation only. When wood floors are installed, all other trades should have finished their work on the job site. By being installed the week before the closing date, the newly installed wood floors will be subject to less potential for damage. The floor will remain in top condition for the consumer's final walk-through.

Pre-finished wood floors should be climatized, as it is installed during the same time frame as carpet. By coordinating the timing of the two installations, there should be less construction traffic, and the heating and air conditioning units can be activated a week before the installation. If this industry proven practice is not followed, the installation will look great at move in, but shortly thereafter the floor will begin to separate. What caused the problem? Acclimation to the job site conditions. Where was the flooring stored on the job site for acclimation? *The likely answer to the problem is that the pre-finished floor was installed too early.* The product should not have been installed on the job site before the new home was under climate control for at least one week. The floor was stabilized to an elevated moisture content, not to conditions after move-in. Also, after move-in, the heat or air conditioning (air movement) systems removed a portion of the job site moisture from the wood, allowing a reduction in the face width which resulted in visual conditions such as: separation between boards (cracks or gaps), face checks, splits, cupping, delamination, raised grain, finish problems, etc.

DO NOT USE PROTECTIVE COVER

The use of protective coverings that are not “breathable” such as plastic, paper, cardboard, Masonite, carpet or carpet padding, etc., over new wood floors may cause future moisture related problems. Like a lid on a Tupperware jar, these kind of protective coverings will trap moisture normally being released by the boards and drive it back down into the wood flooring and subsurface. The overall effect is that of a “hot house” as the boards overheat and go into stress shock. This can result in elevated moisture levels, cupping, crowning, buckling, board delamination, peeling, or flaking of the finish, side and end joint gaps, stress fracture face checks, or split ends. This is NOT the result of any manufacturing deficiencies in the wood flooring product. The burden to resolve this issue is that of the person who chose to cover the floor.

PREVENTING GAPS BETWEEN BOARDS

If the wood flooring was delivered to a new home and was installed prior to the conditioning of

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the home through its air conditioning and heating system, gaps between planks may occur at a later date. In addition, there would have been no consistent movement of air across the new wood floor. When it was turned on, it would have caused the home to start drying out due to the dehumidifying action of the air conditioning and/or heat. During this time it extracts most of the moisture out of the wood floor, making the wood contract or shrink and allow objectionable gaps to occur. Wood flooring is a part of the interior finish. Just like a grand piano, wood flooring should not be delivered or installed until after all of the construction dampness is gone, the building closed in, and under complete, stable temperature and humidity control.

We recommend:

- A) Letting a humidifier run in the home until the relative humidity comes within the recommended 40% to 50% level (preferably 45% - 50%) with the temperature between 60° and 80° F, preferably between 68° to 72° F. This level should be maintained for another two weeks until stable. Then closely examine these gapped planks.
- B) As needed, rework the planks or replace the gapped planks. Once the floor has gone through a complete year of seasons and gaps have not filled up, *they will remain gapped*. Sanding and refinishing the floor will do nothing to improve the appearance. Filling in the cracks with putty would be a “band-aid” approach, as the putty will become loose and fall out as the boards expand and contract.

PRE-INSTALLATION WARNING: Sonora Floors is designed and manufactured to strict manufacturing tolerances for use in typical residential environments. Once our quality product “leaves our hands”, we no longer have any control. Only you, the installation contractor, can conduct the mandatory moisture testing of the sub floor and boards to make sure they are within 2% or less of each other. If the interior relative humidity is too high or too low, you are responsible to alert all parties of the issues you're having. If the relative humidity is less than 40%, installed boards may cup, split, check, crack, shrink (or delaminate, if engineered). In such dry conditions, we recommend the use of humidifier to introduce moisture to the home. Floor boards installed onto a wet sub floor may experience checks, splits, crowning, cupping, buckling, shrinking, swelling, coreboard telegraphing (if engineered), delamination or edge or cornering edge raise. It's possible the installed boards can be soaked from above by clean-up crews or other contractors in the home.

Again, conduct the **MANDATORY** moisture testing on the sub floor and new floor boards. **DO NOT INSTALL THIS FLOORING ON A WET SUB FLOOR OR WHEN THE HOME'S ENVIRONMENT IS EXPERIENCING DRY CONDITIONS.**

RELATIVE HUMIDITY REALLY MATTERS

When the indoor relative humidity is maintained at a consistent level throughout the year, natural expansion and contraction of the boards will be minimized.

- During the heating season, forced air heating, wood stoves and electric heat tend to create very dry conditions. A whole house humidifier is recommended if the home has a forced air heating system. Otherwise, the use of a portable humidifier is a good choice. An average size portable humidifier is suggested for every 400 square feet of installed flooring. Be sure to read the humidifier's operating instructions for best results.

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- Non-Heating Season: The reverse is usually the issue. The home's air conditioner or a dehumidifier should be used to lower the interior relative humidity if it exceeds 50%. Turning on the heating system periodically can also control the interior environment.

WOOD FLOORING HAS A COMFORT LEVEL, TOO

The National Wood Flooring Association states the following in page 5 of their technical publication A-100, entitled "Water and Wood":

Wood flooring will perform best when the interior environment is controlled to stay within a relative humidity range of 30% to 50%, and a temperature range of 60°F to 80°F. Fortunately, that's the same comfort range most humans enjoy. The chart below indicates the moisture content the wood will likely have at any given combination of temperature and humidity. Note that equilibrium moisture contents in the recommended temperature/humidity range coincide with the 6% to 9% range within which most hardwood flooring is manufactured. Although some movement can be expected even between 6% and 9%, wood can expand and shrink dramatically outside that range.

Wood floors perform best when the interior environment's relative humidity range is kept between 35-50% (preferably 45-50%). The temperature range from 60-80 degrees Fahrenheit is acceptable, but the ideal temperature is 68 degrees Fahrenheit.

To recap, the ideal:

- Relative humidity is 45%.
- Temperature is 68 degrees Fahrenheit.

When these guidelines are not maintained, damage to your wood floor will be most likely to occur. Some of these objectionable appearances can be, but are not limited to, dry cupping, cracking, splits, cracks, gaps at joints, delamination of plies, finish issues such as peeling, flaking, chipping, rupturing, wet cupping, tenting, buckling or noises emitting from the floor when walked on.

It is extremely important to keep the environment surrounding your wood floor at the "normal" living conditions as described above. If necessary, heating systems, air exchanges, air conditioners, dehumidifiers, whole house or portable humidifiers should be used to control these environmental conditions.

Because wood is a natural material that is hygroscopic, it constantly reacts to the moisture (relative humidity), high or lack of in the home's environment.

While the temperature of the interior environment is an important factor, it is absolutely critical to maintain a relative humidity of no lower than 35 percent and no higher than 50 percent.

Stagnant air is not good for wood flooring; therefore, we recommend that you leave the HVAC system's fan switch in the "On" position to provide a flow of air across the floor.

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If away from home, the climate controls should be left within the parameters suggested above.

The key to preventing future problems with your hardwood flooring is to keep the job site environment within its comfort zone at “normal living conditions”. See the peach colored box in the chart below.

MOISTURE CONTENT OF WOOD AT VARIOUS TEMPERATURES AND RELATIVE HUMIDITY READINGS																				
30°F	1.4%	2.6%	3.7%	4.6%	5.5%	6.3%	7.1%	7.9%	8.7%	9.5%	10.4%	11.3%	12.4%	13.5%	14.9%	16.5%	18.5%	21.0%	24.3%	26.9%
40°F	1.4%	2.6%	3.7%	4.6%	5.5%	6.3%	7.1%	7.9%	8.7%	9.5%	10.4%	11.3%	12.4%	13.5%	14.9%	16.5%	18.5%	21.0%	24.3%	26.9%
50°F	1.4%	2.6%	3.7%	4.6%	5.5%	6.3%	7.1%	7.9%	8.7%	9.5%	10.4%	11.3%	12.4%	13.5%	14.9%	16.5%	18.5%	21.0%	24.3%	26.9%
60°F	1.6%	2.5%	3.6%	4.6%	5.4%	6.2%	7.0%	7.8%	8.6%	9.4%	10.2%	11.1%	12.1%	13.3%	14.6%	16.2%	18.2%	20.7%	24.1%	26.8%
70°F	1.3%	2.5%	3.5%	4.5%	5.4%	6.2%	6.9%	7.7%	8.5%	9.2%	10.1%	11.0%	12.0%	13.1%	14.4%	16.0%	17.9%	20.5%	23.9%	26.6%
80°F	1.3%	2.4%	3.5%	4.4%	5.3%	6.1%	6.8%	7.6%	8.3%	9.1%	9.9%	10.8%	11.7%	12.9%	14.2%	15.7%	17.7%	20.2%	23.6%	26.3%
90°F	1.2%	2.3%	3.4%	4.3%	5.1%	5.9%	6.7%	7.4%	8.1%	8.9%	9.7%	10.5%	11.5%	12.6%	13.9%	15.4%	17.3%	19.8%	23.3%	26.0%
100°F	1.2%	2.3%	3.3%	4.2%	5.0%	5.8%	6.5%	7.2%	7.9%	8.7%	9.5%	10.3%	11.2%	12.3%	13.6%	15.1%	17.0%	19.5%	22.9%	25.6%
	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	98%
<p>Table Key: The far left column represents interior temperature of the job site. The lower column represents the relative humidity level of the job site. The corresponding value represents the likely moisture content of the hardwood flooring, given the job site temperature and relative humidity values.</p> <p>The values highlighted this color represent the ideal moisture content levels of the hardwood flooring (and the corresponding ideal job site temperature and relative humidity levels).</p> <p>Chart taken from Wood Handbook: Wood as an engineering material, (Agricultural Handbook 72), Forest Products Laboratory, U.S. Department of Agriculture.</p>																				

Moisture meter manufacturers state that moisture meters accurately measure the moisture content of wood products when the moisture content is in the range of 6% to 30%. Any moisture meter readings outside of the range of 6% to 30% will not be scientifically accurate. Through deductive reasoning and the data obtained from the Forest Products Laboratory, US Department of Agriculture, an accurate estimation of the wood's moisture reading can be determined.

WOOD SUBFLOOR GUIDELINES

Part I – Wood Subfloor Specifications

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- Subfloor panels should conform to US Voluntary Product Standard PS1-95, Construction and Industrial Plywood and/or US Voluntary PS2-04 and/or Canadian performance standard CAN/CSA 0325.0-92 Construction Sheathing. Other CSA standards also apply.
- Solid-board subflooring should be $\frac{3}{4}$ " x $5\frac{1}{2}$ " (1" x 6" nominal), Group 1 dense softwoods, No. 2 Common, kiln-dried to less than 15 percent moisture content.
- Both CD EXPOSURE 1 plywood and OSB Exposure 1 subfloor panels are appropriate subflooring materials, but the proper thickness of the material will be determined by the factors noted below in **Part IV – Panel Products Subflooring, E – Acceptable Panel Subfloors**.
- Particle board is **NOT** recommended by Sonora Floors.

Part II – Subfloor Moisture

Note: The National Association of Home Builders' Green Home Building Guidelines contains the following directive under Section 5.3.8: “NAB Model Green Home Building Guidelines: Check moisture content of wood flooring before enclosing on both sides. Ensure moisture content of subfloor/substrate meets the appropriate industry standard for the finish flooring material to be installed.”

- For solid strip flooring (less than 3" wide), there should be no more than 4 percent moisture content difference between properly acclimated wood flooring and subflooring materials.
- For wide-width solid flooring (3" or wider), there should be no more than 2 percent difference in moisture content between properly acclimated wood flooring and subflooring materials.

Part III – Subfloor Flatness and Integrity

- Wood subfloors must be flat, clean, dry, structurally sound, free of squeaks and free of protruding fasteners.
 - For installations using mechanical fasteners of $1\frac{1}{2}$ " and longer, the subfloor should be flat to within $\frac{1}{4}$ " in 10 feet, or $\frac{3}{16}$ " in 6 feet.
 - For glue-down installations and installations using mechanical fasteners of less than $1\frac{1}{2}$ ", the subfloor should be flat to within $\frac{3}{16}$ " in 10 feet or $\frac{1}{8}$ " in 6 feet.
- If peaks or valleys in the subfloor exceed the tolerances specified above, sand down the high spots and fill the low spots with a leveling compound or other material approved for use under wood flooring. However, it is the builder's or general contractor's responsibility to provide the wood-flooring contractor with a subfloor that is within the tolerances listed above.

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- Inspect the subfloor carefully. If there is movement or squeaks in the subfloor, refasten the subfloor to the joists in problem areas.
- Protruding fasteners are easily remedied by driving those fasteners deeper into the subfloor.

Part IV – Panel Products Subflooring

- For panel products subflooring, check for loose panels and re-nail or screw down loose panels securely.
- Ensure that there is proper expansion space ($\frac{1}{8}$ ") between the panels. If the subfloor panels are not tongue-and-grooved and if there is no sufficient expansion space, use a circular saw to create the specified space. DO not saw through joints on T&G subfloors.
- Also check for delaminated or damaged areas and repair those areas as needed.
- Make sure the subfloor is free of debris before beginning installation.
- Acceptable Panel Subfloors: Truss/joist spacing will determine the minimum acceptable thickness of the panel subflooring.
 - On truss/joist spacing of 16" (406mm) o/c or less, the industry standard for single- panel subflooring is nominal $\frac{5}{8}$ " ($\frac{19}{32}$ " , 15.1 mm) CD Exposure 1 Plywood subfloor panels (CD Exposure 1) or $\frac{23}{32}$ " OSB Exposure 1 subfloor panels, 4' x 8' sheets.
 - On truss/joist spacing of more than 16", up to 19.2" (488mm) o/c, the standard is nominal $\frac{3}{4}$ " ($\frac{23}{32}$ " , 18.3mm) T&G CD EXPOSURE 1 Plywood subfloor panels, (Exposure 1), 4' x 8' sheets, glued and mechanically fastened, or nominal $\frac{3}{4}$ " $\frac{23}{32}$ " , 18.3mm) OSB Exposure 1 Plywood subfloor panels, (Exposure 1), 4' x 8' sheets, glued and mechanically fastened.
 - Truss/joist systems spaced over more than 19.2" (488mm) o/c up to a maximum of 24" (610mm) require nominal $\frac{7}{8}$ " T&G CD EXPOSURE 1 Plywood subfloor panels, (Exposure 1), 4' x 8' sheets, glued and mechanically fastened, or nominal 1" OSB Exposure 1 subfloor panels, 4' x 8' sheets, glued and mechanically fastened – or two layers of subflooring. Or brace between truss/joists in accordance with the truss/joist manufacturer's recommendations and with local building codes. Some truss/joist systems cannot be cross-braced and still maintain stability.
 - For double-layer subfloors, the first layer should consist of nominal $\frac{3}{4}$ "

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(²³/₃₂"

18.3mm) CD Exposure 1 Plywood subfloor panels (CDX), 4' x 8' sheets or nominal ³/₄" (²³/₃₂" , 18.3mm) OSB Exposure 1 subfloor panels, 4' x 8' sheets. The second layer should consist or nominal ¹/₂" (¹⁵/₃₂" , 11.9mm) CD EXPOSURE 1 plywood subfloor panels, (Exposure 1) 4' x 8' sheets. The ¹/₂" plywood should be offset by ¹/₂ panel in each direction to the existing subflooring. The panels may also be laid on a diagonal or perpendicular, with 1/8" spacing between sheets. Nail on a 12" minimum grid pattern, using a ring-shanked nails or staples.

- Fastening and Spacing Specifications
 - Follow the panel manufacturer's recommendations for spacing and fastening.
 - Typical panel spacing and fastening requirements for truss/joist systems call for approximately ¹/₈" (3.2mm) expansion space around the perimeter of each panel, with panels fastened every 12" (305mm) along intermediate supports.
 - Edge swell should also be flattened. This can usually be accomplished by using an edger sander.

Part V – Solid Board Subflooring

Solid board subflooring should be: ³/₄" x 5 ¹/₂" (1 x 6 nominal), Group 1 dense softwoods (SYP, Doug Fir, Larch, etc.), No. 2 common, kiln-dried to less than 15% MC.

Solid-board subflooring should consist of boards no wider than 6 inches, installed on a 45 degree angle, with all board ends full bearing on the joists and fastened with minimum 8d rosin-coated or ring-shanked nails, or equivalent.

Some types of wood flooring should not be installed directly over solid-board subflooring.

Thin-classification solid strip flooring must have a ³/₈" or better plywood underlayment installed over solid board subflooring.

INSTALLATION OVER EXISTING FLOORS

Sonora does not recommend their flooring to be installed over existing floors.

CONCRETE SUBFLOOR GUIDELINES

Part I – Concrete Subfloor Specifications

- Subfloor Must Be Flat

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- o Make sure the concrete slab is flat to a flatness tolerance of $\frac{1}{8}$ " to $\frac{3}{16}$ " in a 10- foot radius.
 - o If the slab is out of specification, consider grinding, floating or both. Many high spots can be removed by grinding, depressions can be filled with approved patching compounds, and slabs also can be flattened using a self-leveling concrete product.
 - o When sanding or grinding concrete, care must be taken to minimize the amount of silica dust produced. OSHA recommends using dust-collection devices, or applying water to the concrete before sanding. Approved respirators may also be used to minimize the amount of silica dust inhaled.
- Subfloor Must Be Dry
- o Refer to Moisture Requirements and Moisture Testing.
 - o Concrete moisture meters and other tests can be useful in identifying moisture problem areas. However, NWFA guidelines specify using relative-humidity testing (ASTM F-2170), calcium chloride testing (ASTM F-1869) or calcium carbide (CM) testing (ASTM D-4944-04 and MilSpec CRD-C154-77) to identify the moisture content of the slab.
 - o If a slab tests too high in vapor emission to glue a floor down, consider using a vapor retarder type product, installing a vapor retarder and a plywood sub-floor or using an alternative installation method.
 - o Moisture readings should not exceed 4.5 when using a Tramex concrete moisture encounterer.

END-USER RESPONSIBILITY

End-User Presence Is Critical

The wood manufacturer states, in their installation and warranty guidelines, that they control all of the steps involved in its production of prefinished wood floors from kiln drying to finishing. As hardwood is a product of nature, it is not perfect. Industry standards allow a tolerance in quality variation not exceeding 5% of the total quantity purchased. We strongly recommend that the customer interview several prospective wood flooring installers for their qualifications. Ask them for references and make telephone calls to check them out. Approximately 40% of the reasons for installation failure and/or customer dissatisfaction is due to installer error. They must be the professional on the job. However, **YOUR PRESENCE DURING THE INSTALLATION IS CRUCIAL.** If you decide to hire an installer who will install your hardwood (or bamboo) floor without your supervision it is YOUR responsibility to ensure the good judgment of the installer. The installer must inspect and cull those boards which are defective or undesirable. The installer should be selective when assessing the quality of the wood, grading, and lengths of boards, and when arranging floor boards according to the natural variations, such as color and grain of the species selected. If you were present during the

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installation of your floor you can ask your installer to place boards in areas that are less visible and according to your taste, rather than in the center of the room or near the focal point of the room, such as the fireplace. The wood manufacturer cannot be held responsible for any unpleasant surprise resulting from the installer's lack of qualifications or poor judgment. Once the floor is installed the ownership and responsibility to resolve any disputes is between the installer and the end user.

Board Selection – Customer and Installer

The end user and installer are responsible for the final inspection and approval of boards being installed. If the customer chooses not to be present during the installation period, they forgo their ability and right to participate in the board selection process. In doing so, they have left the selection of boards up to the judgment of the installer. Once installed, the end user and installer own the floor. This has been a long standing wood flooring industry standard.

Failure of Installer to Satisfy the Owner

The installer is commissioned and contracted by the owner. Owners should choose their installer carefully by checking references and previous job experience, etc. The cheapest is not always the best. Installing hardwood flooring is a highly skilled operation. The contract to install is between the owner and the installer. Sonora is in no way responsible for the owner's choice of installer or any failure by the installer to satisfy the owner.

Installer and Customer Own the Floor

This certified wood flooring inspector finds that this customer's issues should clearly be resolved between the consumer and the installer. The installer did not follow industry installation guidelines as set forth by the National Wood Flooring Association. Once the wood flooring is installed, the installer and the end user have accepted ownership. Any consideration of this customer's claim will be at the discretion of the wood manufacturer and/or seller.

INSTALLING A SUBFLOOR OVER CONCRETE

Part I – Direct Gluing a Subfloor Over Concrete

- Always follow the adhesive manufacturer's recommendation for proper application, proper adhesive and correct trowel notch and spread rate.
- If necessary, add vapor retarder recommended by the adhesive manufacturer before applying adhesive.

Part II – Floated Subfloor

- In on-grade and below-grade applications, always add vapor retarder before applying underlayment.
- A vapor retarder is recommended anytime solid $\frac{3}{4}$ " wood flooring is installed over concrete. A vapor retarder is required for installation over concrete with a calcium chloride reading greater than 3 pounds, a relative humidity reading of greater than 75%, or a calcium carbide (CM) reading of greater than 2.5%.

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- Floated Subfloor System
 - Materials
 - 2 layers nominal 3/8" (10mm) minimum CD Exposure 1 Plywood subfloor panels (CDX) 4' x 8' sheets.
 - Installation method:
 - Place the first plywood layer with edges parallel to wall, without fastening. Leave 3/4" space between wall and plywood.
 - Plywood panels should be placed with 1/8" gaps between sheets.
 - Lay the second layer perpendicular or at 45 degree angle to the first.
 - Plywood panels should be placed with 1/8" gaps between sheets and a 3/4" minimum expansion space at all vertical obstructions and wall lines.
 - Staple or staple and glue (with urethane or construction adhesive) the second layer to first layer on 12" interior grid pattern (6" on the perimeter). Be careful not to penetrate the vapor retarder.
- Alternate Subfloor System
 - Materials
 - Use nominal 3/4" (23/32", 18.3mm) CD Exposure 1 Plywood sheathing, 4' x 8' sheets.
 - Installation method
 - Cut sheets to 16" x 8' or smaller panels, scored on back 3/8" deep a minimum of every 12" across width.
 - 16" planks oriented perpendicular or diagonally to direction of flooring.
 - Panels staggered every 2', and spaced 1/8" between ends, with 3/4" minimum expansion space at all vertical obstructions.

Part III – Glue Down Subfloor

- Always follow the adhesive manufacturer's recommendation for proper subfloor, spread rate and trowel notch.
- If necessary, add vapor retarder before applying underlayment. A vapor retarder is recommended anytime solid 3/4" wood flooring is installed over concrete.
- Glue-Down Subfloor System:
 - Materials
 - Use nominal 5/8" (19/32", 15.1mm) CD Exposure 1 Plywood subfloor panels, (Exposure 1), 4' x 8' sheets.
 - Installation method:
 - Cut the plywood panels to 2' x 8', or 4' x 4' sections.

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- Score the back of the panels $\frac{1}{2}$ the thickness on a 12" x 12" grid.
- Apply an adhesive approved for the installation of plywood, per the plywood manufacturer's recommendations.
- Lay sections in a staggered joint pattern in the adhesive, with $\frac{1}{8}$ " spacing between sheets, and $\frac{3}{4}$ " minimum expansion space at walls and all vertical obstructions.

Part IV – Nail-Down Subfloor

- Always follow Sonora's recommendations for proper subfloors as previously discussed.
- In on-grade and below-grade applications, always add vapor retarder before applying underlayment. In above-grade applications, follow the flooring manufacturer's recommendations.
- A vapor retarder is recommended anytime solid $\frac{3}{4}$ " wood flooring is installed over concrete.
- Nail-Down Subfloor System Over Concrete
 - Materials
 - Minimum: use nominal $\frac{5}{8}$ " ($\frac{19}{32}$ ", 15.1mm) CD Exposure 1 Plywood subfloor panels (CDX), 4' x 8' sheets.
 - Installation method

NOTE: Fasteners may be powder-driven pins, pneumatic driven nails, screws, deformed pins, or other fasteners suitable for concrete application. Check with fastener manufacturer for specification such as length, drill size, and/or shot load where applicable.

- Stagger panel joints allowing approximately $\frac{1}{8}$ " expansion space around all panels to prevent edge peaking due to compression caused by panel swell.
- Allow $\frac{3}{4}$ " minimum expansion space at all vertical obstructions.
- Panels should be mechanically fastened. For powder load or pneumatic pressure information, contact your local supplier.
- Fasten 2" from the edge every 6-8" along the perimeter of the sheet and one fastener or more spaced every 12" in the interior of the panel. Fasten the center first to prevent the subfloor from bowing.
- Areas with higher humidity may require additional fasteners.

Part V – Screed System

- Sonora does not recommend the installation of their engineered wood flooring over screeds.

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SOLID STRIP AND PLANK FLOORING INSTALLATION

Part I – Acceptable Jobsite Conditions and Jobsite Checklist

- Refer to previously described guidelines.

Part II – Acclimation Guidelines

- Refer to previously described guidelines.

Part III – Appropriate Grade Levels

- Solid strip and plank wood floors can be installed successfully above grade level or on grade, but are not recommended for installation below grade.
- The entire flooring level is considered to be below grade where soil is present along any perimeter wall and is more than 3” above the installed wood flooring level. Ground should be sloped away from the house for proper drainage. (Follow local building codes.)

Part IV – Subfloors – Wood Joist Systems

- Refer to previously described guidelines.

Part V – Subfloors – Concrete Slab

- Refer to previously described guidelines.
- When installing solid strip and solid plank flooring over concrete, a vapor retarder is always required over the concrete slab and below the subflooring material. A minimum 6 mil construction grade polyethylene film, with perm of 0.13, or other impermeable material with a perm of 0.15 or less is recommended.
- Sonora does not recommend our solid hardwood floors to be installed by the direct-glue down method over a concrete slab.

Part VI – Solid Strip & Plank Installation Methods

- Always follow the Sonora's recommended installation procedures.
- Basic Tools and Accessories:
 - Rubber mallet / 4d-6d Flooring nails / Jamb saw or hand saw / Chalk line / Pencil / 15 lbs. Asphalt felt / Table saw or band saw / Hammer / Tape measure / Leading brand of hardwood flooring cleaner / Broom / Pownail manual 45 T&G Pownailer, pneumatic 445 Pownailer or other machines designed or adapted specifically to ¾” solid wood flooring / Quality moisture meter with manufacturer's relevant exotic species calibration figures.

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NOTE: $\frac{3}{4}$ " is meant for nail-down or staple-down (with 2" fasteners) installation only.

- Unfinished and factory-finished solid strip and solid plank flooring should be installed perpendicular to the joists or on a diagonal for any single layer subfloor. (Exception: Over diagonal, solid subfloor boards, install perpendicular to joists or subfloor direction.)
- When $\frac{3}{4}$ " solid strip and solid plank flooring is laid parallel with the floor joists, follow one of these two steps:
 - Add a layer of minimum nominal $\frac{1}{2}$ " (15/32") CD Exposure 1 (CDX) plywood underlayment to the existing subfloor (as previously recommended).
 - Or brace between truss/joists in accordance with the truss/joist manufacturer's recommendations and with local building codes. Some truss/joist systems cannot be cross-braced and still maintain stability.
- Before installing wood flooring, place an approved vapor retarder. Some examples of acceptable vapor retarders over wood subfloors include:
 - An asphalt laminated paper meeting UU-B-790a, Grade B, Type I, Style 1a.
 - Asphalt-saturated kraft paper or #15 or #30 felt that meets ATM Standard D-4869 or UU-B-790 Grade D.
 - **These moisture retarders do not replace the need to conduct mandatory moisture testing of floor boards and subfloor!**
- Wall Line Layout
 - Choose a starting wall according to the most aesthetically or architecturally important elements in the room, taking into consideration fireplaces, doors, cabinets and transitions, as well as the squareness of the room. The starting wall will often be the longest unbroken wall in the room.
 - Snap a working line parallel to the starting wall, allowing $\frac{3}{4}$ " expansion space between the starting wall and edge of the first strip or plank run.
 - Random-width plank is laid out with alternating courses varying by widths. Start with the widest board, then the next width, etc., and repeat the pattern.
 - Lay one row of strip or plank along the entire length of the working line.
 - Top-nail and blind-nail the first row (hand-nail if necessary), using appropriate fasteners. Denser species may require pre-drilling. Each succeeding row should be blind-nailed with the nailing machine wherever possible. At the finishing wall and other obstructions, it may be necessary to blind-nail by hand until top nailing is required.
 - Distribute lengths, avoiding "H" patterns, stair stepping and other discernible

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patterns in adjacent runs. Stagger end joints of boards row to row a minimum of 6" for strip flooring, 9" for 3", 12" for 4", 15" for 5" and 18" for planks wider than 5".

- To minimize expansion on floors wider than 20 feet, more or less spacing between rows may be needed, depending on geographical area, interior climate control and time of the year.
- Where spacing is required: Use a washer or removable spacer to leave additional space every few rows and/or start in center of room and work out to both sides. Do not use spacers that may cause damage on our factory-finished floors.
- Nailing: Blind-nail through the tongue using 1 ½" - 2" fasteners. Use 1 ½" fasteners with nominal ¾" plywood subfloor direct to concrete slab. Face-nail boards where needed using 6d-8d casing or finish nails. Fasteners should be spaced every 6" - 8" on blind-nailing, or every 10" - 12" on face-nailing.
- For additional fastening, any of the following options may be used in addition to the nailing schedule.
- For wide-width plank flooring (5" or wider), to assist the nailing schedule of 6" - 8" and increase holding power, there are three options.
 - Screw and plug at end joints, alternating at staggered locations and intervals along each board.
 - Apply an approved urethane wood flooring adhesive, such as Bostik's Best.
 - Use kerfing or relief cuts every 8" to 12" parallel to the grain – using more relief cuts for wider boards. Typically, the relief cut should be 3/8" on a ¾" board.

NOTE: These options, however, will not necessarily eliminate cupping.

- Blind-nail and face-nail, as necessary, to complete the final rows.
- Center Line Layout

NOTE: For instructions on using trammel point method to square a room and find the center point, see Trammel Point Method.

- Find the center of your room, measuring off the two longest walls, and snap a line down the center of that room.
- Install a starter board on the line. Fasten the starter board to the floor using wood screws.
- Nail the first row of wood flooring against the starter board, being careful not to move the starter board when nailing. The groove of the flooring should be against the starter board.
- Drill and hand-nail the first three rows through the tongue. DO NOT USE

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TOP NAILS.

- Use a blind nailer to install the remaining rows of wood flooring. Use the nailing practices described earlier in the chapter.
- After installing in one direction, remove the starter board and start rows going in the opposite direction.
- Install a spline or a slip tongue in the groove of the board that was against the straight-edge. Put wood glue down the entire length of the groove before installing the spline.
- Install the spline using a blind nailer. To keep the spline in alignment for the next flooring board, use a scrap piece of wood flooring to run along the length of the spline as you nail.
- Install the remaining rows in the opposite direction. Use the nailing practices described earlier in the chapter.

Tongue and Groove – Too Loose

Caution! When first starting to nail the flooring down and after nailing down a small section of approximately 25 square feet, make sure that this initial test section of flooring, once nailed to the subfloor, is firmly affixed. In particular, check to make sure that the groove side of each piece, being held down only by the tongue of the adjacent piece, does not rock up and down if weight is placed on it and then removed. If the groove side does exhibit up/down movement, STOP!

This movement will not sand out nor can this up and down movement be corrected later on! It will be necessary to glue this floor down in addition to nailing it in order to correct this condition, which is caused by a too loose tongue and groove. Loosely milled flooring may be nailed and installed in beads of a non-hardening construction adhesive such as “a Liquid Nails caulking type” laid on 8” centers or the flooring may be laid with a full mastic spread in addition to nailing.

It is the installers responsibility to ascertain whether this “too loose of a T & G” condition exists in the flooring prior to installation. If the flooring is found to have a “too loose T & G condition”, Sonora will, upon notification from the installer prior to installation, correct the problem as follows: At Sonora's option, Sonora will either replace the flooring, refund the purchase cost of the flooring, or compensate the installer for the extra cost of the adhesive/mastic now necessary to insure a good installation. Sonora shall not be responsible for replacing any flooring in excess of the 25 square foot nailed down as the test section and then found to have excessive up and down movement.

ENGINEERED WOOD FLOORING INSTALLATION

Part I – Acceptable Jobsite Conditions and Jobsite Checklist

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- Refer to instructions previously described

Part II – Acclimation Guidelines

- Sonora Engineered Wood Flooring should be stored in the climate controlled job site for 72 hours to adjust to room temperatures. The planks should be left in unopened cartons until ready for installation.

Part III – Appropriate Grade Levels

- Engineered wood floors can be installed successfully on, above or below grade level. Engineered wood floors can be installed directly to concrete or wood subfloor.
- The entire flooring level is considered to be BELOW grade where soil is present along any perimeter wall and is more than 3” above the installed wood flooring level. Ground should be sloped away from the house for proper drainage. (Check local building codes. Local building codes prevail. Follow local building codes.)

Part IV – Subfloors – Wood Joist Systems

- See instructions previously described.

Part V – Subfloors – Concrete Slab

- See instructions previously described.

Part VI – Engineered Flooring Installation Methods

- Sonora engineered wood flooring should not be installed directly to screeds.
- Note on random-width plank
 - Random-width plank is laid out with alternating courses varying by widths. Start with the widest board, then the next width, etc., and repeat the pattern.
- Choose a Starting Wall
 - Choose a starting wall according to the most aesthetically or architecturally important elements in the room, taking into consideration fireplaces, doors, cabinets and transitions, as well as the squareness of the room. The starting wall will often be the longest unbroken wall in the room.
- GLUE-DOWN ENGINEERED STRIP AND PLANK**
- Basic Tools and Accessories:
 - Rubber mallet / 4d-6d Flooring nails / Jamb saw or hand saw / Chalk line / Pencil / 15 lbs. Asphalt felt / Table saw or band saw / Hammer / Tape measure / Leading brand of hardwood flooring cleaner / Broom / Powernail manual 45 T&G Powernailer, pneumatic 445 Powernailer or other machines designed or adapted specifically to ¾” solid wood flooring / Quality moisture meter with manufacturer's relevant exotic species calibration figures.

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- There are several different ways to start an installation of glue-down engineered wood flooring. The following has proven successful.
- Test the substrate for moisture according to appropriate moisture testing procedures described previously. Excessive/elevated moisture should not be present. The subfloor should be within acceptable moisture content as per adhesive manufacturer's recommendation before installing.
- An expansion space of 9/16" (or the thickness of the planks) should be left around the perimeter and at all vertical stops.
- Snap a working line parallel to the starting wall, the width of the board, plus the tongue and recommended expansion space.
- Install a starter board along the edge of the working line and begin installation. Alternatively, lay one row of plank in the adhesive along the length of the working line.
- Follow the installation procedure recommended by the adhesive manufacturer, which includes a subfloor moisture content, spread rate, trowel size, open time, working time and flash time as necessary. Spread the adhesive as instructed up to and along the working line.
- Distribute lengths, avoiding "H" patterns, stair stepping and other discernible patterns in adjacent runs. Stagger end joints of boards row to row a minimum of 6" for strip flooring, 9" for 3" plank, 12" for 4", 15" for 5", and 18" for planks wider than 5".
- 3-M Blue Tape should be used. Do not use 3M's quality #2090 tape.
- If recommended by the adhesive manufacturer, roll the floor with the proper roller.
- **MECHANICALLY FASTENED STRIP AND PLANK**
 - CAUTION: It is extremely important to use the appropriate adapters as well as staples or cleats. Improper fasteners, machines, and air pressure can cause severe damage.
 - If necessary, add a vapor retarder.
 - Snap a working line parallel to the starting wall, allowing expansion space.
 - Lay one row of plank along the entire length of the working line.
 - Top-nail and blind-nail the first row (hand-nail if necessary), using appropriate fasteners. Denser species may require pre-drilling. Each succeeding row should be blind-nailed wherever possible.
 - Typical: narrow crowned (under 3/8") 1" - 1 1/2" staples or 1" - 1 1/4" hardwood flooring cleats designed for engineered flooring.

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- Typical: every 3-4" with staples, every 4-6" with cleats, and within 1-2" of end joints. Use appropriate size fastener for top nailing first row, last row and any area where blind nailer will not fit.
- Add each additional row of flooring. Distribute lengths, avoiding "H" patterns, stair stepping and other discernible patterns in adjacent runs. Stagger end joints of boards row to row a minimum of 6" for strip flooring, 9" for 3" plank, 12" for 4", 15" for 5", and 18" for planks wider than 5".
- During installation of flooring pieces, push or gently tap boards flush to the previous row. Tap against the tongue; tapping the groove may damage the edge. To prevent damage to the finish, avoid tapping the face of the board with a rubber mallet.
- **FLOATING ENGINEERED FLOORING**
 - Additional tools for floating installation:
 - Pull Tool or Crowbar
 - Floating floor pad with built in moisture barrier foam with moisture barrier 2 in 1 or 3 in 1
 - Tapping Block (used with care)
 - 3-M Blue Tape – Do Not Use 3-M #2090
 - Glue – Franklin Titebond II or Equivalent PVA-2 floating floor (poly vinyl acetate) adhesive
 - Subfloor flatness is critical to the success of a floating floor installation. (See Wood Subfloor Guidelines and Concrete Subfloor Guidelines.)
 - Test the substrate for moisture according to appropriate moisture testing procedures. Excessive/elevated moisture should not be present. The subfloor should be within acceptable moisture content as per manufacturer recommendation before installing.
 - If necessary, add vapor retarder. (See Acceptable Vapor Retarders in Moisture Requirements and Moisture Testing.)
 - At least 9/16" expansion space should be left around the perimeter and at vertical stops.
 - Typical: Subfloors are covered with a resilient material, foam underlayment or cork. A 2-in-1 or 3-in-1 underlayment is a good choice.
 - Sonora engineered flooring must be edge-glued.
 - End joints must be staggered 12" - 18" apart. No two end joints should be within three rows of each other. If they are not, the floor installation may lose dimensional stability, causing gapping and/or tenting.