PROBLEMS, CAUSES, AND CURES

nwfa
National Wood Flooring Association

Technical Publication No. C200 • Revised © 2018 | 3rd Edition

NOTICE

This technical publication was developed by subject matter experts serving on the Problems, Causes, and Cures Taskforce, and on the NWFA Technical Standards and Publications Committee, using reliable principles, with research of all available wood flooring data, and in consultation with leading industry authorities.

The information contained in this publication represents widely accepted industry practices. There are, however, no universally approved methods of troubleshooting wood floors. Therefore, manufacturers' recommendations for use of specific products should always supersede the recommendations contained in this publication.

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PROBLEMS, CAUSES, AND CURES

This publication is organized into categories for easier navigation. Some topics may be relevant in more than one general category. Every effort has been made to adequately identify them, but due to the variable nature of each floor, some cross-reference may be inadvertently omitted. Reference the Index to find a specific problem.

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Introduction

Wood floors are a product of nature. They are produced utilizing a living organism – trees – which are classified by scientists as a biotic material. These materials, by definition, are derived from living organisms.

All living organisms respond to their environment, and wood floors are no exception. They literally change every day as a result of the environment in which they're installed. In most cases, these changes in the physical structure of a wood floor are not noticeable, but there are times when the changes can be very noticeable, or even destructive, as a result of dramatic fluctuations in temperature and humidity. This is just one example of how a wood floor can react to its surroundings, but there are many other variables that can affect both the appearance and the performance of a wood floor. These variables have been organized in general groupings to help flooring professionals identify problems that can impact wood floors, including wood distortion, wood aesthetics, sounds/noises/movement, installation appearance, filler/putty, sanding aesthetics, color inconsistencies, finish aesthetics, and finish performance. It is important to note that some issues could fall into several categories. Every effort has been made to cross-reference these occurrences, but not all may be identified.

This publication will explore some of the issues that can impact a wood floor, their causes, and potential cures. Not every issue is contained in this publication, nor is every cause or cure included. This is because of the wide variety of wood products on the market today, as well as the extensive environmental and structural variables that can impact a wood floor.

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Evaluating Irregularities

The Standard for Evaluation is based on viewing a wood floor within the scope of NWFA Guidelines in order to determine acceptability:

1. Evaluation of a wood floor must be observed from a standing position on the floor being assessed.
2. Evaluation of a wood floor must be conducted with ambient lighting. Glare from a direct light source must not be used during evaluation.
3. Inspection by an NWFA Certified Wood Floor Inspector may be conducted to determine cause, which may include examination of the flooring system carefully and critically. Inspection may take place from floor level, with assistance of magnification, and/or through destructive testing in order to determine cause of irregularities, but not necessarily to determine acceptability.

Identification of the Problem

The first step in evaluating a claim is determining exactly what the perceived issue is. Sometimes, floors that have a "problem" from the customer's perspective are well within industry standards, or may be a natural characteristic of wood that may not be fully understood. Other times, floor failures are the product of a larger story within the facility or below the floor. Wood floors can also exhibit problems due to improper environmental conditions, installation methods, sanding or finishing techniques, manufacturer defects, or a combination of all of the above.

Even when there is a problem, the floor doesn't have to be a failure. If the cause of the problem can be identified and addressed in a timely, professional manner, you can still have a satisfied customer.

Finding the Cause

Once you have defined what the problem is, it's time to determine why the problem happened (or still is happening). Sometimes this is obvious — such as when you see a footprint in the topcoat. More often, determining the cause takes more investigation. If you're the one who installed the floor, the trouble-shooting may be easier to identify the cause. If you're inspecting another contractor's failed floor, it may take a more-detailed investigation. Be mindful that in many scenarios, it may be deemed unethical for you to inspect another contractor's floor and then offer the customer a price to make repairs.

In order to identify the cause of the problem, you must do some research. Identifying the cause of the problem is a fact-gathering mission:

- Listen to the concerns of all parties.
- Be sympathetic with the end-user.
- Remain objective.
- Collect all facts and pertinent information through interviews with all involved parties regarding the concern reported.
- Thoroughly conduct tests relevant to the reported concern.
- When invasive testing is required to adequately determine the underlying cause of the problem, the end-user must be made aware of, and give written approval acknowledging, the risk involved. It is also necessary to identify who will be responsible for subsequent repairs.
- Record all necessary and pertinent data. Keep written records throughout the project, from the first contact through a full inspection. This includes getting a full description of the stated problem.
- Refrain from offering opinions or making statements during the investigation that may put you and/or any of the involved parties into a liability situation.

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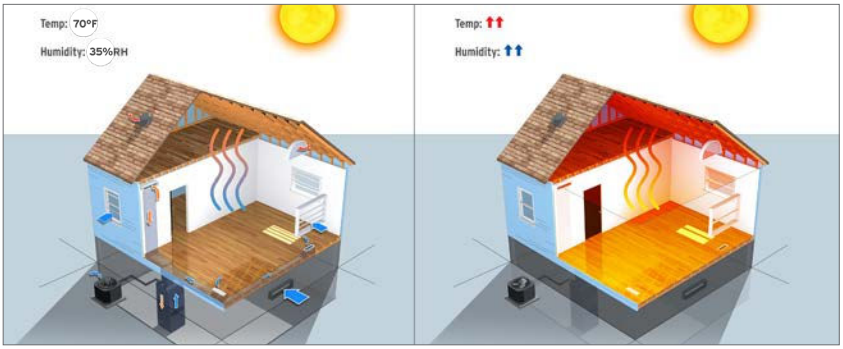
Common Tools Used to Investigate Wood Floor Failures

- NWFA Technical Publications and Guidelines
- Manufacturer instructions and tech data
- Graph paper
- Camera
- Flashlight
- Lighted magnifying lens
- Wood moisture meters
  - Pin meter with extra pins
  - Hammer-probe with insulated pins
  - Pinless meter
- Thermo-hygrometer
- Extra batteries
- Concrete moisture tests
  - RH tests
  - CaCl tests
  - Meters
- Infra-red thermometer
- Rare earth magnets
- Digital calipers
- Straight-edge (6'-10')
- Laser level/string line
- Taper gauge
- Automotive feeler gauge
- Dental pick
- Wood floor cleaner
- Clean white towels
- Touch-up/repair kit
- pH strips
- Painter's safe-release tape
- Standard hand-tools
  - Tape measure (standard & metric)
  - Crowbar
  - Utility knife
  - Hammer
  - Pliers
  - Scraper
  - Steel ruler
  - Calculator
  - Pen/pencil
  - Knee pads

Wood Distortion

Greenhouse Effect/HVAC Systems

DEFINITION: When Heating, Ventilation, and Air Conditioning (HVAC) systems are not used or are completely shut down for an extended period of time, the conditions necessary for the performance of the home, its contents, and the wood floor will be compromised. Without air exchange, sunlight through windows can generate heat, which can lead to drastic fluctuations in humidity levels. Floors will shrink or swell due to the inconsistent humidity levels. This can result in cupping, buckling, gapping, crowning, endlift, end-swell, delamination, compression-set, and more. Controlling the atmosphere before, during, and after the installation of the wood floor is critical to avoid issues caused by what we define as the Greenhouse Effect.



Warp

DEFINITION: Any variation of the intended shape of a piece of wood flooring from a true or flat plane.

Left to right: Bow, Crook, Twist

Bow - A deviation in the lengthwise flatness of a board, measured end to end.

- Solid wood flooring: Bow occurs when one side of the floor board shrinks more in length than the other. It causes the lengthwise curvature of the plank that resembles a bow used in archery. Because longitudinal shrinkage in solid wood is minimal, bow is normally not an issue that affects installation.
- Engineered wood flooring: Bow occurs when the wear layer and the core begin to shrink in opposing lengthwise directions, forcing the uninstalled planks to bow. Manufacturer and industry standards (HPVA) dictate tolerances and milling requirements for the amount of bow allowed in an engineered wood floor at the time of manufacture. This may or may not coincide with uninstalled flooring at the jobsite due to change in moisture content as a result of jobsite conditions.

Crook - A deviation in the end-to-end straightness along the edge of a board. Sometimes referred to as "side-bend." Crook occurs when one edge of solid flooring shrinks more in length than the other, due to the characteristics of the wood in relation to the orientation of the grain.

Twist - A deviation where the four corners of a board face are no longer in a flat plane.

CAUSES:

- Wood is an anisotropic material, meaning it will shrink/swell in relation to its grain orientation. The extent to which solid wood shrinks, swells, or changes shape is also directly related to its size and how it was cut from the tree. It is not uncommon to see one side of a board shrink or swell more or less than the opposite side of the board when seasonal or moisture conditions change, which may result in a slightly warped appearance.
- Improper or unmanaged handling of the environmental conditions surrounding the flooring material after it was manufactured, either during transport, while in storage, while acclimating at the jobsite, or from opened or damaged packaging.
- May be the result of engineered flooring manufactured out of balance (core and wear layer having an unbalanced EMC).
- Inconsistent moisture content.

CURES:

- For uninstalled flooring:
  - Ensure the jobsite environment and the wood flooring moisture content are compatible before installation.
  - Cut the material into shorter sizes and use as starters/finishers during the installation.
  - Cull objectionable material and do not install those boards.
- For installed flooring:
  - Replace affected boards as necessary.
  - Perform aesthetic repairs; use fillers or slivers, and blend with remaining floor.

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Buckling

DEFINITION: The wood flooring has separated or lifted from the subfloor.

CAUSES:

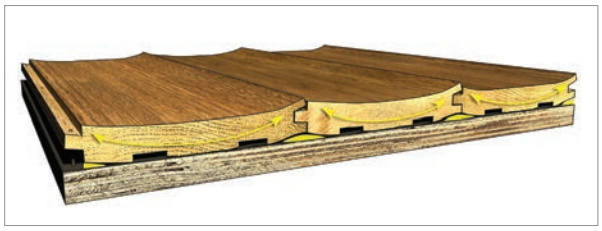
- An increase in moisture conditions. Potential sources of moisture may include:
  - Inadequate or inoperable HVAC systems resulting in elevated humidity levels. (See Greenhouse Effect.)
  - Wet subflooring (wood or concrete slab).
  - Inadequate moisture control systems installed beneath the wood floor.
  - Poor building drainage resulting in rainwater runoff or subsurface groundwater.
  - Moisture from inadequately ventilated or unconditioned crawl spaces or basements.
  - Portable water sources/appliances, building leaks, or plumbing leaks.
  - Maintenance-related:
    - Wet-mopping resulting in standing/topical liquid moisture left on the floor.
    - Use of steam mops/cleaning devices.
    - Use of non-breathable rugs on the floor.
    - Not maintaining relative humidity levels year-round to support the installed flooring.
- Factors that may aggravate the problem include these improper installation techniques:
  - Nail-down wood floors:
    - Improper acclimation/conditioning of the flooring and the building.
    - Inadequate perimeter or expansion space at all vertical obstructions, or internal expansion space (washer rows) within the floor. The recommended expansion space may have been adequate at time of installation and closed due to environmental changes.
    - Inadequate nailing schedule.
    - Incorrect fasteners used.
    - Incorrect or inadequate subfloor material.
    - Non-elastomeric adhesive used under the wood flooring at perimeters/pull-up walls or within the floor system. The wrong adhesive can restrict natural flooring movement, thus creating an anchor within the flooring system.
  - Glue-down wood floors:
    - Improper acclimation/conditioning of the flooring and the building.
    - Inadequate perimeter expansion space at vertical obstructions. The recommended expansion space may have been adequate at time of installation and closed due to environmental changes.
    - Inadequate internal expansion spacing (washer rows) within the floor. The recommended expansion space may have been adequate at time of installation and closed due to environmental changes.
    - Improper application of adhesive.
    - Incorrect adhesive.
    - Insufficient adhesive.
    - Wrong trowel used to apply the adhesive.
    - Inadequate adhesive transfer.
    - Poor subfloor preparation.
    - Subfloor contamination.
    - Floor not approved by the wood flooring manufacturer to be glued down.
  - Floating wood floors:
    - Improper acclimation/conditioning of the flooring and the building.
    - Inadequate perimeter expansion space at vertical obstructions. The recommended expansion space may have been adequate at time of installation and closed due to environmental changes.
    - Pinch points caused by door jams, door stops, closet tracks, baseboards, trim or adhesive caulking restricting lateral movement.
    - Heavy (or fixed in place) furniture or cabinets restricting lateral movement.
    - Flooring length and/or width exceeding manufacturer's requirements.
    - Lack of, missing, or improperly installed transitions.

CURES:

- Identify and eliminate the source of moisture. In some cases this will require the use of dehumidification systems to stabilize the ambient conditions and bring them to within the acceptable target range.
- Flooring and subflooring must be allowed to dry to what would be considered "normal levels" for the area before any repairs take place.
- Maintain the environment within the flooring manufacturer's requirements. When conditions are not specified by the manufacturer, maintain temperature between 60º-80ºF(15.6º-26.7ºC), and relative humidity between 30%-50%.
- Release stress on the floor by providing relief at vertical obstructions.
- Removal and replacement of the affected area is often necessary.

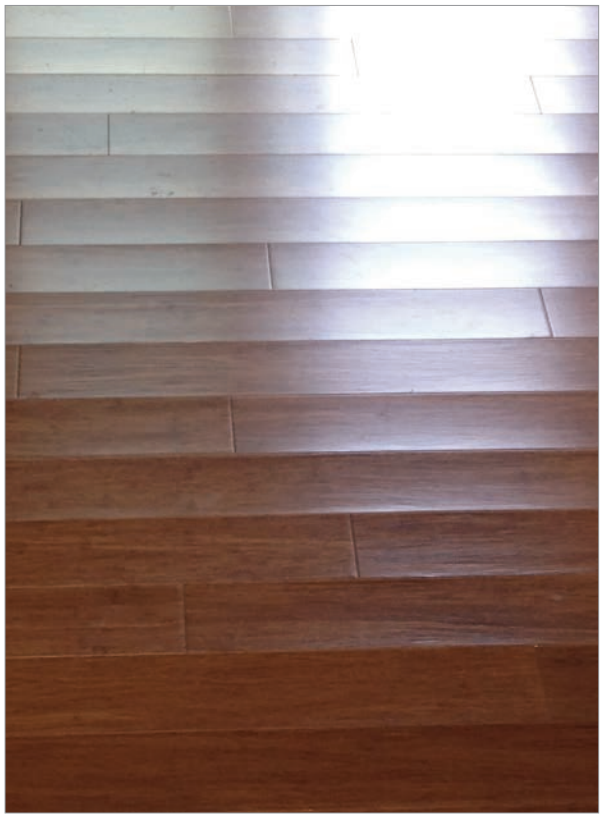
Cupping

DEFINITION: A concave or dished appearance of individual boards with the edges of the board raised higher than the center. This is also a type of warp.



CAUSES:

- Wood is an anisotropic material, meaning it will shrink/swell in relation to its grain orientation. The extent to which solid wood shrinks or swells is also directly proportional to its width. With an installed solid wide plank plainsawn material, it is not uncommon to see the top of a board shrink or swell more or less than the underside of the board when seasonal conditions change, which may result in a slight crowned or cupped appearance.
- A moisture imbalance through the thickness of the wood, a gradient between the top and the bottom of the board; the wood usually has a higher moisture content on the underside of the flooring than on the top.
- An increase in moisture conditions. Potential sources of moisture may include:
  - Inadequate or inoperable HVAC systems resulting in elevated humidity levels. (See Greenhouse Effect.)
  - Wet subflooring (wood or concrete slab).
  - Inadequate moisture control systems installed beneath the wood floor.
  - Poor building drainage resulting in rainwater runoff or subsurface groundwater.
  - Moisture from inadequately ventilated or unconditioned crawl spaces or basements.
  - Portable water sources/appliances, building leaks, or plumbing leaks.
  - Maintenance-related:
    - Wet-mopping resulting in standing/topical liquid moisture left on the floor.
    - Use of steam mops/cleaning devices.
    - Use of non-breathable rugs on the floor.
    - Not maintaining relative humidity levels year-round to support the installed flooring.
- Wood flooring installed at a lower moisture content than the in-use conditions allow. This gain in moisture may result in the installed boards swelling and cupping.
- Wood flooring installed in an environment drier than the in-use conditions.
- Slight cupping can occur with over-wetting the wood when water popping, applying wood bleach, or reactive conditioners. Over-wetting would be described as liquids running down the cracks between the boards. This cupping will usually subside, but must be accounted for with subsequent coats of finishes or colorants.



- Slight cupping/edge-lift can occur with normal application of water-based sealers and finishes, water-based stains, and water-soluble dyes, or with application of multiple coats of water-based finish in one day, prior to previously applied coats being adequately dried. This cupping will usually subside, but must be accounted for with subsequent coats and intercoat abrasion.
- Slight cupping/edge-lift can occur when floors have been damp-mopped in dry-climate conditions. This cupping will usually subside when conditions return to normal.
- Solid flooring may cup when a wood floor experiences conditions that cause rapid drying on the surface. This condition will normally exhibit gaps as the flooring shrinks. This sometimes is considered solid wood dry cupping.
- Cupping can occur with use of water-based adhesive under floors not recommended with these types of adhesives.
- When flooring is cupped prior to installation, causes may include:
  - Improper or unmanaged handling of the environmental conditions surrounding the flooring material after it was manufactured, either during transport, while in storage, or while acclimating at the jobsite.
  - Engineered flooring manufactured out of balance (core and wear layer having an unbalanced EMC).

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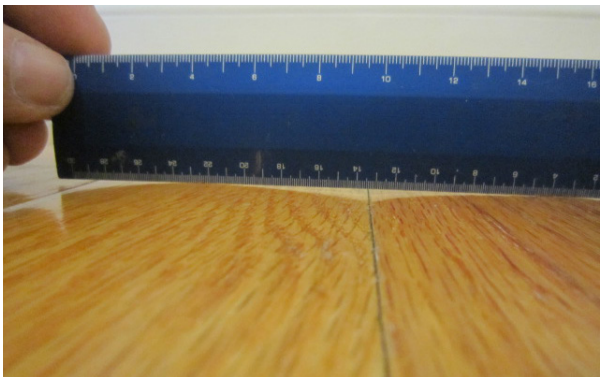
CURES:

- Never attempt to repair a cupped floor until all of the sources of moisture have been located and eliminated.
- The moisture content of the solid wood floor must be at equilibrium with the expected in-use (normal living) conditions prior to resanding a cupped floor. As long as the wood is not permanently deformed or damaged, the flooring should return to its original shape and size when it returns to its original moisture content. This process may take weeks, months or even an entire heating season. Sanding should not take place until all moisture levels have returned to normal. As a general rule of thumb, if there is a difference of 2% moisture content or more between the top-side and the underside of the flooring, it is not likely done drying.
- When excessive moisture compromises the ability of the flooring fastener or the adhesive to adequately hold the flooring in place, or results in movement, audible squeaks, crackles, or pops, the affected flooring and/or wood subflooring material may need to be replaced, fastened, or injected with an approved adhesive.
- Maintain the environment within the flooring manufacturer's requirements. When conditions are not specified by the manufacturer, maintain the temperature between 60º-80ºF (15.6º-26.7ºC), and relative humidity between 30%-50%.
- With slight cupping caused by maintenance, from the finishing processes, or as seen with wide plank flooring, no remedy may be necessary.

Crowning

DEFINITION: A convex or crowned appearance of individual boards with the center of the board higher than the edges. This can also be a type of warp.



CAUSES:

- Wood is an anisotropic material, meaning it will shrink/swell in relation to its grain orientation. The extent to which solid wood shrinks or swells is also directly proportional to its width. With an installed solid wide plank plainsawn material, it is not uncommon to see the top of a board shrink or swell more or less than the underside of the board when seasonal conditions change, which may result in a slight crowned or cupped appearance.
- A moisture imbalance through the thickness of the wood, a gradient between the top and the bottom of the board; the wood usually has a higher moisture content on the top of the flooring than on the underside.
- An increase in moisture conditions. Potential sources of moisture may include:
  - Inadequate or inoperable HVAC systems resulting in elevated humidity levels. (See Greenhouse Effect.)
  - Wet subflooring (wood or concrete slab).
  - Inadequate moisture control systems installed beneath the wood floor.
  - Poor building drainage resulting in rainwater runoff or subsurface groundwater.

Continued on pg. 8

Crowning *(continued)*

- Moisture from inadequately ventilated or unconditioned crawl spaces or basements.
- Portable water sources/appliances, building leaks, or plumbing leaks.
- Maintenance-related:
  - Wet-mopping resulting in standing/topical liquid moisture left on the floor.
  - Use of steam mops/cleaning devices.
  - Use of non-breathable rugs on the floor.
  - Not maintaining relative humidity levels year-round to support the installed flooring.

- A previously cupped or flooded solid wood floor that has been sanded prior to the moisture content not being stabilized at normal, in-use EMC. In this case, sanding too soon will remove the raised edges of the cupped floor resulting in thinner or lower edges than the center of the board. As the board moves (dries) towards a lower EMC, the sanded down edges will drop below the center.
- High humidity levels combined with a dry substrate and/or heat from below the floor (radiant heating systems) can cause a moisture imbalance between the underside of the flooring and the surface.
- Wood flooring installed in a dry environment, then exposed to higher relative humidity levels post installation, resulting in a moisture imbalance in the flooring.
- May be the result of engineered flooring being manufactured out of balance (core and wear layer having a balanced EMC).
- With factory-finished flooring, crowning may be an intentional characteristic of the product. This is most common with eased or pillowed beveled edges.

CURES:

- Determine if the moisture content in the subfloor and floor have stabilized and returned to the moisture content that coincides with the expected in-use (normal living) conditions. Once the floor has stabilized, resand and finish.
- Maintain the environment within the flooring manufacturer's requirements. When conditions are not specified by the manufacturer, maintain temperature between 60º-80ºF (15.6º-26.7ºC), and relative humidity between 30%-50%.
- When the overall wear thickness is less than 3/32" (2.4mm), the affected areas may need to be replaced.
- Factory-finished flooring may need to be replaced.
- No remedy may be necessary when the crowning is the intended appearance of the flooring.

Dry Cupping

DEFINITION: A concave or dished appearance of individual engineered flooring planks with the edges raised higher than the center.

CAUSES:

- When relative humidity levels remain below the manufacturer's recommendations for long enough, engineered planks can begin to dry cup. When this happens, the wear layer loses moisture and begins to shrink across its outer face, which can exert enough force on the core material to pull the edges of the plank (often the groove side) upward. This causes a cupped appearance across the width of the board.
- In severe cases, layers within the plank may separate from one another when stresses exceed the strength of the wood flooring material itself, resulting in ply separation. This is most common in dry regions and during dry seasons.
- Solid flooring may cup when a wood floor experiences conditions that cause rapid drying on the surface. This condition will normally exhibit gaps as the flooring shrinks.
- Inadequate or inoperable HVAC systems resulting in elevated humidity levels. (See Greenhouse Effect.)

CURES:

- For engineered flooring that has cupped due to dry conditions, without ply separation, relative humidity should be increased to within the manufacturer's recommendations to allow the flooring to go back to its intended shape.
- For engineered flooring that is experiencing ply separation, individual board replacement will be necessary.
- Maintain the environment within the flooring manufacturer's requirements. When conditions are not specified by the manufacturer, maintain temperature between 60º-80ºF (15.6º-26.7ºC), and relative humidity between 30%-50%.

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Wood Shear
(Engineered Flooring)

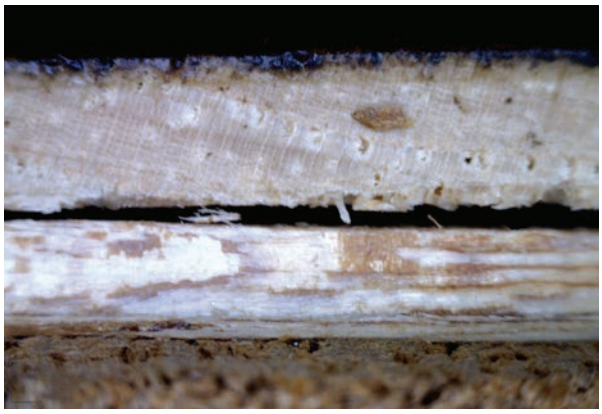
DEFINITION: External stresses exceeding the strength of the wood fibers within an individual plank of engineered flooring, resulting in the wood fibers being torn apart. When examining this type of failure in an engineered wood flooring plank, wood fibers will be visible at the point of separation, remaining bonded to the adhesive layer.

CAUSES:
- Layers within the plank shrink or swell excessively because of low relative humidity or excessive moisture (outside of manufacturer's recommendations), thereby creating excessive force on opposing layers sufficient enough to tear the wood fibers apart.
- Inadequate or inoperable HVAC systems resulting in elevated humidity levels. (See Greenhouse Effect.)

CURES:
- Maintain the environment within the flooring manufacturer's requirements. When conditions are not specified by the manufacturer, maintain temperature between 60º-80ºF (15.6º-26.7ºC), and relative humidity between 30%-50%.
- Replacement of affected boards.

Delamination/ Glue-Line Separation
(Engineered Flooring)

DEFINITION: Engineered flooring is manufactured by adhering several layers/plies together. The separation of two layers/plies within a piece of engineered flooring due to the lack of an adhesive bond is typically identified as a clean separation at the glue-line. Adhesive bond failure is unrelated to inadequate relative humidity levels.



CAUSES:
- Manufacturing-related:
  - Veneers not bonded together due to improper or inadequate adhesive application, missing adhesive, dried or uncured adhesive, or steam pockets.
- Site-related:
  - Extended or repeated exposure to standing water (flooding).

CURES:
- Replacement of affected planks.
- Injection of adhesive in small areas of delamination and addition of weight (until adhesive cures) to affected area is possible in some cases.
- Any moisture-related issues must be addressed prior to replacement or repair.

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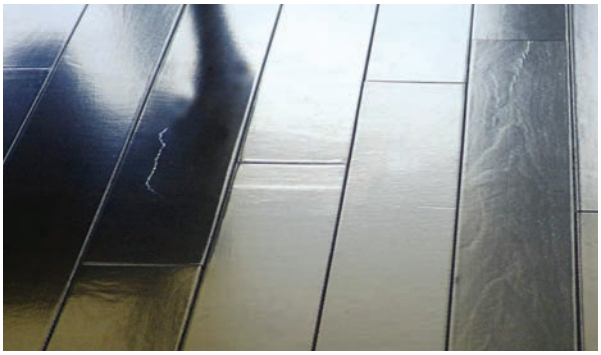
Telegraphing Core Material
(Engineered Flooring)

DEFINITION: Visible patterns on the surface of the wood floor plank that resembles variations in the engineered flooring core material.



CAUSES:
- A gain or loss in moisture, causing wood fillet/finger block core materials to change dimension, which can then telegraph to the surface of the plank.
- Skips, voids, missing/open knots, or overlaps within the core material, that telegraphs to the surface of the plank.

CURES:
- Correct moisture issues within the structure.
- Check with the flooring manufacturer for proper repair recommendations.
- Replace affected boards.

Endlift/Ski
(Engineered Flooring)

DEFINITION: A condition where the ends of installed engineered wood flooring boards deviate from the flat plane and appear raised or curved upward.

CAUSES:
- Flooring incompatible with the environment in which it is installed.
- Engineered flooring that has experienced an increase in moisture, where the core material running perpendicular to the face of the board swells at a different rate and in a different direction than the adjoining layers, forcing the ends of the material to lift, which can then telegraph to the surface of the plank.
- Inadequate or inoperable HVAC systems resulting in elevated humidity levels. (See Greenhouse Effect.)
- Improperly selected, improperly installed, or improperly applied moisture control systems (vapor retarders) that do not provide adequate protection from below the floor.
- Maintenance-related:
  - Wet-mopping resulting in standing/topical liquid moisture left on the floor.
  - Use of steam mops/cleaning devices.
  - Use of non-breathable rugs on the floor.
  - Not maintaining relative humidity levels year-round to support the installed flooring.

CURES:
- Never attempt to repair a floor with moisture issues until all of the sources of moisture have been located and eliminated.
- Replace affected boards.
- Resand or refinish if the flooring has an adequate wear layer (minimum 3/32"), and once the MC has stabilized.

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End-Swell/Flared-Ends
(Solid Flooring)

DEFINITION: A condition where the ends of solid wood flooring boards deviate from the flat plane and/or parallel plane, and may appear wider or thicker than the rest of the board.

CAUSES:

- During the acclimation/conditioning process, the packaging boxes are opened and exposed at the ends only, introducing moisture into the wood fibers through the exposed end joints of individual planks, resulting in an increase in moisture. The result is that not all of the material is conditioned to the environment at the same rate.
- During storage or transportation, the flooring becomes exposed to high moisture levels, specifically affecting the outermost portion of palletized materials.
- Fluctuation in material thickness based on change in moisture content (most common in quarter and rift sawn flooring).
- Moisture from substrate or from below the floor.
- Building or plumbing leaks.
- Inadequate or inoperable HVAC systems resulting in elevated humidity levels. (See Greenhouse Effect.)
- Maintenance-related:
  - Wet-mopping resulting in standing/topical liquid moisture left on the floor.
  - Use of steam mops/cleaning devices.
  - Use of non-breathable rugs on the floor.
  - Not maintaining relative humidity levels year round to support the installed flooring.

CURES:

- Never attempt to repair a floor with moisture issues until all of the sources of moisture have been located and eliminated.
- Replace affected boards.
- Perform aesthetic repairs; sand flat, using fillers or slivers and blend with remaining floor.
- For uninstalled flooring:
  - Condition the boards to the expected (in-use) environment, cut the swollen material from the ends and use the unaffected material as starters/finishers.
  - Do not install the affected boards.

Reaction or Juvenile Wood

DEFINITION: Natural and unique features, properties, and growth patterns in wood that cause it to appear and perform non-traditionally, resulting in distortions from non-uniform swelling and shrinking.

CAUSES:

- Reaction-wood (or compression-wood in conifers) is wood that forms in response to environmental factors, stresses, or unique growing characteristics in the tree during its life. This can include leaning trees, gravity, or growth from wind stresses.
- Juvenile wood is the wood that is formed near the pith (center) of the tree. This portion of the wood may display characteristics such as reduced strength, lower specific gravity, higher longitudinal shrinkage, or even thinner cell walls.
- A characteristic found in some species such as burls, wavy, or curly grain.
- Distorted or irregular grain patterns within the wood (sometimes known as shelly-grain) can become exposed or lifted with changes to humidity or moisture levels.

CURES:

- Board replacement of objectionable boards may be necessary.
- No remedy may be necessary.

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Checks (Solid Flooring or Sawn/ Sliced Engineered Flooring)

DEFINITION: A lengthwise separation of the wood cells that normally extend across the rings of annual growth (parallel to, or along the wood rays), as results of stresses from the drying process. Checks may be acceptable in all flooring grades, however, the length and extent of the check is determined by the manufacturer for each particular grade product. Identification of the type of checking cannot typically be determined without destructive testing and/or third-party analysis. When checks develop during the manufacturing drying process, they are identified into three general categories:

Surface-Checks - Surface checks are separations in the wood fibers that usually occur in, or adjacent to, the wood rays on the faces of plainsawn (flatsawn) boards. These separations occur during the early phases of the drying process where the external and internal stresses cause the wood to tear itself apart.

End-Checks - Like surface checks, end checks occur in, or adjacent to, the wood rays, but on the ends of the boards rather than the face. These separations occur due to the normal movement of moisture along the length of the boards, where the ends of the boards dry more rapidly leading to stress fractures on the ends of the boards.

Internal Checks (Honeycomb) - An internal defect in the wood that may not be visible on the surface of the board, but occurs in the core (inner part of the board) of solid boards. These checks can become exposed when the boards are sanded or milled. They can also become exposed on the surface of the board with a loss in moisture or changes in RH after installation.

CAUSES:

- Checks usually develop as a result of drying stresses from the seasoning process that exceed the tensile strength of the wood.
- Checks may become apparent with improper handling and maintenance practices, such as:
  - Inoperable or lack of RH control within the structure, reducing the humidity levels to below the manufactured tolerances.
  - Excessive moisture used to clean the floors. Excessive moisture would be described as steam or standing water/solution remaining on the floor or able to seep between the boards during the cleaning process.
- Checks may develop or become apparent with improper management of direct heating sources, such as radiant heating systems, surface heat from uncovered windows, or heat registers.
- Checks may develop or become apparent with extreme conditions, or excessive cycling of very high and very low moisture levels (outside manufacturer's recommended levels) within the installed area over an extended period of time. These conditions may be seasonal or regional.
- Checks may develop or become apparent with the process of drying a flooded floor from improperly monitored or misused on-site moisture remediation systems and procedures.
- Checks may telegraph through to the finished surface of the wood causing less elastic finishes to display fine linear cracks in the surface of the finish film precisely in the same location as the underlying anomaly.

CURES:

- Checks are permissible in all flooring grades at the time of manufacture. Check with the manufacturer's grade standards and recommendations for addressing. No repairs may be necessary.
- Maintain the environment within the flooring manufacturer's requirements. When conditions are not specified by the manufacturer, maintain temperature between 60º-80ºF (15.6º-26.7ºC), and relative humidity between 30%-50%.
- Correct or redirect heating sources from the flooring.
- Increase the moisture levels within the facility to reduce the visible appearance of the checks.
- Isolation repairs such as wood filler, color-matched putties, or slivers may be used to address aesthetic concerns.
- Replacement of affected boards may be necessary.

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Lathe Checks (Rotary Peeled/ Sliced Engineered Flooring)

DEFINITION: In engineered flooring with rotary peeled or sliced face veneers, as the knife separates the veneer from the log, the separated sheet of wood is laid flat where stresses can occur in the region near the knife edge. If the strength of the wood is exceeded, this stress is relieved by separations (or checks) of the wood fibers parallel to the grain of the veneer at the knife edge. The knife edge of the veneer is known as the open (or loose) side, and the opposite side of the veneer is known as the closed (or tight) side. Lathe checks are not normally visible on the face of the finished board.

CAUSES:

- Lathe checks may become apparent/transfer to the surface with failure to maintain the ambient interior conditions specified by the manufacturer for the life of the product through all seasons. Loss of moisture or inadequate conditions post-manufacture can expose/generate fractures in the face veneer/lamina at any time.
- Excessive and rapid fluctuating environmental conditions from above or below the floor can cause stresses in the veneers sufficient enough to cause fractures in face veneer at any time.
- Lathe checks may develop or become apparent under any of the following circumstances:
  - Improper maintenance practices.
  - Improper management of direct heating sources, such as underfloor radiant heating systems, surface heat from uncovered windows, or near heat registers.
  - When the floor is covered post-installation with impermeable floor protection, exposing the floor to conditions outside of the manufacturer requirements.
  - Hand scraped products that have been scraped too deep exposing the lathe checks.
  - Inadequate or inoperable HVAC systems resulting in elevated humidity levels. (See Greenhouse Effect.)
- Manufacturing-related:
  - Damage caused during the slicing of the face veneer by the knife, by the pounding action of dull knives, knives with too small of a clearance angle, or excessively jointed knives.
  - Excessive pressure by certain machine parts such as feed rolls, pressure bar, or a chip-breaker can also cause this cracking in the wood.
  - Face-checks may become apparent when the manufacturer inadvertently installs this side of the veneer upside down (or face up). This is a rare occurrence and can only be verified by close examination of the cell structure of the exposed substrate of the face veneer.
- Lathe checks may telegraph through to the finished surface of the wood causing less elastic finishes to display fine linear cracks in the surface of the finish film precisely in the same location as the underlying anomaly.

CURES:

- Maintain the environment within the flooring manufacturer's requirements. When conditions are not specified by the manufacturer, maintain temperature between 60º-80ºF (15.6º-26.7ºC), and relative humidity between 30%-50%.
- Correct, properly adjust, or redirect heating sources from the flooring.
- Isolation repairs such as wood filler, color-matched putties, stain markers, graining markers or pens may be used to address aesthetic concerns.
- New construction trade damage, or embedded drywall dust may require deep cleaning the surface of the floor and/or a complete recoat. (See Open-Grain Contamination.)
- Replacement of affected boards may be necessary.

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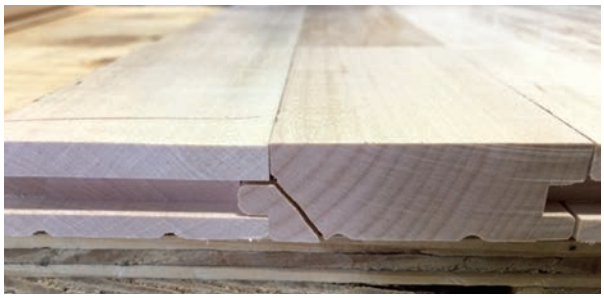
Splits/Cracks

DEFINITION: A tearing apart or rupturing of the wood that may run at various angles to the growth rings.



CAUSES:

- Mechanical damage caused by a variety of potential sources including:
  - Damage from when the tree hits the ground as it is felled during harvest.
  - Mishandling of the product in the factory, during transport, or during installation, such as when the product is dropped, banged, or in other ways damaged.
  - Overdriven or improper fasteners can split or crack the tongue as a result of incorrect air compressor pressure settings.
  - Too close of a fastener schedule.
- Splits or cracks may become apparent with a loss of moisture content, usually as a result of a reduction in relative humidity or extreme dry conditions (low RH), exposing prior damage to the wood.
- Splits/cracks may telegraph through to the finished surface of the wood causing less elastic finishes to display fine linear cracks in the surface of the finish film precisely in the same location as the underlying anomaly.

CURES:

- Isolation repairs such as wood filler or color-matched putties may be used to address aesthetic concerns.
- Replacement of affected boards.
- No remedy may be necessary.

Slivers/Splinters

DEFINITION: Sharp fragment of wood separated/fractured away from the edge or face of the board protruding from the floor.

CAUSES:

- Unevenness of the flooring surface from textured, distressed, hand scraped, wire-brushed, rough-sawn, reclaimed, or otherwise purposefully manufactured or site-altered flooring.
- Damage during installation of the flooring.
- Dents or gouges. The force of a dent crushes the wood in the center, and can separate the wood fibers at or near the edge of the dent, resulting in immediate, noticeable splinters, or splinters that appear with floor use.
- Unevenness in the flooring surface caused by expansion, cupping, edge-crush, compression-set, grain raise from moisture issues, or subfloor irregularities.
- Vertical deflection in the wood floor or subfloor system resulting in broken and splintered edges.
- Normal foot traffic can have the effect of concentrating a disproportionately high amount of force on high spots/areas, resulting in splinters, either immediately, or over time.
- A wood floor that has been sanded past its useful life, resulting in splintering on the groove side of the individual boards.
- Distorted or irregular grain patterns within the wood (sometimes known as shelly-grain) can become exposed or lifted with changes to humidity or moisture levels. This is a natural characteristic of the wood.
- Sidebonded flooring boards resulting in fractured and splintered edges. (See Sidebonding.)
- Maintenance-related (steam cleaners, moisture). Excess moisture can expand the wood grain, resulting in splinters. Application of steam can alter the orientation of wood fibers, and may result in splinters.
- Not to be confused with, but often accompanied with, shake. (See Shake.)

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CURES:

- Address any moisture-related issues prior to correcting any splinters or slivers.
- For minor slivers/splinters along the edges of boards, carefully shave off with a razor knife, then touch-up as necessary.
- For wire brushed, distressed, or grain-raised flooring, address as suggested by the flooring manufacturer. In some cases it may be possible to buff with a Tampico/soft bristle brush attachment in order to remove loose splinters/slivers. Based on the severity and type of floor, a recoat or touch-up may be necessary.
- Replacement of affected boards may be necessary.
- No action necessary. Nothing can be done to avoid how textured flooring wears or performs. No two floors are identical and every board is unique in how it receives texture. All parties should be made aware of the variability and inconsistency of textured, distressed, hand-scraped, wire-brushed, rough-sawn, reclaimed, or otherwise purposefully manufactured or site-altered flooring during the sales process. A lifesyle change or protective footwear may be necessary to live on these types of floors.

Shake
(Ring Shake/Ruptured Grain)

DEFINITION: A separation of the wood's fibers along the grain (parallel to the growth rings), that usually occurs between the rings of annual growth.

CAUSES:

- Can be the result of any of the following in the standing tree:
  - Gale or hurricane-force winds.
  - Tree wound.
  - Tree age.
  - Site and environmental conditions.
  - Wood structure and chemical composition.
- Damage that can be caused during the felling of the tree.
- Changes in environmental conditions can expose existing shake when it was not visible at the time of grading or installation.
- During the finishing process, when water popping, using chemical-reactive conditioners, water-based stains or water-based finish products (sealer, finish, or stain) on a newly sanded wood floor, the wood surface and exposed fibers are hydrated resulting in grain raise, which can "lift or distort" the edge of previously concealed shake, not visible at the time of grading or installation.
- Site conditions on factory finishes can expose existing shake when it was not visible at the time of grading or installation.

CURES:

- Shake is not typically allowed in most grades of flooring, and should not be installed if visible at the time of installation.
- When shake becomes apparent in site-finished flooring, a low-viscosity adhesive, such as cyanoacrylate adhesives (CA), may be used to create a bond in the area of concern. Then sand and refinish as necessary.
- If low-viscosity adhesive is not an alternative, individual board replacement of affected boards may be necessary.
- In factory-finished flooring, replacement of the affected plank is typically the recommended remedy.

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Wood-Destroying Insects

DEFINITION: An invasion of live wood-destroying insects, which may include powderpost beetles or termites. Almost all wood flooring is kiln-dried. Properly kiln-dried lumber will kill any insects and larvae in the wood. Wormholes in the face of wood products that were present at installation can also be from pinworms, shot worms, grub worms, flag worms, or other wood-boring insects that were in the living tree, but are no longer present or alive, and do not represent an active infestation. These wormholes are acceptable within many flooring grades and should not be cause for concern.

- **Powderpost (Lyctid/Anobiid) Beetle -** The larvae of wood-eating insects bore in and feed on the wood fibers causing damage to both hardwoods and softwoods. Properly kiln-dried lumber will normally eliminate powderpost beetles, but infestations can occur at any point after the kiln-drying process, including during storage, transport, or from other wood products.
  - Infestation often occurs long before, but can even occur after the wood floor is installed. Female beetles lay their eggs within the pores of the bare, unfinished wood. The larvae feed on the wood, creating tunnels that fill with a powdery substance called frass. Later, when the larvae mature, they exit the wood, creating small pinholes, generally measuring 1mm-3mm (1/16"). In active infestations, the holes will be surrounded by this frass (light-colored powder). This frass material is very fine and will feel like talcum powder when rubbed between two fingers. The presence of an actual beetle, beetle larvae, or frass is the only way to absolutely confirm an active infestation.

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- **Termites -** Termites are attracted to areas where moisture accumulates in and around your home, including damp basements, laundry rooms, bathrooms, and leaky foundation walls.
  - Termites will eat any kind of wood including mulch, rotting wood, new wood, painted wood, and treated wood.
  - Stagnant, moist air in the home provides the perfect breeding ground for termites.
  - Termite-damaged wood is usually hollowed out along the grain, with bits of dried mud or soil lining the feeding galleries. Wood damaged by moisture or other types of insects will not have this appearance.
  - Termite infestations are a site-specific condition.

CAUSES:

- Improperly dried or stored lumber.
- Lyctid Powderpost Beetles are usually brought into the house in wood products that contains eggs or larvae that may have been in furniture, firewood, untreated reclaimed lumber, joists or framing, molding, trim, wood paneling, cabinets, or even the pallets used to transport the flooring.
- Termites and Anobiid Powderpost Beetles normally prefer to infest wood that is damp; therefore, infestations usually begin in moist, poorly ventilated areas such as in unconditioned crawl spaces or basements.

CURES:

- **Powderpost Beetles:**
  - Powderpost Beetle treatment should be conducted by a professional. The company should be licensed by the Department of Agriculture or agency responsible for regulating powderpost beetle control in your state.
  - As a surface treatment over raw wood, pesticidal formulations containing borate insecticide (disodium octaborate tetrahydrate) may be used by a pest management professional to treat structural wood.
  - Removal and replacement of the affected wood.
  - In the rare case of severe, widespread infestations, when insects have spread into walls, between floors, or other areas where access/ wood removal is impractical, structural fumigations may be necessary.
  - Reduce and maintain moisture levels below 12% in and below the floor.
- **Termites:**
  - Termite treatment should be conducted by a professional. The company should be licensed by the Department of Agriculture or agency responsible for regulating termite control in your state. The treatment professional may use one of two general categories of termite treatment, liquids or baits.
  - Since termites require wood with high moisture content, correction of the moisture source is necessary.
  - Structural damage should be repaired. Damaged flooring should be removed and replaced.

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WOOD AESTHETICS

Grading Discrepancies

DEFINITION: A discrepancy in the designation of the aesthetic appearance and/or quality of a manufactured piece of wood flooring (knots, grain pattern, naturally occurring color variations, etc.). Grading tolerances for both solid and engineered wood flooring are manufacturer and product specific. There are many proprietary grades from one manufacturer to another that dictate aesthetic and physical characteristic tolerances within a designated grade.

NOFMA Clear Red Oak

NOFMA Select Red Oak

NOFMA No. 1 Common Red Oak

NOFMA No. 2 Common Red Oak

CAUSES:

- Unrealistic or unclear customer expectations.
- Objectionable boards that were not culled out during the installation process.
- Ordering mistake by the specifier, supplier, seller, buyer, contractor, installer, or end-user.
- Improperly labeled product.
- Improper grading at the mill.
- Grading variances from one manufacturer to another.
- Outdated or aged samples. Samples may also not show or describe all of the characteristics within the flooring grade.
- Some manufacturers may allow up to 5% of the shipped flooring to be below the product's labeled grade.

CURES:

- Proper culling of material prior to/during installation.
- Replacement of objectionable boards may be necessary.
- No action may be necessary.

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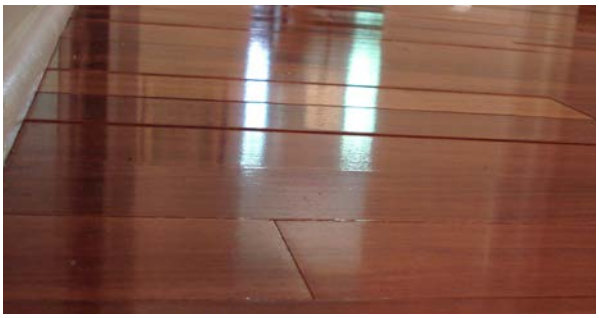
Overwood/Underwood

DEFINITION: A vertical offset that exists between two adjoining installed floorboards.



CAUSES:

- Manufacturing defect. Can be determined with destructive testing or on uninstalled wood flooring boards. Solid and engineered wood flooring manufactured tolerances outside of the applicable industry manufacturing standards (NWFA/NOFMA, HPVA, or similar).
- Intentionally placed in the surface of the floor as an aesthetic design feature.
- A characteristic of reclaimed, distressed, or sculpted floors.
- Installation-related causes:
  - Insufficient subfloor fastener holding power.
  - Irregular subflooring.
  - Substrate not flat to within required tolerance, or that contains protruding subflooring fasteners that were not set prior to installation.
  - Deflection in subflooring.
  - Debris between boards or subfloor during installation.
  - Improper fastener schedule.
  - Improper fastener used (wrong length, gauge, type).
  - Overdriven/underdriven fasteners as a result of incorrect air compressor pressure settings.
  - Cracked tongues.
  - The wrong type of adhesive, trowel, or spread rate.
  - Improperly installed floating floor.
  - Board replacement in which the replaced board(s) were not sanded flat or properly prepared to match the elevation of the surrounding floor.
  - Installer manipulated material.

CURES:

- When flooring is outside of the industry tolerance, or standard, board replacement may be necessary.
- When accompanied by deflection, correct the deflection issue before addressing flooring.
- When flooring installation related, affected area may need to be replaced or sanded flat.
- When it is a characteristic of the flooring material itself, no action may be necessary.

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Uneven Bevels

DEFINITION: Bevels within an installed or uninstalled wood floor appear inconsistent in width, depth, shape, profile, or size.

CAUSES:

- Mis-milled flooring.
- Flooring installed from different product lines/ manufacturers/runs.
- Normal and within grade for flooring installed (such as hand scraped/distressed/reclaimed).
- An existing floor with bevels that was resanded and resulted in uneven bevels.
- Installer manipulated material.

CURES:

- Replacement of affected boards when the boards are outside of grading tolerances may be necessary.
- Repair or recreate by hand to match the bevel profile.
- No repair necessary when the inconsistency is within grade.
- When uneven bevels are the result of a resanded wood floor that contains bevels, the inconsistency may be unavoidable due to the site conditions and the sanding process.

Wood Discoloration

DEFINITION: The wood itself changes color over time (darkens or lightens).

CAUSES:

- Wood changes color through oxidation and/or photochemical exposure, which is a change that cannot be prevented. This is a naturally occurring phenomenon. All woods will change color, but some more drastically than others. This is a natural change, and should be taken into account when selecting flooring from sample boards.
- Some woods darken with age. Some examples of species that darken include American cherry, Brazilian cherry (jatoba), Douglas fir, and purpleheart. Not all boards will change color to the same extent.
- Some woods lighten with age. Some examples of species and products that lighten include black walnut and cork. Not all boards will change color to the same extent.
- Areas covered with rugs or furniture, exposed to less direct light, may change color at a slower rate than those areas exposed to more sunlight. Window coverings or UV protection may aid in slowing the issue over time, but will not eliminate it.

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- Flooring protection used during the construction process. Wood floors exhibiting color change in exposed areas as compared to partially protected/unexposed areas of the floor.
- A repaired area, or newer flooring that does not match the existing untouched flooring. (Different species or subspecies used.)
- When sanding multi-species wood floors, some species natural colors from wood dust can bleed into adjoining woods, affecting the natural intended colors within the floor.

CURES:

- Wood color change is a natural occurrence. Nothing can be done to avoid this natural changing of color. All parties should be made aware of this naturally occurring phenomenon during the sales process. Window coverings or UV protection may aid in slowing the issue over time, but it will not eliminate it.
- If shadows are left in areas of the floor that have been covered by furniture or area rugs, moving the furniture or area rugs around periodically to expose the covered flooring may help equalize the color.
- Customized color matching, shading, or tinting lighter areas to match is not often the best long-term option, as the natural color-change will alter the color of the repaired areas.

Mineral Streaks/Deposits

DEFINITION: A discolored line, spot, or band in the wood that may range in color from light gray to tan, olive green, brown, purple, blue, or black. Mineral streaks/deposits are naturally occurring and they are often considered to add value and appeal to the wood.

CAUSES:

- The source of these mineral streaks/deposits is often undetermined, and is considered a naturally occurring characteristic of living trees. These deposits may develop as the tree absorbs and deposits minerals from the surrounding soil such as limestone, sulfur, nitrogen, phosphorus, potassium, silica, gypsum, or any other mineral found in the region where the tree was grown.
- Some mineral deposits such as silica are often mistaken for chemical stains in some imported species, because of how they may appear as spots or blotches.
- Some mineral streaks may be caused by normal cell physiology occurring from wounds caused by insects, animals, weather, or logging.

CURES:

- Mineral streaks are allowed in many grades of wood flooring, and are dictated by length, width and/or total surface area. The grading of the material used should be a part of the end-user's decision when selecting product.
- Mineral streaks generally will not sand out.
- Proper culling of material prior to/during installation.
- Replacement of objectionable boards may be necessary.
- When grade falls within tolerance, no action may be necessary.

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Sap Stains
(Blue-Stain or Brown-Stain)

DEFINITION: A discoloration in the sapwood. Sapwood itself is the active wood near the outside of the living tree. It is often lighter in color than the heartwood of the tree. Sapwood color variation is normal and acceptable in all grades, and must not be confused with sap stain.

CAUSES:

- Sap stain is caused by the growth of certain fungi on the surface and in the interior of the wood when the moisture content and surrounding conditions are prime for this fungal growth. The wood may become prone to this fungi in standing or fallen timber, or during seasoning prior to the kiln-drying process.
- This discoloration is often known as Blue-Stain or Brown-Stain due to the color of the fungi. In kiln-dried lumber, this fungus is not living, does not cause decay, is not a mold, will not spread, is not a health concern, and will not affect the structural integrity or the strength of the wood.

CURES:

- Sap stains are permissible in many flooring grades. It is important to check with the flooring manufacturer's grade standards and communicate the allowance with the end-user prior to selling or installing the flooring.
- Replacement of affected boards may be necessary.
- No action may be necessary.

Sticker Stains/Shadow

DEFINITION: A discoloration on the face of a board associated with the location of the stacker sticker. Sticker stain should not be confused with machine burn, which may look similar, but will often sand out.

CAUSES:

- Stickers are thin strips or boards used to separate the layers of lumber stacked in a pile in order to permit air circulation during seasoning. These stickers can leave a brown or blue stain that develops in seasoning lumber where it has been in direct contact with the boards.
- Sticker stain discoloration is the result of naturally occurring chemicals within the wood (drying wood and/or stickers) that occur during the drying process.
- Seldom, if ever, will there be any fungi associated with sticker stains.

CURES:

- Sticker stain, unlike machine burn, generally will not sand out and may require replacement of affected boards.
- Sticker stains are permissible in many flooring grades. It is important to check with the flooring manufacturer's grade standards and communicate the allowance with the end-user prior to selling or installing the flooring.

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Moisture Stains

DEFINITION: The wood or finish changes color with exposure to moisture.

CAUSES:

- Rust from the fasteners or metal shavings. (See Iron Stains.)
- Plant pots or other containers in direct contact with the floor, exposing the floor to topical moisture or condensate.
- Pet feces and urine stains. (See Chemical Stains.)
- Mildew-related stains - typically black in color.
- Decay-related stains - typically brown/white in color.
- Fungus or mold-related stains - typically grey, black, blue, or orange in color.
- Alkaline conditions - typically white, brown, or even grey/black in color.
- Moisture from below can cause dark staining, or a white haze between seams and on the surface of the wood.
- Topical moisture (incompatible maintenance products, spills, steam, etc.) can cause blushing or damage to the finish itself.
- Acrylic impregnated/infused flooring reaction with moisture can cause temporary color change.
- Tannic acid present in some wood species is water-soluble and may discolor when it gets in contact with iron and water, which usually appears as a bluish/grey discoloration on the wood. (See Tannic Acid Discoloration.)

CURES:

- For moisture-related stains, eliminate the source of moisture, and then evaluate the condition of the flooring before deciding whether resanding or replacement will be required.
- Factory-finished floors may require replacement of affected boards (refer to manufacturer recommendations for proper repairs).
- Resand or scrape the affected areas when the structural integrity of the flooring system has not been compromised and when sanding effectively removes the staining. Once removed, recoating will be necessary.
- In some cases, staining may be removed, but abnormal gapping or compression set remains. In this case evaluate the condition of the flooring before deciding whether filler or slivers are sufficient for repair, or if replacement is required.
- When these stains cannot be removed by sanding, structural issues remain, or the damage has become permanent, replacement of the affected flooring is likely necessary.
- Pet feces and urine stains that cannot be sanded out, or removed often require replacement of the affected area.

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Iron Stains

DEFINITION: A result of a chemical reaction between wood tannins, water, and iron.

CAUSES:

- A chemical reaction between extractives in the wood and iron in steel products, such as nails, screws, and other fasteners and appendages.
- Floor scraper filings/shavings left on the flooring surface that reacts with water or water-based products.
- Residual from some types of abrasives left on the flooring surface that reacts with water-based products.
- In extreme moisture condition cases, substrate exposure to moisture leaching into the wood floor from below (iron fasteners or from within the slab).
- Metal containers or objects (such as paint or watering cans) in direct contact with the floor, which have been exposed to moisture.

CURES:

- On raw, unfinished wood, oxalic acid (wood bleach) reacts with iron tannates to form a colorless chemical complex, and can minimize or dissolve the stain completely.
- Sand the stain out.
- No repair may be necessary when it doesn't take away from the overall appearance of the floor.

Tannic Acid Discoloration/ Tannin-Pull

DEFINITION: Tannic acid includes various naturally occurring soluble astringent complex phenolic substances found in trees (and plants) as a way of protecting the tree from insects, fire, and bacteria. High levels of tannic acid present in woods like oak, walnut, and mahogany can produce a dark discoloration when coming in contact with some products used in the finishing and maintenance of wood floors.

CAUSES:

- Tannic acid is water-soluble and may discolor when it comes in contact with iron and water, which usually appears as a bluish/grey discoloration on the wood.
- Tannic acid discolors when it comes in contact with materials that are alkaline by nature, such as ammonia. Most water-based finishes are manufactured with pH adjusters (such as ammonia), which can cause a green/brown discoloration on the surface of the wood, and may also partially bleed into the finish.
- Unevenly applied water-based coatings, especially heavy spots, puddles or streaks.
- Not using or improper application of a tannin-blocking sealer.
- Application of a top-coat over a sealer that has not adequately dried.

CURES:

- The coating and discoloration needs to be removed down to bare wood in the affected area, which may require scraping or sanding.
- Avoid tannic acid discoloration by applying special tannin-blocking sealers and finishes evenly, consistently, and per the manufacturer recommendations.

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Chemical Stains

DEFINITION: Irregular shaped spots or discolorations on areas of the finished floor caused by reactive chemicals and/or air pollution.

CAUSES:

- Household chemical spills or cleaning products (nail polish remover, ammonia, chlorine, mustard, iodine, oil, milk, ethyl alcohol, acetic acid, etc.) reaction with wood floor finishes.
- Pet feces and urine stains.
- Reactive conditioners or bleaches used during the coloring processes that have been applied too heavily and allowed to run down the cracks between boards. This can cause staining at the seams due to a heavier reaction with the tannic acid.
- Stone/tile grout drips on wood floor, and sulfamic acid used to remove grout haze from tile installations.
- Urethane/isocyanate flooring adhesive reaction with factory-finished floors.
- Naturally occurring oils from various exotic wood species adversely affecting the drying process of the finish or sealer, sometimes resulting in discoloration on the surface of the boards.
- Some mineral deposits, such as silica, are often misidentified as chemical stains. (See Mineral Streaks.)

CURES:

- Factory-finished floors may require replacement of affected boards (refer to manufacturer recommendations for proper repairs).
- Sanding or scraping to remove topical stains from the surface may be sufficient. Once removed, recoating will be necessary.
- Resand the affected areas when the structural integrity of the flooring system has not been compromised and when sanding effectively removes the staining.
- In some cases, staining may be removed, but abnormal gapping or compression set remains. In this case, evaluate the condition of the flooring before deciding whether filler is sufficient for repair, or replacement is required.
- When these stains cannot be removed by sanding, structural issues remain, or the damage has become permanent, replacement of the affected flooring is likely necessary.
- Stains caused by naturally occurring oils in some exotic wood species require sealing immediately after the floor has been sanded by a sealer recommended by the finish system manufacturer.

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SOUNDS/NOISES/MOVEMENT

Squeaking/Popping/ Crunching Sounds

DEFINITION: Audible squeaking, popping, or crunching noises in an installed wood floor or within the floor system. Squeaks are not a direct concern with the installed wood floor as long as movement accompanying the audible squeak does not affect the performance of the installation. An occasional squeak within any properly installed wood floor system is not abnormal.

CAUSES:

- Old age of the floor and/or structure.
- Wood flooring installed while not in equilibrium with the end-use environment. A change in temperature/humidity that causes the wood floor to change moisture content, and ultimately change dimension of the flooring and tongue and groove match, can result in audible noises, squeaks, pops, or crunching sounds.
- Mis-milled flooring/loose tongue and groove engagement (outside of manufacturing tolerances at the time the material was manufactured).
- Wood subflooring systems (See APA - technical note C468N for more detailed info):
  - Loss of fastener holding power as a result of reduction in moisture within the wood subflooring system.
  - Improper subflooring material that will not adequately hold fasteners.
  - Weak subfloor or subfloor system.
  - Foundation or support pillar settlement.
  - Water-damaged subflooring.
    - Plywood - swelling, distortion, and delamination can occur when exposed to high levels of moisture. This will directly affect how existing fasteners hold the wood flooring to the subflooring material. The plywood subfloor material should be replaced when damage is evident.
    - OSB - swelling can occur when exposed to water. This swelling can create a decrease in density and a reduction in within-board strength due to the release of the compaction stress that is created from the manufacturing process (which involves the pressing of wood chips and resins into panels). This will directly affect how existing fasteners hold the wood flooring to the subflooring material. The OSB subfloor material should be replaced when damage is evident.
  - Improper spacing between abutting wood subfloor panels.
  - Improper or missing adhesive between the wood subfloor panel and joist systems.
  - Improperly driven nails or screws in wood subfloor panels.
  - Noisy or missing tongue and groove in subflooring material.
  - Improper joist spacing/panel thickness combination.
  - Deformed or fractured joists.
  - Ductwork below the subfloor rubbing against the underside of the wood subfloor.
  - Delamination of plywood material.
  - Screed/sleeper systems out of flatness tolerances.
- Nail-down wood floors:
  - Flooring not installed tightly together.
  - Void between wood floor and subfloor.
  - Underside of the flooring blown-out from the fastener used, forcing the flooring off of the subfloor.
  - Debris between boards or subfloor during installation.
  - Wood floors installed parallel to the floor joists over inadequate substrate.
  - Deflection in subflooring.
  - Improper fastener schedule.
  - Improper fastener used (wrong length, gauge, or type).
  - Overdriven/underdriven fasteners as a result of incorrect air compressor pressure settings.
  - Cracked tongues.
  - Substrate not flat to within required tolerance (3/16" in 6', or 1/4" in 10').
  - Improper underlayment material used under wood floor.
  - Lack of expansion around vertical obstructions.
  - Metal floor trusses coming into direct contact with fasteners.

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- Glue-down wood floors:
  - Flooring not installed tightly together.
  - Void between wood floor and subfloor.
  - Debris between flooring and subfloor during installation.
  - Early foot traffic while adhesive was drying.
  - Deflection in subflooring.
  - Concrete substrate moisture.
  - Incorrect adhesive and/or moisture mitigation system used.
  - Inadequate bond between the subfloor and the adhesive (poor preparation or incompatibility).
  - Improper use of the adhesive.
    - Wrong trowel or spread rate as required by the adhesive manufacturer.
    - Inadequate adhesive transfer as required by the adhesive manufacturer.
    - Improper flash time allowing adhesive to skin over.
    - Not using a roller when recommended by the adhesive manufacturer.
  - Substrate not flat to within required tolerance (1/8" in 6', or 3/16" in 10').
  - Lack of expansion around vertical obstructions.
  - Improperly mixed lightweight gypsum concrete or patching compound.
- Floating wood floors:
  - Debris between flooring and subfloor during installation.
  - Deflection in subflooring.
  - Improper underlayment material used under wood floor.
  - Improper glue used or improper glue application.
  - Failed or broken glue bond.
  - Broken, missing, or disengaged locking mechanism.
  - Lack of expansion around vertical obstructions.
  - Pinch-points in the installation.
  - Bowing of flooring outside of manufacturer's tolerances.
  - Substrate not flat to within required tolerance (1/8" in 6', or 3/16" in 10').
  - Flooring installed that wasn't approved for floating installation method.
  - Subfloor moisture.

CURES:

- The structural integrity of the subfloor system is not the responsibility of a wood flooring contractor unless he/she installed the subfloor system. Refer to APA (technical note C468N) for recommended suggestions to repair subfloor systems. Structural-related issues should be addressed by a qualified professional.
- Removal of wood floor may be necessary to repair improperly installed, improperly mixed, or failing subfloor systems.
- Moisture-related issues must be identified and addressed prior to correcting any issues related to noise.
- Lubricating materials such as talcum powder or WD-40 are sometimes used to temporarily minimize board-to-board noises, but may also affect the existing finish system, or subsequent coats of finish, and are not considered permanent fixes.
- Mis-milled wood flooring should be addressed as suggested by the flooring manufacturer. Individual board replacement or injected adhesives are commonly acceptable repairs.
- Unidentifiable noises in specified areas may be repaired by injecting adhesives into the area of concern.
- Screwing from below, adhesives, wedges, shims, or similar repairs in order to strengthen the subfloor system from below.
- Inadequate perimeter expansion may require cutting in expansion into an existing floor.
- Replacement of affected flooring is sometimes necessary.
- Other installation-related issues should be identified and addressed as necessary.

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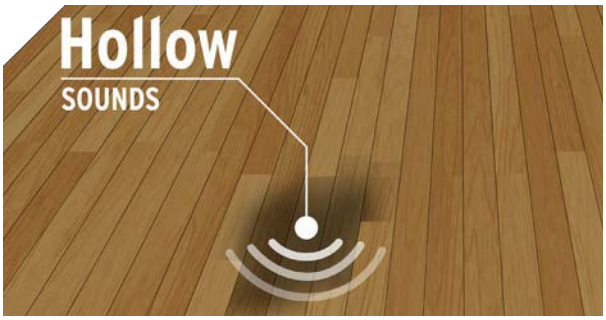
Hollow Sounds

DEFINITION: An audible hollow sound in the installed wood flooring. When no deflection is present, this may be considered normal with many installation methods provided that the installation followed proper installation procedures. Hollow sounds are not a direct concern with the performance of an installed wood floor as long as there is not movement accompanying the audible hollow sound.



CAUSES:

- Nail-down wood floors:
  - A void in the flooring itself (wormholes, shake, bark pockets, engineered flooring core voids, etc.).
  - Slight imperfections or voids in the subfloor.
- Glue-down wood floors:
  - A void in the flooring itself (wormholes, shake, bark pockets, engineered flooring core voids, etc.).
  - Slight imperfections or voids in the subfloor.
  - Concrete subfloor flatness should be within 1/8″ in 6′, or 3/16″ in 10′. Undulations in the concrete surface can cause the wood planks to bridge the dip, resulting in hollow sounds and/or deflection.
  - Small area voids in the adhesive or voids within the properly applied adhesive.
  - Inadequate bond between the subfloor and the adhesive (poor preparation or incompatibility).
  - Improper use of the adhesive.
- Floating wood floors:
  - Hollow sounds and slight vertical movement are considered normal in a properly installed floating wood floor.

CURES:

- When a void between the flooring and substrate is directly tied to vertical deflection within the installed flooring system, issues with flooring performance may become a factor and should be assessed on an individual basis.
- Adhesive injections.
- Individual board replacement.
- No remedy necessary when vertical deflection is not present.
- No remedy necessary with properly installed floating flooring.

Deflection

DEFINITION: Isolated areas in an installed floor system that exhibit vertical (up and down) movement when pressure is applied.

CAUSES:

- A void in the flooring itself (wormholes, shake, bark pockets, engineered flooring core voids, etc.) resulting in vertical movement.
- Mis-milled flooring/loose tongue and groove engagement (outside of manufacturing tolerances at the time material was manufactured).
- Many sports floors have bounce or deflection build in to the system.
- Nail-down wood floors:
  - Slight imperfections or voids in the subfloor.
  - Deflection in subflooring.
  - Substrate not flat to within required tolerance (3/16″ in 6′, or 1/4″ in 10′). Undulations in the wood subfloor can cause the wood planks to bridge the dip, resulting in hollow sounds and/or deflection.
  - Improper subflooring material that will not hold fasteners.
  - Weak subfloor or subfloor system.
  - Foundation or support pillar settlement.
  - Improper joist spacing/panel thickness combination.
  - Wood flooring installed parallel to the floor joists over inadequate substrate.
  - Loss of fastener holding power as a result of fiber shrinkage due to a reduction in moisture within the wood flooring or wood subflooring system.
  - Improper fastener schedule.
  - Improper fastener used (wrong length, gauge, type).
  - Overdriven/underdriven fasteners as a result of incorrect air compressor pressure settings.
  - Underside of the flooring blown-out from the fastener used, forcing the flooring off of the subfloor.
  - Cracked tongues.
  - Improper underlayment material used under wood floor.
- Glue-down wood floors:
  - Slight imperfections or voids in the subfloor.
  - Concrete subfloor flatness should be within 1/8″ in 6′, or 3/16″ in 10′. Undulations in the concrete surface can cause the wood planks to bridge the dip, resulting in hollow sounds and/or deflection.
  - Small area voids in the adhesive or voids within the properly applied adhesive.

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  - Inadequate bond between the subfloor and the adhesive (poor preparation or incompatibility).
  - Improper use of the adhesive.
    - Wrong trowel or spread rate as required by the adhesive manufacturer.
    - Inadequate adhesive transfer as required by the adhesive manufacturer.
    - Improper flash time allowing adhesive to skin over.
    - Not using a roller when recommended by the adhesive manufacturer.
  - Adhesive failure.
  - A bowed board that did not adhere fully to the subfloor when installed.
- Floating wood floors:
  - Substrate not flat to within required tolerance (1/8" in 6', or 3/16" in 10'). Undulations in the subfloor outside of these tolerances can cause the wood planks to bridge the dip, resulting in movement within the wood flooring system that could damage the tongue and groove or locking mechanisms.
  - Hollow sounds and slight vertical movement are considered normal in a properly installed floating wood floor.

CURES:

- The structural integrity of the subfloor system is not generally the responsibility of a wood flooring contractor unless he/she installed the subfloor system. Refer to APA (technical note C468N) for recommended suggestions to repair subfloor systems. In most situations, structural-related issues should be addressed by a qualified professional.
- When vertical deflection is present within nailed-down or glued-down flooring systems, issues with flooring performance may become a factor and should be assessed on an individual basis.
- Mis-milled wood flooring should be addressed as suggested by the flooring manufacturer.
- Individual board replacement.
- Deflection in specified areas may be repaired by injecting adhesives into the area of concern.
- Screwing from below, adhesives, wedges, shims, or similar repairs in order to strengthen the subfloor system from below.
- Other installation-related issues should be identified and addressed as necessary.
- No remedy may be necessary.

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INSTALLATION APPEARANCE

Seasonal/Normal Gaps

DEFINITION: Gaps that appear between individual boards, opening and closing with seasonal humidity changes. Wider boards can experience wider gaps. Gap size is directly related and proportional to the board width.

CAUSES:

- Most normal gaps are caused by seasonal fluctuations in relative humidity. The floor expands with high humidity and contracts with periods of low humidity. This type of expansion and contraction is considered to be normal and expected with wood floors when exposed to seasonal variations.
- When wood flooring is installed during dry seasons where relative humidity is not maintained, it is normal to leave internal expansion spaces/gaps (washer rows) within the floor to accommodate for seasonal humidity changes.

CURES:

- Seasonal gaps can be minimized or completely eliminated by using the HVAC system to maintain temperature and relative humidity within the flooring manufacturer's requirements. When conditions are not specified by the manufacturer, maintain temperature between 60º-80ºF (15.6º-26.7ºC), and relative humidity between 30%-50% on a year-round basis. The use of humidifiers during the dry season and dehumidifiers during the humid season will help maintain consistent wood moisture content resulting in reducing or eliminating gapping issues.
- With internal expansion spaces/gaps (washer rows) that have been built into the flooring system, no remedy is necessary.

Abnormal Gaps

DEFINITION: Gaps between abutting wood floor boards in the installed floor that were not intentionally placed and remain with seasonal fluctuations in moisture and humidity.

CAUSES:

- Flooring not installed tightly together.
- Debris between the boards during installation.
- Solid wood flooring installed at higher moisture content than what the normal, in-service conditions can support.
- Inadequate or inoperable HVAC systems resulting in elevated humidity levels. (See Greenhouse Effect.)
- Edge-crush/compression-set from exposure to extreme moisture after the floor was installed.
- Distorted wood flooring from the manufacturing process (such as crook, pistol-grip, end joints out-of-square, etc.) or from a gain/loss in moisture (such as end-swell/flared-ends or any form of warp) thatcauses gaps between boards during installation.
- Subfloor-related:
  - Loss of fastener holding power as a result of reduction in moisture within the wood subflooring system.
  - Wood subflooring with excessive moisture during wood floor installation. Gaps will be most noticeable at approximate intervals coinciding with the subfloor joints. (See Panelization.)
  - Improper subflooring material that will not adequately hold fasteners.
  - Substrate not flat to within required tolerance (See NWFA Wood Flooring Installation Guidelines for flatness requirements).
  - Movement or deflection within the subflooring system.
  - Weak subfloor or subfloor system.
  - Structural, foundation, or support pillar settlement.

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  - Water-damaged subflooring.
    - Plywood - swelling, distortion, and delamination can occur when exposed to high levels of moisture. This will directly affect how existing fasteners hold the wood flooring to the subflooring material. The plywood subfloor material should be replaced when damage is evident.
    - OSB - swelling can occur when exposed to water. This swelling can create a decrease in density and a reduction in within-board strength due to the release of the compaction stress that is created from the manufacturing process (which involves the pressing of wood chips and resins into panels). This will directly affect how existing fasteners hold the wood flooring to the subflooring material. The OSB subfloor material should be replaced when damage is evident.
  - Loose, or improperly installed, sleepers/screeds.
  - Hot spots in the subfloor, such as poorly insulated heating ducts, hot water plumbing lines, radiant heating systems, register openings, and appliance motors.
- Nail-down floors:
  - Improper subflooring materials that will not hold the fastener.
  - Wrong fastener used per flooring manufacturer (length, gauge, type).
  - Improper fastener schedule or fasteners too close together resulting in cracked tongues.
  - Overdriven or underdriven flooring fasteners as a result of incorrect air compressor pressure settings.
- Glue-down floors:
  - Early foot traffic before the adhesive has had time to set up during or following the installation.
  - Improper use of straps or tape used during the installation.
  - Incorrect adhesive used for the flooring being installed.
  - Inadequate bond between the subfloor and the adhesive (poor preparation or incompatibility).
  - Improper use of the adhesive.
    - Wrong trowel or spread rate as required by the adhesive manufacturer.
    - Inadequate adhesive transfer as required by the adhesive manufacturer.
    - Improper flash time allowing adhesive to skin over.
    - Not using a roller when recommended by the adhesive manufacturer.
- Floating floors:
  - Failure to follow flooring manufacturer's installation instructions.
  - Improper acclimation/conditioning of the flooring and the building.
  - Moisture or environmentally related issues.
  - Inadequate perimeter expansion space at all vertical obstructions. The recommended expansion space may have been adequate at time of installation and closed due to environmental changes.
  - Pinch points caused by door jams, baseboards, trim, or adhesive caulking restricting lateral movement.
  - Heavy (or fixed in place) furniture or cabinets restricting lateral movement.
  - Flooring length and/or width exceeding manufacturer's requirements.
  - Lack of, missing, or improperly installed transitions.
  - Improper or missing glue used on tongue or groove of flooring.
  - Improper glue application to tongue or groove.
  - Loss of the glue bond between the tongue and groove.
  - Broken or missing locking mechanism.
  - Mechanical lock becomes disengaged. This is most common on end joints with deflection due to a subfloor out of flat tolerances or improper underlayment material.
  - Improper underlayment material used (per the flooring manufacturer) below the flooring.

CURES:

- Never attempt to repair a floor with moisture issues until all of the sources of moisture have been located and eliminated.
- The structural integrity of the subfloor system is not generally the responsibility of a wood flooring contractor unless he/she installed the subfloor system. In most situations, structural-related issues should be addressed by a qualified professional.
- Isolation repairs (such as wood filler, color-matched putty, or matching wood slivers) to address aesthetic concerns.
- For square-edge material, replace the board(s) with matching material, then recoat or resand as necessary.
- For beveled edge flooring material, replace the board(s) with matching material. Additional steps may need to be accounted for when replicating bevels or edge profiles. Color-matched putty or slivers may also be necessary and appropriate in some cases.
- In the case of widespread gaps throughout the floor, removal and replacement of affected areas may be necessary.
- Recoat or resand isolated areas or the entire floor as necessary.

End-Gaps

DEFINITION: A separation that occurs on the ends of two abutting wood floor boards.

CAUSES:

- Loss/gain of moisture in engineered flooring.
  - Due to the construction of engineered flooring, each layer shrinks and swells in different directions and at different rates than the adjoining layers. It is common for it to shrink/swell in its length when exposed to changes in moisture content.
- Loss of moisture in solid flooring.
  - Solid wood will generally only shrink/swell .1%-.2% its overall length with changes in moisture content. The pith of the tree may shrink/swell at higher rates.
- Flooring not installed tightly together.
- Debris between the boards during installation.
- End joints of flooring manufactured or cut out of square, or mis-milled tongue and groove profile.
- Subfloor-related:
  - Movement within the subflooring system, and structural or foundation settlement.
  - Wood subflooring with excessive moisture during wood floor installation.
  - Wood flooring laid perpendicular to the direction of the wood subfloor material. Both plywood and OSB generally shrink/swell twice as much in width than in length.
- Nail-down floors:
  - Debris between butt-ends of the boards during installation.
  - Improper subflooring materials that will not hold the fastener.
  - Wrong fastener used per flooring manufacturer.
- Glue-down floors:
  - Early foot traffic before the adhesive has had time to set up during or following the installation.
  - Improper use of straps or tape used during the installation.
  - Incorrect adhesive used for the flooring being installed.
  - Inadequate bond between the subfloor and the adhesive (poor preparation or incompatibility).
  - Improper use of the adhesive.
    - Wrong trowel or spread rate as required by the adhesive manufacturer.
    - Inadequate adhesive transfer as required by the adhesive manufacturer.
    - Improper flash time allowing adhesive to skin over.
    - Not using a roller when recommended by the adhesive manufacturer.
- Floating floors:
  - Failure to follow flooring manufacturer's installation instructions.
  - Improper acclimation/conditioning of the flooring and the building.
  - Moisture or environmentally related issues.
  - Inadequate perimeter expansion space at all vertical obstructions. The recommended expansion space may have been adequate at time of installation and closed due to environmental changes.
  - Pinch points caused by door jams, baseboards, trim, or adhesive caulking restricting lateral movement.
  - Heavy (or fixed in place) furniture restricting lateral movement.
  - Flooring length and/or width exceeding manufacturer's requirements.
  - Lack of, missing, or improperly installed transitions.
  - Improper or missing glue used on tongue or groove of flooring.
  - Improper glue application to tongue or groove.
  - Loss of the glue bond between the tongue and groove.
  - Broken or missing locking mechanism.
  - Mechanical lock becomes disengaged. This is most common on end joints with deflection due to a subfloor out of flat tolerances or improper underlayment material.
  - Improper underlayment material used (per the flooring manufacturer) below the flooring.

CURES:

- Never attempt to repair a floor with moisture issues until all of the sources of moisture have been located and eliminated.
- Issues with the subfloor must be resolved. This is not typically the responsibility of the flooring contractor.
- For end-gaps caused by a loss of moisture in engineered flooring, restore and maintain the humidity levels to normal conditions. This may help return the floor to an acceptable appearance.
- Isolation repairs (such as wood filler, color-matched putty, or matching wood slivers) to address aesthetic concerns.
- For square edge material, replace the board(s) with longer matching material, then recoat or resand as necessary.
- For beveled edge flooring material, replace the board(s) with longer matching material. Additional steps must be accounted for when replicating bevels or edge profiles.
- In the case of widespread end-gaps throughout the floor, removal and replacement of affected areas may be necessary.

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Compression-Set

DEFINITION: A generally uniform appearance of gaps between wood floor boards that directly coincides with the narrowing/crushing of individual board edges as a result of permanent cellular damage. The appearance of a compression-set floor may be similar to gaps from other causes, such as flooring that was milled and installed with high moisture content. When they are at the same moisture content at which they were milled, compression-set boards will be narrower than the milled width and may exhibit slightly raised edges along the board edges.

CAUSES:

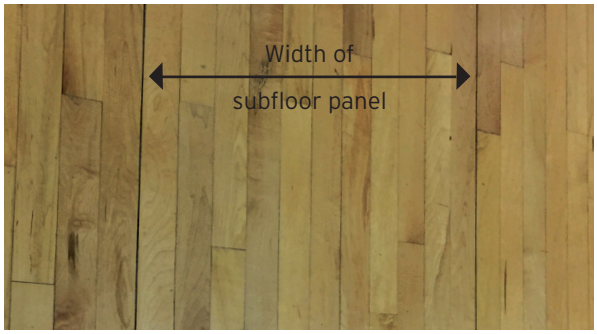
- Exposure to substantial moisture causing excessive expansion, and resulting in damage to board edges, followed by lower moisture levels and subsequent contraction of the affected boards.
- Once the wood fibers have been damaged, they may be unable to regain their original dimensions.
- The compression can become exaggerated by debris becoming embedded in the gaps between boards.
- Filling seasonal gaps during the dry season can cause compression-set when the floor expands again during the more-humid months.

CURES:

- Never attempt to repair a floor with moisture issues until all of the sources of moisture have been located and eliminated.
- Isolation repairs (such as wood filler, color-matched putty, or matching wood slivers) to address aesthetic concerns.
- For square edge material, replace the board(s) with matching material, then recoat or resand as necessary.
- For beveled edge flooring material, replace the board(s) with matching material. Additional steps must be accounted for when replicating bevels or edge profiles.
- In the case of widespread gaps throughout the floor, removal and replacement of affected areas may be necessary.
- Recoat or resand isolated areas or the entire floor as necessary.
- Repairs related to seasonal fluctuations should only be done during months of moderate RH to avoid the development of future gaps or to exacerbate the cellular damage.
- No remedy may be necessary.

Panelization

DEFINITION: A generally uniform appearance of gaps or peaks in the surfaces of the wood floor that directly coincide with movement in the subfloor material beneath it.



CAUSES:

- Moisture-related subfloor issues.
- Acclimation related issues:
  - Moisture content of the wood floor and subfloor are not aligned at the time of installation.
  - Wood subflooring with excessive moisture during wood floor installation, then losing moisture resulting in gaps between boards at the seams of the subfloor. These types of gaps are typically most noticeable at approximate intervals that directly coincide with the subfloor panel widths.
- Hot spots in the subfloor, such as poorly insulated heating ducts, hot water plumbing lines, radiant heating systems, register openings, and appliance motors resulting in subfloor movement or shrinkage post wood floor installation. These types of gaps may or may not align with joints in the subfloor.
- Movement within the subflooring system due to structural or foundation settlement.
- Wood flooring installed parallel to solid board subfloor planks or parallel to an existing wood floor.
- During full spread adhesive application, skipped, inconsistent, or improper application of adhesive resulting in uneven movement of the flooring system.

Continued on pg. 34

Panelization *(continued)*

CURES:

- Never attempt to repair a floor with moisture issues until all of the sources of moisture have been located and eliminated.
- The use of humidifiers during the dry season and dehumidifiers during the humid season will help maintain consistent wood moisture content resulting in reducing or eliminating gapping issues.
- The structural integrity of the subfloor system is not generally the responsibility of a wood flooring contractor unless he/she installed the subfloor system. In most situations, structural-related issues should be addressed by a qualified professional.
- Isolation repairs (such as wood filler, color-matched putty, or matching wood slivers) to address aesthetic concerns.
- For square edge material, replace the board(s) with matching, wider material, and then recoat or resand as necessary.
- For beveled edge flooring material, replace the board(s) with matching material. Additional steps must be accounted for when replicating bevels, edge profiles, and width variations.
- In the case of widespread gaps throughout the floor, removal and replacement of affected areas may be necessary.
- When flooring has been installed parallel to solid board subfloors or existing wood floors, the wood floor will likely need to be removed.
- Recoat or resand isolated repair areas or the entire floor as necessary.
- No remedy may be necessary.

Sidebonding

DEFINITION: A condition where localized gaps develop between flooring boards while adjacent groupings of boards remain tightly bonded together with no apparent separations. These gaps will sometimes exhibit wood fractures along the gap as a result of the finish bond tearing away small pieces of wood from the adjoining plank. Sidebonding should not be confused with panelization. (See Panelization.)

CAUSES:

- When installed wood flooring shrinks due to a loss of moisture, and the edges of individual boards have become adhered to one another due to:
  - Finish (most common with water-based finishes) that has seeped between the boards, drying and forming a permanent bond adjoining/gluing boards together.
  - Glue that has been used on the tongue and groove during installation, adhering the planks together.
- Not using a sealer, either water-based or oil-based (sealer, stain, or polyurethane), as recommended by the finish manufacturer, prior to applying the rest of the finish system.
- With recoat scenarios in which cracks are present or unfilled, finish will fill the voids and potentially result in sidebonding.

CURES:

- The use of humidifiers during the dry season and dehumidifiers during the humid season will help maintain consistent wood moisture content resulting in reducing or eliminating gapping issues.
- To prevent sidebonding from occurring, use appropriate water-based sealers, oil-based sealers, oil-based stains, or natural oils, as recommended by the finish manufacturer.
- Isolation repairs (such as wood filler, color-matched putty, or matching wood slivers) to address aesthetic concerns.
- For square edge material, replace the board(s) with matching, wider material, then recoat or resand as necessary.
- For beveled edge flooring material, replace the board(s) with matching material. Additional steps must be accounted for when replicating bevels, edge profiles, and width variations.
- In the case of widespread gaps throughout the floor, removal and replacement of affected areas may be necessary.
- Recoat or resand isolated repair areas or the entire floor as necessary.
- No remedy may be necessary.

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Telegraphing Fastener/Dimpling

DEFINITION: Dimples or bumps along the nailing surface of the finished flooring, directly related to fastener location and/or installation method.

CAUSES:

- Improper fastener used for the wood installed (the wrong gauge staple or cleat).
- Underdriven fasteners (not seated properly) in the nail pocket of the flooring displacing the wood fibers as a result of incorrect air compressor pressure settings.
- Overdriven fasteners displacing the wood fibers resulting in bumps/dimples on the surface of the boards (common with denser species) as a result of incorrect air compressor pressure settings.
- Thin veneers of engineered flooring that are forced upward by the installation process/fastener used, also affecting installation of adjoining boards.
- Improper use of the flooring nailer, including placement/improper angle of the driven fastener.
- Damage from the installation process from the floor nailer, mallet, hammer, pry bar, tapping block, or any other installation tools used to install the flooring.
- Debris embedded within the tongue and groove displacing the wood fibers.

CURES:

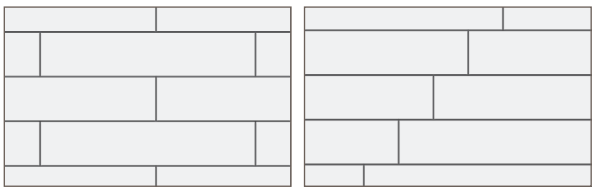
- Replace affected boards.

Flooring Rack Discrepancies

DEFINITION: End joints of adjacent boards installed in close proximity to each other, resulting in clustered end joints, stair-stepping, H-joints, or an undesirable (aesthetically displeasing), discernable pattern. In general, end joints should be staggered per NWFA Wood Flooring Installation Guidelines (staggering row to row should generally be a minimum of twice the width of the flooring being installed), or per manufacturer's installation instructions.

With solid or engineered wood flooring installed over concrete or a wood panel subfloor and joist systems that meet or exceed NWFA minimum requirements, properly staggered end joints are an appearance/aesthetic consideration.

With 3/4" and greater strip or plank wood flooring installed over bare joists, solid board subfloors (1"x6"), "perpendicular car decking," sleepers/screeds, other non-continuous subfloor systems, or panel-type subfloors that do not meet NWFA minimum requirements, the layout of the entire floor, and end joint placement, are not only an appearance/aesthetic consideration, but also add a structural element to the finished installation. Stair-stepped and clustered end joints may reduce the ability of the flooring system to withstand the additional stresses created in these circumstances.



CAUSES:

- During the installation, the floor was laid out in a pattern with end joints close together.
- During the installation, the flooring boards were not randomly distributed from multiple bundles, resulting in undesirable, discernible patterns.
- The inability for the installer to follow the proper or traditional racking composition due to short average product lengths and/or widths of material.
- The inability for the installer to follow the proper or traditional racking composition due to the structural requirements and limitations of the substrate system below.
- Repairs completed in an installed floor with end-joints landing close together.
- An intentionally installed pattern.

CURES:

- An occasional end joint placement that does not fall within tolerance (whether structural or aesthetic) does not always justify repairs or replacement.
- Replace affected area or boards as necessary, unless structural considerations apply.
- When structural considerations apply, consult a building professional prior to repairs.
- No remedy may be necessary.

Crooked Installation Discrepancies

DEFINITION: An installed wood floor appearing bowed or out-of-square within the room in which it is installed. No wood floor installation is perfectly straight, parallel, or perpendicular to walls or fixtures. When the straightness of the installed floor takes away from the overall appearance of the floor within the structure, an aesthetic remedy may be necessary. The performance and structural integrity of the wood floor is not normally affected with any floor that has been installed out-of-square or out-of-a-straight-line.

CAUSES:

- The existing structure or fixtures within the structure are out-of-square. This is out of the flooring contractor's control.
  - Walls within a structure are never perfectly square, parallel, or perpendicular to one another. The wood floor can quickly highlight a wall that is out of square. During the installation, the floor was laid-out and installed in a relatively straight line, but appears crooked in comparison to adjoining fixtures (walls, floor coverings, cabinets, etc.).
  - One room may be square within the structure, while the next room is not.
  - The new wood floor was intentionally installed to match an existing crooked fixture (walls, floor coverings, cabinets, etc.), or design element within the structure.
- The installation of the wood floor is not in a singular-line-plane from one end of the floor to the other During the installation, the flooring "drifted" out of a singular-line-plane, resulting in a "crooked" or "bowed" pattern/appearance in the otherwise straight installation. This may be due to many causes:
  - Flooring not installed in a straight line.
  - Floor moving out of a straight line during installation.
  - Premature foot traffic on a glued-down floor that has not yet set-up.
  - Debris between floor boards not allowing boards to be installed tightly together.
  - Mis-milled flooring, flooring that varies in width, warped flooring, or an out-of-square parquet pattern.
  - Tying two floors together that are not aligned.
  - Adding on to an existing crooked floor.
- Customer expectations.

CURES:

- Rarely are all features within a structure true and square. The wood floor installer should take into account extreme crooked jobsite obstacles during the layout of the wood floor with the end-user, specifier, general contractor, and builder to determine what installation layout best fits each scenario to accommodate, hide, or repair crooked jobsite obstacles.
- It is not the responsibility of the flooring contractor to correct existing jobsite fixtures.
- During installation:
  - Boards may be tapered to accommodate crooked features within the structure.
  - This process takes additional time and materials, and must be taken into account when pricing the job.
- Post installation:
  - Replacement of offensive sections may be necessary.
  - Work with the end-user, specifier, general contractor, and builder to correct aesthetically displeasing crooked jobsite features.
- No correction may be necessary.

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Floor Flatness/ Telegraphing Substrate

DEFINITION: The installed wood floor system appears to be uneven, wavy, or out of flat. Wood floors may be installed over out-of-level subfloors, but should fall within NWFA floor flatness tolerances. Subfloor flatness cannot be quantifiably measured when a floor covering is in place over it (without potentially extensive destructive testing), however, may give a good indication of what is happening below.

It is the responsibility of the flooring installer to assess substrate flatness, moisture requirements, and panel thickness/joist span combinations prior to installation. Reference NWFA Wood Flooring Installation Guidelines, and the flooring manufacturer installation instructions, for applicable tolerances. Gradual variations in subfloor flatness may not affect the performance of the installed wood floor, but may be considered unacceptable when overwood, vertical movement, slight gapping, squeaking, or noisy floors are present.

CAUSES:

- Flooring installed over abrupt variations in elevation/flatness of the subfloor system or screeds within a short distance (refer to NWFA Wood Floor Installation Guidelines or manufacturer instructions for flatness tolerances).
- Improperly installed or inadequate subfloor or subfloor system.
- Improper joist spacing/panel thickness combination.
- Structural conditions.
- Altered subfloor or subfloor system post-installation.
- In a concrete slab system, movement or cracking within an existing slab.
- Flooring installed over improperly applied compounds, improperly installed underlayment materials, or uneven screeds.

CURES:

- Removal of the wood flooring may be necessary to assess and address any substrate-related issues.
- Correcting uneven concrete subflooring may require grinding high spots and/or filling low spots with the use of self-levelers and patches designed for this purpose and that are industry acceptable. (See OSHA silica safety rule and NWFA Wood Flooring Installation Guidelines for more information.)
- Correcting uneven wood subflooring may require sanding, use of shims, or other approved material. (See NWFA Wood Flooring Installation Guidelines for complete subfloor flattening procedures.)
- Corrective repairs to the existing floor joists or subfloor system may be necessary.
- Structural subfloor-related issues should be addressed by a qualified professional.

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FILLER/PUTTY

Filler Color Variation

DEFINITION: The wood filler from one area of the floor is different from the overall color tone of the floor. No two trees from the same species are identical, no two boards from the same tree are identical, and color and grain patterns can vary even within one individual plank of wood. Wood filler will never perfectly match, nor is it designed to match every board within a wood floor.

CAUSES:

- Filler that doesn't change color with the wood.
- Knot hole and crack filler intentionally colored differently than the overall color of the floor.
- Wrong filler color used on the floor.
- Dirty, contaminated, or improperly mixed filler.
- Installed wood slivers or Dutchmen of different colored species or drastic variation in the grain orientation.
- Customer expectations.
- The drastic variations in many wood species will not always match the filler color used.

CURES:

- In some cases, with site-finished flooring, it is possible to use wood dust filler systems mixed with the same species to allow for similar color change.
- Aesthetic touch-ups with permanent colored or stain markers.
- Remove discolored filler and replace with filler that is closer coordinated to the overall color tone of the floor.
- No action may be necessary.

Popped Filler

DEFINITION: Wood floor filler that has become loose or no longer fills the void it was once in.

CAUSES:

- A normal occurrence due to seasonal movement within any wood floor, normal rattles and vibrations, footfall, maintenance, or other normal wear-and-tear on a wood floor.
- Loose floor or vertical deflection within the wood floor.
- Loose substrate system.
- A lower moisture content in the wood floor (lower humidity levels) than when the filler was applied, resulting in a larger gap between the boards.
- Improperly maintained radiant heating systems resulting in lower MC levels.
- Wood filler only bridging the gap, not properly pushed between the boards when it was applied.
- Filler improperly applied over loose dust or debris in nail holes, knot holes, beveled edges, or in gaps.
- Refinished or resanded floors that were previously finished with waxes or maintained with products incompatible with the new finish. Fillers may not always work on older floors.
- Improperly mixed 2-component fillers or powdered fillers.
- Floor filled with products not suitable for wood flooring.

CURES:

- Correct any loose flooring or substrate issues when possible, prior to filling the floor. Refilling without correcting the movement will likely result in the same "popped filler."
- The structural integrity of the subfloor system is not the responsibility of a wood flooring contractor unless he/she installed the subfloor system. Structural-related issues should be addressed by a qualified professional.
- In areas with humidity swings, do not fill seasonal gaps during the dry seasons (winter months). Filler used in these situations will likely cause damage to the flooring when the wood expands again in the humid seasons.
- Add humidification to the space to maintain proper RH levels.
- Control temperature within radiant heat system.
- Remove loose filler and re-apply new filler.
- In cases where floors previously had been finished with wax, repair may not be feasible.
- No remedy may be necessary.

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SANDING AESTHETICS

Sanding Marks

DEFINITION: Sanding imperfections seen as drum marks, side cuts, sanding scratches, or swirl marks. Sanding marks should be viewed from a standing position on the floor being assessed, in ambient lighting conditions. Glare from a direct light source must not be used during evaluation. Inspection may take place from floor level and/or with assistance of magnification in order to determine causes of irregularities, but not to determine acceptability.

CAUSES:

- Sanding-process related:
  - Poor workmanship/sloppiness.
  - Running the machine in the wrong direction.
  - Running the machine too slow, too fast, or at an inconsistent pace.
  - Inconsistent operator walking speed.
  - Inadequate 1st cut angle.
  - Not enough overlap with each pass of the big machine, the buffer, or the multi-head sander.
  - Too much drum pressure.
  - Power surges during operation/inadequate power to the machine.
  - Running the machine outside of manufacturer's recommendations.
  - "Heeling" the buffer.
  - Improper clocking of the buffer or edger.
  - Grit or debris left behind on the flooring that wasn't adequately vacuumed or removed during the sanding process, affecting the subsequent scratch patterns.
  - Skipped steps in the sanding process.
- Machine-related:
  - Improperly installed paper on a floor sander.
  - Out-of-balance or out-of-round drum or upper roller.
  - Improperly aligned upper roller assembly.
  - Debris on upper roller assembly.
  - Wheels on the big machine that are out-of-round or dirty.
  - Bad, worn out, or loose drive belts/pulleys or fan belts/pulleys.
  - Bad bearings in the fan housing or drum shaft.
  - Poorly maintained machine, bent edger pad, or buffer drive plate.
  - Improper voltage for machine (too high or low).
- Abrasive-related:
  - Poor splice/seam on the abrasive belt.
  - Poor quality or improperly manufactured abrasive.
  - Contaminated or damaged abrasive.
  - Improper abrasive selection or improper abrasive sequence.
- Site conditions:
  - Substrate-related issues causing equipment malfunction.
  - Settled, or otherwise unlevel flooring.
- Factory-finished flooring:
  - Areas on the face of individual boards exhibiting sanding marks from the manufacturing process that remain visible after the finishing process. Not to be confused with finish or color marks.

CURES:

- Refer to NWFA Wood Flooring Sand and Finish Guidelines for proper sanding processes.
- If the cause of the issue is with the equipment, it must be corrected prior to addressing.
- Address any abrasive issues prior to correcting the problem.
- Correct any structural issues prior to correcting problem.
- Isolated sanding marks can be addressed by repairing/resanding individual areas.
- Resanding of the affected areas may require the first cuts with the big machine to be on a steep angle, followed up with straight cuts.
- Use of a hard plate, multi-disc, or planetary sander will also help alleviate some sanding marks.

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Chatter

DEFINITION: Slight unintentional indentations causing a ripple-like wave effects or "bars" that run perpendicular to the wood's grain direction on the surface of a wood floor which can become visibly pronounced in direct lighting. The width of these "bars" can range from just a few millimeters to nearly an inch from peak to peak, and can occur in limited regions or can span the entire floor.

CAUSES:

- Machine-related:
  - Improperly installed paper on a drum sander.
  - Out-of-balance or out-of-round drum or upper roller.
  - Loose drum nut.
  - Wheels on the big machine that are out-of-round or dirty.
  - Bad, worn out, or loose drive belts/pulleys or fan belts/pulleys.
  - Bad bearings in the fan housing or drum shaft.
  - Poorly maintained machine.
  - Dust build-up within the machine.
  - Improper voltage for machine (too high or low).
- Abrasive-related:
  - Poor splice/seam on the abrasive belt.
  - Poor quality or improperly manufactured abrasive.
  - Contaminated or damaged abrasive.
- Harmonic-vibration:
  - The structural integrity of, or undulations in, the subfloor.
  - Undulation of the floor from joist truss deflection.
  - Improper subfloor thickness, insufficient subfloor orientation (parallel vs. perpendicular), seams not ending on joists.
  - Undersized joists, undersized beams/supporting joists, improper joist or beam span (end-to-end or between joists/beams).
  - Flooring installed parallel with floor joists.
  - Insufficient or loose fasteners, incorrect fastening schedules, etc.
  - The structural integrity of the floor being sanded.
  - Sanding of a loose, poorly installed, or floating wood floors.
  - Older, historic wood flooring installed directly to floor joists resulting in more deflection between the joists.
  - Any subfloor or wood floor system with "built-in-give," such as with some gym floor systems.

CURES:

- Correct any equipment or power problems prior to addressing the issue.
- Correct any loose flooring or structural problems when possible, prior to addressing the issue.
- The structural integrity of the subfloor system is not the responsibility of a wood flooring contractor unless he/she installed the subfloor system. Structural-related issues should be addressed by a qualified professional.
- To remove chatter in an existing floor, the first cut should be on a steep angle, followed up with straight cuts, followed by use of a hard plate, multi-disc, or planetary sander to help alleviate or remove the chatter. (Refer to NWFA Wood Flooring Sand and Finish Guidelines.)
- No repairs may be necessary.

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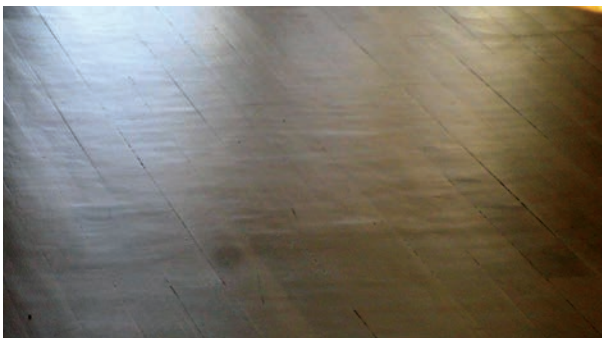
Wave

DEFINITION: Indentations, usually repeating undulations, visible on a site-sanded wood floor surface, most often visible after a finish has been applied. The width of these irregularities typically range from one inch to three inches or more, and can occur in limited regions or can span the entire floor. Wave can sometimes be in conjunction with, or confused with, dishout.



CAUSES:

- The structural integrity of the floor being sanded.
- The structural integrity of, or undulations in, the subfloor.
- Foreign objects stuck on sander wheels/wheels out-of-round.
- Knots or density differentials in the flooring causing sanding inconsistencies.
- Poorly maintained machine.
- Power surges during operation/inadequate power to the machine.
- Improper big machine sanding techniques.
  - Floor not properly sanded flat during initial cuts.
  - Inconsistent operator walking speed.
  - Improper abrasive selection/sequence.
  - Inadequate 1st cut angle.
  - Operating the big machine in the wrong direction.
  - Not enough overlap with each pass of the big machine.
  - Dust build-up within the machine.

CURES:

- Correct any loose flooring or structural problems when possible, prior to addressing the issue.
- The structural integrity of the subfloor system is not the responsibility of a wood flooring contractor unless he/she installed the subfloor system. Structural-related issues should be addressed by a qualified professional.
- Correct any power problems prior to addressing the issue.
- Structural subfloor-related issues should be addressed by a qualified professional.
- To remove wave in an existing floor, the first cuts should be on a steep angle, followed up with straight cuts, followed by use of a hard plate, multi-disc, or planetary sander to help alleviate or remove the wave. (Refer to NWFA Wood Flooring Sand and Finish Guidelines.)

Dishout/Shellout

DEFINITION: Undulations in the surface of individual boards or within the wood floor, resulting from softer areas having been worn, hollowed, or sanded to a lower level than harder adjacent areas.

CAUSES:

- May be an intended characteristic of some site or factory-finished floors (such as wire brushing).
- Sanding-process related:
  - Sanding of a floor assembled of mixed species of different hardness characteristics such that material is removed at different rates through the sanding process (for example: borders, feature strips, medallions).
  - Cross-grain sanding (running the belt/drum sander perpendicular to the installed direction) of any area of a wood floor.
  - An incomplete or inconsistent sanding procedure accompanied with an inadequate abrasive grit selection for the floor being sanded.
  - Improper use of the sanding equipment such as:
    - Using too-heavy of drum pressure for the species being sanded.
    - Using thick, compressive, or doubled-up driver pads on the buffer drive plate with the edger during the final sanding processes.

Continued on pg. 42

Dishout/Shellout *(continued)*

- Using thick, compressive driver pads on the buffer drive plate during the sanding process, allowing for inconsistent material removal based on material hardness characteristics (springwood, softer species). Also known as dishing of springwood.
- Improper buffer sanding technique (over-buffing).
- Removing springwood at a quicker rate than the summerwood. Also known as dishing of springwood.

- Maintenance/wear-related (shellout):
  - Using water or any topical liquid to clean the floor, and it is left standing on the flooring surface. This gain in moisture within the open grain of the springwood fibers can compromise the structural integrity of the wood fibers, which may cause it to become more susceptible to early wear.
  - Using steam cleaners to clean the floor. When steam (vapor water) is used to clean wood floors, the gain in moisture within the open grain of the springwood fibers can compromise the structural integrity of the wood fibers, which may cause it to become more susceptible to early wear.
  - Excessive or aggressive maintenance practices.
  - Areas receiving heavy concentrated foot traffic, particularly at pivot points.
  - Pet nails.
  - Failure to fully remove grit from the floor's surface or shoe bottoms.
  - Worn, dirty, or inadequate floor protection under furniture.
  - Grain patterns on the face veneer of rotary peeled veneers inherently expose more springwood, which can become prone to unusual/excessive foot traffic, often isolated to confined traffic areas and pivot points, resulting in springwood wear patterns.

CURES:

- Refer to NWFA Wood Flooring Sand and Finish Guidelines for proper sanding processes.
- Resand the floor at a minimum 7º-15º angle with the big machine on the first cut to flatten the floor. Sanding at the opposite angle on the subsequent cut may also be necessary to properly flatten the floor. Avoid cross-grain sanding (perpendicular to the direction of the grain) on any area of the floor if possible.
- On multi-directional floors, sand at a 45º angle to the direction of the grain where possible in order to flatten the floor.
- Use of a hard plate, multi-disc, or planetary sander, may help alleviate sanding marks and will minimize or alleviate dishout.
- Eliminate using thick, compressive, or doubled-up driver pads on the buffer drive plate or with the edger during the final sanding processes.
- Halt all cleaning practices that allow moisture to infiltrate the wood flooring.
- No action may be necessary when an intended characteristic.

Veneer Sand-Through

DEFINITION: The top/wear layer veneer (lamina) of engineered flooring has been completely sanded through to the core layer.

CAUSES:

- Sanding of an engineered wood floor beyond the thickness of the top layer of wood to the core layer.

CURES:

- Painting or drawing the colors and grains back into the sanded-through veneer to somewhat match the surrounding wood. This repair will never perfectly replicate adjacent textures and colors.
- Replace the affected board or section of flooring as necessary. This requires precision material removal from the backing of the board in order to match the thickness profile of the surrounding flooring. Carefully spot blend to match.
- Complete replacement may be necessary.

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COLOR INCONSISTENCIES

Finish/Colorant Discoloration

DEFINITION: The finish or colorant systems changes color.

CAUSES:

- Many film-forming finishes, natural penetrating oils, waxes, and colorants may amber/yellow, fade, lighten, or patina in appearance over time. This is normal and to be expected.
- Direct exposure to light may change the color of finishes or colorants over time. This is a natural change, and should be taken into account when selecting flooring, finishes, and color systems.
- Aniline dyes are not colorfast, meaning they may fade over time or when exposed to light.
- Finish applied over an uncured coating or stain, causing color-bleed or color-pull into the finish system.
- Color-bleed from one section of the floor into another, often through taped-off areas or where stains or colorants leached into areas unintentionally.
- Floors finished with the fuming process that have been covered, disallowing the chemical to adequately evaporate, resulting in discolored areas of the floor.
- Water-based finish top-coats applied over oil-based sealers that have been sanded through during the intercoat abrasion process.
- Repairs in a finished floor that did not follow the previous finish or application processes or that do not match aged/older finishes.
- Improper cleaning products, dilutions, or application used on the floor finish.
- Area rugs and non-slip area rug pads that are incompatible with the wood floor finish systems or have been placed over uncured finishes can leave discoloring stains, blushing of the finishes, or impressions in the finish as well as the wood. (See Surface Impressions.)
- Chemical, urine, or moisture exposure.

CURES:

- To minimize finish color change, reduce the floor's exposure to direct light.
- When a recoat will not effectively remove the discoloration, a resand may be necessary (this is not always an option).
- When a resand will not effectively remove the discoloration, or when the wood or flooring system is damaged beyond salvaging, replacement may be necessary.
- When maintenance-related stains have damaged the finish only, a recoat may be sufficient to remove the discoloration.
- Isolation repairs may be an option when attempting to match color variation within smaller areas of the floor.
- No remedy may be necessary.

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Blotchy Stain/Colorant

DEFINITION: The appearance of an inconsistent stain or colorant from one area of a finished floor to another. Stained/colored floors should be uniform in color. Color tones may vary from board to board or within individual boards due to natural variances within the wood.

CAUSES:

- A physical property of the wood species itself (such as maple, black cherry, pine), whereby it does not evenly accept stain or colorant.
- Inconsistent sanding from one area of the floor to another.
- Inconsistent or uneven water-pop from one area of the floor to another.
- Inconsistent stain/colorant application.
- Finish applied over an uncured coating or stain, causing color-bleed or color-pull into the finish system.
- With a resand, not all of the previous coating system was sanded off prior to staining.
- Contamination remaining on the flooring surface prior to staining.

CURES:

- No remedy necessary when the natural characteristics of the wood species cause the blotchy appearance.
- Resand of the entire floor may be necessary when inconsistent sanding, uneven water pop, inconsistent stain/colorant application, previous coatings were not removed, or when contamination is present.
- A preventative measure prior to stain application is to water pop species that are prone to blotchiness to help reduce the appearance. Follow NWFA Wood Flooring Sand and Finish Guidelines.

Picture Framing/Halo

DEFINITION: The edges of the room appear to be a slightly different color than the rest of the room.

CAUSES:

- Improper sanding sequence. The degree to which stains color a wood floor is largely based on the sanding process, abrasive selection, and sequence used to sand the floor.
  - Sanding the edges of the room with an abrasive grit different from the abrasive grit used to sand the field.
  - Inadequately blending the scratch pattern of the perimeter of the floor with the field of the floor in the final sanding stages.
- Inconsistent or uneven water-pop/stain/sealer/finish application around the perimeter of the floor.
- Improper curing around the perimeter with site-cured UV finishes.
- Repairs around the perimeter not blending with the main field of the floor. (See Finish/Colorant or Wood Discoloration.)

CURES:

- For improper sanding sequence, resand affected rooms following NWFA Wood Flooring Sand and Finish Guidelines.
- For stain/color/sealer-related causes, a complete resand may be necessary.
- For finish-related causes, a recoat or complete resand may be necessary.
- For UV curing-related causes, a recoat or complete resand may be necessary.

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Stain Bleed Back

DEFINITION: A staining phenomenon occurring after the initial application of the stain, where the stain seeps back to the surface of the wood. This may happen at board seams, with open-grain species, tight grain, knots, or burls.

CAUSES:

- A change in moisture content and/or jobsite environmental conditions causing higher moisture content levels within the flooring. The resulting swelling of the flooring can force out any undried stain residual within, or between boards.
- Jobsite conditions too hot or too cold during stain application may alter the intended application and dry times.
- Pouring stain directly onto the floor surface during application and allowing pools of stain to sit on the floor surface long enough to run down the cracks between boards, or soak into the open grain of ring-porous woods like oak.
- The space between boards allows for stain penetration below the surface of the floor, and between the boards. The abundance of stain remaining below the floor surface is not allowed to dry at the same rate as the stain on the surface, often remaining wet for longer periods of time. After the surface dries, the wet leftovers start to seep, by capillary action, back to the surface.
- The open grain of some species may absorb an abundance of stain into the cell cavities of the wood. Much of the stain absorbed deep into the cell cavities is not allowed to dry at the same rate as the stain on the surface. After the surface dries, the wet leftovers start to seep, by capillary action, back to the surface.
- Previously stained areas on the floor where stain does not completely sand out.
- Applying water-based sealer or finish to oil-based stained floors that are not adequately dried. The oil-based products migrate from below to the surface of the floor resulting in a spider-type effect under the coating.
- With factory-finished floors, the undried finishes, pigments, stains, or colorants that are absorbed into open grain, knots, checks, burls, or other open voids during the application process may sometimes not dry at the same rate as it does on the surface. A gain in moisture can cause wood cell cavities to swell, squeezing out the undried residual to the surface of the boards. In these cases, the surface film-finish will be pushed upward into a bubble or smear onto the floor surface.

CURES:

- When stain bleedback occurs, address it before applying the first coat of sealer or finish. Use towels, rags, or buff with a non-abrasive white pad to remove excess stain bleedback prior to full dry/cure.
- When stain bleedback has dried, use a mild solvent (virgin mineral spirits, paint thinner, or naphtha) in conjunction with a piece of red or white buffer pad to loosen and remove the bleedback. Stain touch-ups may then be required. When reapplying stain, allow for proper dry-times prior to sealer or finish application.
- If finish has been applied over stain bleedback, a complete resand of affected area may be necessary.
- With factory-finished floors, individual board repair or replacement may be necessary.
- Preventative measures:
  - Trowel filling the entire floor during the sanding process can minimize stain bleedback.
  - Avoid pouring stain directly onto the floor surface during application and allowing pools of stain to sit on the floor surface long enough to allow it to run down the cracks between boards or soak into the floor before wiping.

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FINISH AESTHETICS

Finish Film-Thickness Discrepancy

DEFINITION: A discrepancy in the depth of the film of finish applied to a wood floor. Mil/film thickness of finish can be evaluated, but should not determine acceptability.

CAUSES:

- Inadequate sanding process, including skipping grits, or final sanding with too-coarse of grit abrasive.
- Not following the finish manufacturer's recommendations (spread rate, application method, number of coats, etc.).
- A normal consequence of penetrating oil or other non-film-forming finish systems.
- Perception due to the soft grain characteristics of ring porous (open grain) species (oak, ash) not completely filled. This is a natural occurrence, which varies from board to board, and does not compromise the integrity of the floor.
- Perception due to the natural characteristic and intentional appearance of wire brushed, distressed, reclaimed, or sculpted floors.
- Customer expectations.

CURES:

- Apply an additional coat of finish.
- When the floor has been improperly sanded, a resand may be necessary.
- No remedy may be necessary.

Roughness/Grain-Raise

DEFINITION: The surface of the wood floor feels rough to the touch.

CAUSES:

- Result of grain raise from water popping the floor, application of water-based finishes, sealers, stains, or water-soluble dyes not adequately knocked down during intercoat abrasion.
- Inadequate sanding process, including skipping grits or final sanding with too-coarse of grit abrasive.
- Natural characteristic of wire-brushed or other sculpted floors.
- Improperly applied or maintained natural oil finishes or finish systems.
- With factory-finished flooring, improper sanding process, sealer, finish application, or intercoat abrasion during the finish application process.
- Steam cleaners add vapor moisture to the wood floor, which may cause grain raise or roughness of the finished surface.

CURES:

- The moisture content of the floor must coincide with the normal living conditions of the facility prior to any remedy.
- Abrade and recoat per NWFA Wood Flooring Sand and Finish Guidelines, and manufacturer's recommendations.
- Resanding affected areas may be necessary.
- No remedy may be necessary.

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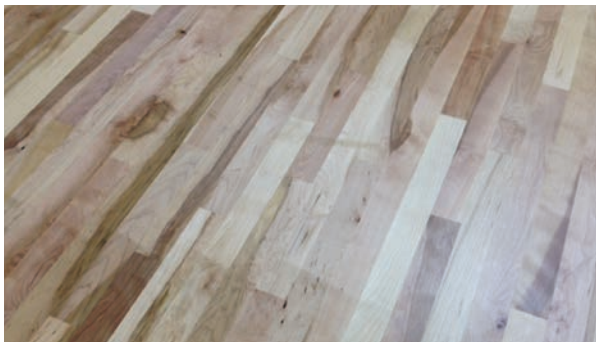
Applicator/Finish Streaks

DEFINITION: Visible ridges, lines, or marks left on the wood floor, representing the application tool used from any stage of the finishing process.



CAUSES:

- Improper finish application (not feathering out or coating cross-grain).
- Improper applicator used to apply the finish.
- Using an applicator that has hardened spots in the fibers.
- Inconsistent finish film thickness/improper coverage rates, where finish was applied too heavy or too thin.
- Matting agents in the finish not mixed adequately, resulting in sheen streaks.
- Expired finish or expired hardeners/crosslinkers affecting the application and flow of the finish.
- Finish stored or exposed to extreme temperatures outside of the manufacturer recommendations.
- Finish not acclimated to room temperature prior to application affecting the application of the finish, where the jobsite conditions are too hot or too cold for finish application.
- Excessive air movement over the surface causing the finish to partially set up/skin over before it has a chance to flow and level.
- Applying finish over a hot surface (under a window with direct sunlight or radiant heat) causing the finish to set up, dry too rapidly, and not flow properly during the application process.
- Multiple coats of film-forming finish can sometimes exacerbate applicator marks left from otherwise properly applied finishes (most commonly seen with multiple coats of satin or semi-gloss sheen finishes).
- Inconsistent application of colorants (dyes, stains), reactives (bleach, iron acetate), or sealers, leaving streaks in the finished floor.
- Finish applied over undried stains, colorants, or like-solvent aniline dyes, unintentionally pulling or reconstituting the color into the rest of the floor.
- Finish applied over chemical reactives, pulling or reactivating the chemical.
- With factory-finished floors, inconsistent or uneven application of colorants, reactives, or finishes from the manufacturing finishing processes.

CURES:

- Ambient conditions of the space must be at living conditions, and within the finish manufacturer recommendations prior to any repairs. Finish coats may require extended dry times dependent on many variables. Reference NWFA Wood Flooring Sand and Finish Guidelines for proper sanding and finishing procedures.
- Choose abrasive to adequately remove the marks from the floor, proceed upward in grit sequence to appropriate grit for finish being used.
- Select an applicator better suited for the type of flooring or used finish. For example, a roller application may be better suited for a multi-directional installed floor.
- Follow the finish manufacturer's directions.
- With colorant/reactive application related streaks, a resand may be necessary.

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Holidays/Skips

DEFINITION: An exposed area of uncoated wood or the undercoating, when the intention was to coat the entire area.

CAUSES:

- Inconsistent finish, sealer, or colorant application.

CURES:

- Use correct finish application techniques, per NWFA Wood Flooring Sand and Finish Guidelines.
- Recoat or repair the affected area as necessary.

Debris in Finish

DEFINITION: A raised bump in the film of finish often consisting of dust, hair, applicator fibers, foreign contaminates, solid finish particles, or other artifacts. Due to the nature of most coating environments, minimal amounts of debris within reason can be expected in any coat of finish.

CAUSES:

- Flooring surface, facility (window sills, countertops, door jams), or mechanic (shoes, clothing) inadequately cleaned prior to final coat application.
- Insufficient removal of already-existing debris prior to subsequent coats.
- Uncontrolled air movement and airborne debris landing in the final coat of finish as it is drying.
- Unfiltered, improperly mixed, contaminated finish or dried finish film particles within the finish.
- Finish applicator fibers or contaminated applicator.
- Normal debris that may be found on most jobsites that, regardless of process, will exist under, within, or on, a newly applied coat of finish.

CURES:

- Abrade and recoat.
- Most debris within the finish coat will walk-off over time with normal wear.
- No remedy may be necessary.

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Uneven Sheen/Gloss Levels

DEFINITION: The sheen or gloss level of the final coat of finish varies from one area of the floor to another. As film-forming finish products decrease in gloss, they increase in amounts of matting agents. Lower sheen products have the most matting agent, and thus, can more-easily manifest uneven sheen levels. Sheen/gloss levels should not be assessed until all final coats have been applied and are fully cured.

CAUSES:

- Application-related:
  - Contaminated finish applicator.
  - Improper mixing of finish prior to application (matting agents not adequately mixed into the film-finish).
  - Allowing finish to sit too long after mixing, before applying.
  - Not bundling/batching finish from multiple containers on the job.
  - Finish film thickness inconsistencies from one area to another across the flooring surface, normally attributed to not being applied evenly, being applied at improper coverage rates, or leaving applicator ridges, puddles, lap-lines, or pools in the top coat of finish.
  - Top-coat applied over another coating that hasn't adequately dried, trapping solvents within the film, affecting the sheen levels.
  - Flooring top-coated with lower-matte sheen film-finishes applied over higher-gloss base coats, can exhibit sheen variations when the finish film thickness varies. More common with textured floors (wire brushed, scraped, heavy grain).
  - Excessive air movement or high temperatures causing the finish to dry too rapidly during application.
  - Ambient jobsite conditions too cold for finish application.
  - Hot spots on the wood floor during finish application affecting the drying conditions.
- Finish-related:
  - Expired finish and/or hardener or catalyst.
  - Finish that has been exposed to temperatures outside of manufacturer-recommended ranges, during storage or application.
  - After proper mixing, the matting agents within the finish inadequately dispersing and unable to remain suspended long enough to coat a floor.
  - Improperly labeled finish.
  - Sheen inconsistencies from one batch of finish to another (see batching/bundling in previous column).
  - Adding non-manufacturer recommended substances to the finish, or adding too much of manufacturer-recommended thinners, dry-time extenders, bond-enhancers, or other substances to the finish.
- Maintenance-related:
  - Using cleaning products not recommended by the finish manufacturer on the floor.
  - Residue left behind from maintenance products.
  - Heavy foot traffic.
  - Excessive or aggressive maintenance practices.
  - Using steam cleaners to clean the floor.
- Factory-finished flooring:
  - Factory-finished floor mislabeled.
  - Factory-finished flooring sheen inconsistencies from one package to another.
  - Factory applied finish applied improperly, inconsistently, or at different thicknesses.
- Uneven sanding of the floor. Inconsistent scratch patterns and abrasive paths can adversely affect how the finish appears on the surface, resulting in inconsistent sheen levels.
- Natural characteristics or porosity differences within the wood affecting how the finish sheen/gloss levels appear.
- Naturally occurring oils from various exotic wood species adversely affecting the drying process of the finish affecting the sheen.
- The normal and expected appearance of natural oils or other non-film-forming finish systems.
- Unfilled cracks or voids taking the finish coats inconsistently and unevenly, affecting how the sheen/gloss levels appear.
- Optical illusion caused by lighting conditions, height differences, elevation change, floors that are sculpted, distressed, or otherwise possessing underwood/overwood, or by a floor that is not flat.

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Uneven Sheen/Gloss Levels

(continued)

CURES:

- Conditions within the home affecting drying conditions should be taken into account prior to addressing issue, or may not be addressable with repairs, and should be considered when evaluating the conditions.
- Correct improper maintenance practices. A deep clean and recoat may be necessary in some cases. Check with the finish manufacturer for processes and products to use in each scenario.
- Abrade and recoat to correct sheen inconsistencies when applicable.
- For naturally occurring characteristics in any wood species, the end-user should be made aware of the variability within each wood species and how they may affect the outcome of the finish being used.
- Check with the flooring manufacturer for discrepancies in sheen levels within the same floor for repair recommendations.
- Replace boards or sections as necessary and with manufacturer support when factory-finished flooring is mislabeled.
- If lighting or subflooring is the issue, address appropriate evaluation standards (normal lighting, standing position, on the floor being assessed).
- No corrections may be necessary.

Sticky Board Syndrome

DEFINITION: Wood floor finishes that do not dry, adhere, cure properly, or appear the same on specific areas of a board or individual boards.

CAUSES:

- Species with high concentrations of tannic acid, a pH imbalance, natural oils, or sap from a variety of species may adversely affect the finish's ability to properly dry and cure.
- Knots on species such as pine or Australian cypress affecting the ability of the finish to properly dry and cure.
- Contamination within the wood or between boards affecting the ability of the finish to properly dry and cure.
- Insufficiently cured UV finishes (factory-finished or site-finished).

CURES:

- Use of a universal sealer (dewaxed shellac) over the affected boards, or on the entire floor to block the reactions of the wood and the finishes.
- Use a tannin-blocking sealer to minimize the effects of tannic acid on the finishes being used.
- In some situations, a complete resand may be necessary, and an alternative finish system may need to be used. Follow the finish manufacturer's instruction for products, compatibility, and proper use in each unique scenario.
- Replacement of individual boards when only a select few are affected.

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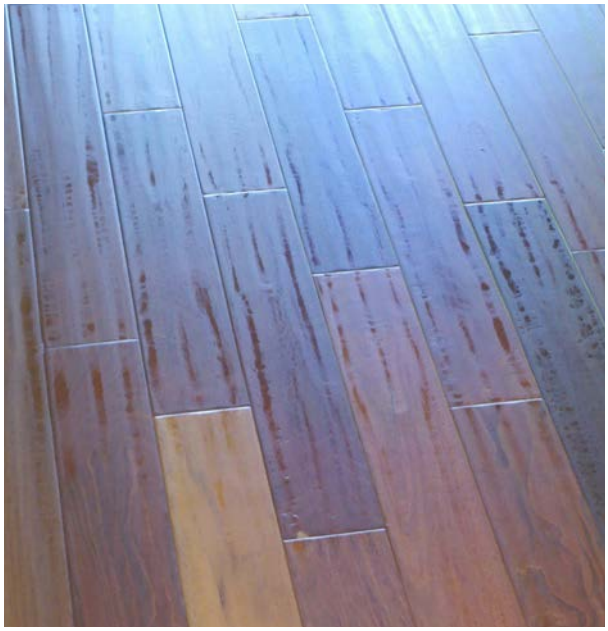
Cloudy Finish

DEFINITION: An unintended white, milky, or cloudy appearance of an otherwise transparent, clear finish.



CAUSES:

- Maintenance-related:
  - Using cleaning products that are incompatible or are not recommended by the finish or flooring manufacturer.
  - A build-up of residue from improper cleaning products.
  - Use of steam mops on wood flooring (forcing vapor moisture into, and between, boards).
  - Using abrasive cleaning pads.
- Solvent trap:
  - Applying finish over a sealer coat, finish, or stain that hasn't dried enough to be recoated yet, causing the solvents to become trapped within the coatings. This is commonly seen between gaps in the floor, resulting in cloudy lines between boards. This haze may be temporary or it may persist. (See White Lines.)
  - If multiple coats of water-based sealers or finishes are applied too quickly (usually more than three in one day), or multiple coats are applied too heavy, water or other solvents may become trapped. Lower temperatures, higher humidity, minimal air flow, and minimal air exchange may exacerbate the condition.
  - With water-based film-finishes, application in conditions where relative humidity is high, or on a floor that is too cold, causing water or solvents to become trapped within the dried film. This is also known as poor coalescence of the finish.
  - With oil or solvent-based film-finishes, application during very high relative humidity conditions, causing water vapor to condense on or under the finish as it is applied or dries. The water is then absorbed into the finish and forms a cloudy appearance (also known as blush or bloom). This is also commonly seen between gaps in the floor, resulting in "blushing" between boards. (See White Lines.)
  - UV coatings cured prior to solvent fully off-gassing, or trapped solvent or water within the coating.
  - UV coatings not properly cured, remaining susceptible to blushing when exposed to water or other chemicals.
- Moisture-related:
  - Excessive moisture in the wood (high MC) prior to sealer/finish application.
  - Factory or site-applied finishes exposed to excessive moisture-related issues (leaks, maintenance, substrate-related, etc.), resulting in cloudy finish and potential poor adhesion.
- A build-up of multiple coats of satin film-finishes.
- Improperly mixed finish.
- Poor adhesion between coats. (See Finish Adhesion Failure.)
- Naturally occurring oils from various exotic wood species adversely affecting the drying process of the finish or sealer.
- Adhesive residue remaining on the flooring surface from the glue-down installation process.

CURES:

- Ambient conditions of the space must be at living conditions, and within the finish manufacturer recommendations prior to any repairs. Finish coats may require extended dry times dependent on many variables. Reference NWFA Wood Flooring Sand and Finish Guidelines for proper sanding and finishing procedures.
- If the cloudiness does not disappear upon wetting the surface, the problem is likely throughout the coating film and may require resanding the floor.
- In the case wherein the cause is coating with water-based sealers or finishes over oil-based stains, sealers, or finishes before they are ready to be coated, the problem may go away over time; this time may take several weeks, especially in cooler, humid conditions. Usually, higher heat, lower humidity, airflow, and air exchange will speed up the process.
- In the case of multiple coats of water-based sealers or finishes applied too quickly or too thick, the problem will usually go away over time; this may take two weeks or more. Usually, higher heat, lower humidity, airflow, and air exchange will speed up the process.

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Cloudy Finish *(continued)*

- If the cloudiness is on the surface of the film of the finish:
  - Where improper maintenance products have been used, change to proper cleaning product and attempt safely removing the contaminates from the surface.
  - For site-finished flooring, if the cloudiness is on the surface of the finish, choose an abrasive to adequately remove the cloudiness from the floor. Check with a damp rag before proceeding upward in grit sequence to ensure the cloudiness disappears. If the finish appears clear, proceed through appropriate grit sequence for the coat of finish being used.
  - For recently coated site-finished flooring, it may be necessary to heavily abrade the finish to allow trapped solvents to escape. This should be accompanied by increasing the temperature and airflow for a minimum of 24 hours and allowing the floor to "bake." Check with a damp rag before proceeding upward in grit sequence to ensure the cloudiness disappears. If the finish appears clear, proceed through appropriate grit sequence for the coat of finish being used.
- For naturally occurring oils in exotic wood species, refer to the finish manufacturer for species-specific recommendations.
- For factory-finished flooring, affected boards may need to be replaced.

White Lines

DEFINITION: White lines appear between board edges of site-applied film-finishes.

CAUSES:

- The optical result of finish or sealer that stretches, rather than breaks, along board edges or seams, with seasonal humidity and temperature fluctuations.
- Applying a more-elastic finish on top of a less-elastic one.
- Solvent-trap:
  - In areas between boards, cracks, seams, butt-joints, or filled knot holes where oil-based stain has penetrated and often pooled, the solvents take longer to evaporate, translating to longer dry times. When the floor gets coated, these solvents become trapped within the finish film at these sites.
  - Applying finish over a sealer coat, finish, or stain that hasn't dried enough to be recoated yet, causing the solvents to become trapped within the coatings. This is commonly seen between gaps in the floor, resulting in cloudy lines between boards. This haze may be temporary or it may persist.

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  - With water-based film-finishes, application in conditions where relative humidity is high, or on a floor that is too cold, causing water or solvents to become trapped between the boards and within the dried film. This is also known as poor coalescence of the finish.
  - With oil or solvent-based film-finishes, application during very high relative humidity conditions can cause water vapor to condense on or under the finish as it is applied or dries. The water can then be absorbed into the finish and form a cloudy appearance (also known as blush). This is also commonly seen between gaps in the floor, resulting in "blushing" between boards.
- Moisture-related:
  - Environmental fluctuations in humidity resulting in seasonal shrinkage between boards.
  - Excessive moisture in the wood prior to sealer/finish application (high MC).
  - Factory or site-applied finishes exposed to excessive moisture-related issues (leaks, maintenance, substrate-related, etc.).
  - Use of steam mops on wood flooring (forcing vapor moisture into, and between boards).
- Loss of adhesion:
  - Vertical or lateral movement between boards resulting in the finish stretching. Finish systems that stretch, rather than break, along board seams and edges can weaken the adhesion of finish or finish layers at that point, potentially resulting in finish chipping or peeling.
  - Poor adhesion of a water-based finish system over oil-based stain or previous coatings that have not dried/cured sufficiently prior to applying the water-based finish.
  - Contamination between seams of the boards affecting adhesion.
  - Poor inter-coat abrasion along the edges of adjoining boards, or in bevels between boards resulting in finish adhesion failure.

CURES:

- Address any seasonal fluctuations to avoid white lines from happening again in the future with any subsequent coats.
- Address any movement between boards before addressing the white lines.
- In situations where seasonal fluctuations or any movement within the flooring system are unavoidable, use a less-elastic finish to minimize the effects.
- Break the finish at the gaps to allow for any trapped solvent to release, and re-apply new coating as recommended by the finish manufacturer.
- Resand the affected areas of the floor as necessary.

Poly Beads

DEFINITION: Small round balls that appear as beads, or "BBs" of finish, that form along the joints of the individual boards. They can be soft and sticky when first formed, and will become hard if left undisturbed. When these wet beads are stepped on, they can become unsightly smears along board edges.

CAUSES:

- During finish application, where the finish collects in voids, such as gaps between boards, it cures at a much slower rate. Later, when the moisture content of the flooring increases (higher humidity levels), the uncured finish can squeeze out from between the boards appearing as small BBs. This is most common with oil-based urethane finishes, higher solids/more-viscous finishes, and conversion varnishes.
- Slow drying conditions, where RH is high, or on a floor that is too cold, can give the finish the opportunity to seep into small gaps between the boards.
- During application of water-based finishes, the flow of product over and into voids, such as gaps between boards, can result in slight finish pooling and appear as small bumps along board seams once the coating has dried.
- With on-site water-based UV coatings, during the curing process, the heat can force excess product in gaps to bead up.

CURES:

- Control seasonal RH fluctuations within the facility.
- For hardened beads, remove them with a sharp tool (scraper, putty knife, razor blade).
- Recoat the floor as necessary after successful removal of the hardened poly beads.

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Bubbles

DEFINITION: Raised bumps, or air-filled bubbles visible in the film of the finish. These include both full bubbles and bubbles that have popped.

CAUSES:

- Improper applicator used to apply the finish.
- Use of improper tacking solvents before or between coats.
- Overworking finish or sealer during application, creating air bubbles/foaming to develop within the applicator and finish.
- Not mixing the finish or sealer as per manufacturer recommendations.
- Finish or sealer that has been mixed and not allowed appropriate "rest" time before use, as per manufacturer recommendations.
- Finish or sealer applied too thick (greater than manufacturer recommended spread-rates), not allowing solvents to escape as they should.
- Air movement across the finished floor causing the finish or sealer to dry too rapidly and skin-over immediately after application, trapping air bubbles.
- Jobsite conditions that are too hot or too cold, causing the surface of the finish to dry too quickly, trapping bubbles at or below the surface.
- Applying finish or sealer over a hot surface (under a window with direct sunlight or over radiant heat) causing the finish or sealer to set up too quickly and not allowing it to flow properly.
- Prior coats not being abraded or sufficiently cleaned between coats of finish or sealer, as per manufacturer recommendations.
- Site-applied UV finishes cured prior to returning to the manufacturer recommended moisture content levels.
- UV lamps left in one place for too long resulting in burnt and blistered finish.
- Finish or sealer that had been exposed to temperatures outside of manufacturer recommended ranges, prior to, or during application (extreme cold/freezing conditions often reduce the effectiveness of the defoamers in the finish).
- Expired finish, sealer, or catalyst/hardener, which reduces the effectiveness of defoamers in the finish.
- Adding non-manufacturer-recommended substances to the finish, or manufacturer recommended substances in improper amounts.
- Manufacturing defects (of finish, sealer, hardener, or catalyst), including being too thick (high viscosity), having ineffective defoamer(s) in the finish or sealer, or inadequate reactive hardener.
- With factory-finished floors, the undried finishes, pigments, stains, or colorants that are absorbed into open grain, knots, checks, burls, or other open voids during the application process may sometimes not dry at the same rate as is does on the surface. A gain in moisture can cause wood cell cavities to swell, squeezing out the undried residual to the surface of the boards. In these cases, the surface film-finish will be pushed upward into a bubble or smear onto the floor surface. (See Stain Bleedback.)

CURES:

- Address any jobsite conditions that may adversely affect the drying of the finish or sealer. Ambient conditions of the space must be at living conditions, and within the finish manufacturer recommendations prior to any repairs. Finish coats may require extended dry times dependent on many variables. Reference NWFA Wood Flooring Sand and Finish Guidelines for proper sanding and finishing procedures.
- Abrade and recoat the floor using the application tool and spread rates as suggested by the finish manufacturer.
- Choose a scraper or abrasive to adequately remove the bubbles from the floor, proceed upward in grit sequence to appropriate grit for finish or sealer being used.
- Select a fresh batch of finish that is known to have been stored under favorable storage conditions.
- Where bubbles are deep below the surface coating, it may be more effective to resand the affected area of the floor.
- Follow the finish manufacturer directions.

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Pin Holes

DEFINITION: A visible finish imperfection where the surface of the finish film recedes from a very small area or areas of the surface.

CAUSES:

- Finish coats applied too thick (outside of the manufacturer recommended coverage rates), resulting in too much film build, not allowing solvents to properly escape.
- Application of finish in high temperature environments.
- Finish coats applied over a previous coating that wasn't adequately dried, resulting in improper or incomplete drying and curing.
- Finish missing from a void area of the board, such as pin-worm holes, nail holes, open grain, or other natural characteristics within the wood.
- With factory-finished flooring, where heat (infrared) is used to dry the finish, it can sometimes cause the finish to dry too quickly, not allowing solvents to properly escape, resulting in pin holes.

CURES:

- Ambient conditions of the space must be at living conditions, and within the finish manufacturer recommendations prior to any repairs. Finish coats may require extended dry times dependent on many variables. Reference NWFA Wood Flooring Sand and Finish Guidelines for proper sanding and finishing procedures.
- Abrade and recoat the floor using the application tool and spread rates as suggested by the finish manufacturer.
- When recoating the affected areas, choose an abrasive or scraper to adequately remove the pin hole from the floor, proceed through appropriate grit sequence for the finish being used. Follow the finish manufacturer directions.
- For factory-finished flooring, individual board replacement may be necessary. Check with the flooring manufacturer for recommended repairs.

Craters/Fisheyes

DEFINITION: A visible finish imperfection that manifests by the crawling of wet finish film into a single area or pattern resembling small dimples or bowl-shaped depressions, sometimes accompanied by a particle in the center.

CAUSES:

- Insufficient removal of already-existing fish eyes/craters prior to subsequent coats.
- Trapped air or solvent bubbles that burst during the flow and leveling of the finish, but didn't have quite enough time to completely level out.
- Contamination:
  - Contamination on the surface, between boards, or within voids of a wood floor where foreign substances such as maintenance products, grease, oils, polishes, soaps, or other contaminants are present before coating, or have been introduced between coats.
  - Sweat or other contaminants dripped, spilled, or over-sprayed onto the floor surface prior to or during finish application.
- Finish-related:
  - Expired finish and/or catalyst, or hardener.
  - Using finish that has been stored, exposed, or applied in temperatures or humidity levels outside of manufacturer recommended ranges.
  - Improper mixing of the finish per manufacturer recommendations.

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Craters/Fisheyes *(continued)*

- Adding non-manufacturer recommended substances to the finish or adding too much of manufacturer recommended thinners, dry-time extenders, bond-enhancers, or other substances to the finish.
- A problem with the defoamer in the finish (including using too much or otherwise insufficient incorporation into the finish), or contamination that occurred during mixing or packaging.

- Application-related:
  - Incompatible finish in the applicator from previous coatings, not adequately cleaned out prior to application.
  - Excess water in the applicator that may imbalance the finish defoamer system.
  - Applicator cleaned with incompatible solvent for the finish being used prior to application.
  - Coating over a not-yet-cured finish or sealer.
  - Coating over an incompatible finish or sealer:
    - Perfluorooctane sulfonate (such as Teflon/Scotchgard) infused finishes that cannot be recoated.
    - Wax finished with urethanes or oils.
    - Incompatible finishes from different manufacturers.
    - Natural oils finished with incompatible urethanes.

CURES:

- Ambient conditions of the space must be at living conditions, and within the finish manufacturer recommendations prior to any repairs. Finish coats may require extended dry times dependent on many variables. Reference NWFA Wood Flooring Sand and Finish Guidelines for proper sanding and finishing procedures.
- Abrade and recoat the floor using the application tool and spread rates as suggested by the finish manufacturer.
- Scrape or sand the affected area with a coarse to medium-grit abrasive and then progress upward in grit sequence, then recoat as necessary (multiple coats may be necessary). Defer to the finish manufacturer for final abrasive recommendations.
- When the floor or finish has been contaminated, a resand may be required to remove the contamination and start the finishing process from raw wood.
- Trowel fill the floor to block contaminates in voids or between boards.
- In cases where the floor cannot be resanded, replacement of the affected areas may be necessary.

Crawling

DEFINITION: A visible finish imperfection where the finish film is repelled from areas of the surface, leaving the appearance of thin or uncoated affected areas. May be very long and oval shaped, and may vary in size.

CAUSES:

- Insufficient removal of already-existing blemishes prior to subsequent coats.
- Contamination:
  - Contamination of the floor where foreign substances such as maintenance products, wax, grease, oils, polishes, soaps, overspray from other sources, or other contaminants are present before coating, or have been introduced between coats.
  - Foreign substances or other contaminants remaining between boards or within voids affecting the new finish application.
- Finish-related:
  - Using finish that has been exposed to temperatures outside of manufacturer recommended ranges, during storage or application.
  - Expired finish or catalyst/hardener.
  - Improper mixing of the finish per manufacturer recommendations.
  - Hot-coating (recoating without abrading and/or before previous coat had adequate dry time) outside of manufacturer recommendations.
  - Recoating a cured floor outside of the manufacturer recommended preparation.
  - Instability of defoamer or surfactant systems within the finish.
  - Adding non-manufacturer-recommended substances to the finish or adding too much of manufacturer-recommended thinners, dry-time extenders, bond-enhancers, or others to the finish.

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Application-related:
- Incompatible finish or sealer in the applicator from previous coatings not adequately cleaned out prior to application.
- Excess water in the applicator that may imbalance the finish defoamer system.
- Applicator cleaned with incompatible solvent for the finish being used prior to application.
- Coating over a not-yet-cured finish or sealer.
- Coating over an incompatible finish or sealer:
  - Perfluorooctane sulfonate (such as Teflon/Scotchgard) infused finishes that cannot be recoated.
  - Wax finished with urethanes or oils.
  - Incompatible finishes from different manufacturers.
  - Natural oils finished with incompatible urethanes.

CURES:

- Abrade and recoat the floor using the application tool and spread rates as suggested by the finish manufacturer.
- Sand or scrape the affected areas, then recoat as necessary.
- When the floor or finish has been contaminated, or when the problem is widespread, a resand and finish may be required.
- If the crawling is caused by contamination between the boards, trowel filling the floor may help prevent further issues.
- Finish coats may require extended dry times dependent on many variables. Reference NWFA Wood Flooring Sand and Finish Guidelines for proper sanding and finishing procedures.

Orange Peel

DEFINITION: A visible finish imperfection where the surface of the dry finish film exhibits a flaw that resembles the texture of an orange peel.

CAUSES:

- Application-related:
  - Using a roller to apply finish that is not suitable to be rolled, improper use of the roller, or use of improper-size nap roller sleeve.
  - Overworking finish or sealer during application, creating air bubbles/foaming to develop within the applicator, causing the finish to not flow out completely before the finish begins to set-up.
  - Improper coverage rates where finish is applied too thin or too thick according to the manufacturer-recommended coverage rates.
  - Using a finish that has not been brought to room temperature, and is too cold, causing poor flow and leveling.
  - Solvent additives or dry-time-extending retarders not used when suggested by the finish manufacturer for unfavorable/drier coating conditions.
  - With factory-finished flooring, orange peel may happen when the finish was applied by rollers, and the roller texture remains.
- Environmental conditions:
  - Hot, dry conditions causing finish to dry/flash-off too quickly.
  - Cool, damp conditions forcing the finish to dry at a slower rate than intended.
  - A substrate that is too hot or too cold during finish application, causing poor flow and leveling.
  - Airflow causing the surface of the finish to skin over, and not flow or level as necessary.

Continued on pg. 58

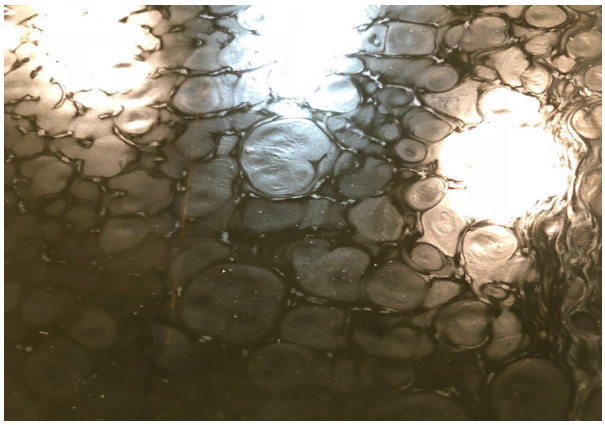
Orange Peel *(continued)*

CURES:

- Abrade and recoat using the application tool and spread rates as suggested by the finish manufacturer, after the finish and jobsite conditions coincide and have been brought to a favorable range within the finish manufacturer recommendations. Ambient conditions of the space must be at living conditions, and within the finish manufacturer recommendations prior to any repairs. Finish coats may require extended dry times dependent on many variables. Reference NWFA Wood Flooring Sand and Finish Guidelines for proper sanding and finishing procedures.
- In some situations, finish manufacturers may recommend adding solvent additives or dry-time-extenders to improve the finish flow and leveling properties.
- In some cases, a resand may be necessary.
- For factory-finished floors, replacement of affected boards may be necessary.

Benard Cells

DEFINITION: A visible finish imperfection resembling a pattern in the smooth finish film that resembles a clustering of "cells." They typically appear as less-glossy, often round, curvy, or geometrical (hexagonal, pentagonal) in shape, and may range in size from very small, up to 1". Benard cells are more common with lower sheen or pigmented finishes.



CAUSES:

- As solvents evaporate from the drying film, convection currents, or "eddies" are caused, where less-volatile coating components like pigments or matting agents may concentrate in patterns in the dried film.
- Normally caused by a rapid escape of solvents from the applied finish (in high temperature and low RH environments).
- Solvent additives or dry-time-extending retarders added to the finish in an improper amount or outside of the finish manufacturer recommendations.
- Allowing finish to "sit" too long after mixing, before application.

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- Finish applied too thick outside of manufacturer recommendations.
- Not using manufacturer-recommended applicator or application method.
- Using finish or sealer that has been exposed to temperatures outside of manufacturer-recommended ranges, during storage or application.
- Using expired finish or catalyst/hardener.
- Finish not mixed per manufacturer recommendations.
- Manufacturing defects where the matting agent did not fully disperse during the recommended mixing procedures. In this case, the matting agent particles may be present in the less-glossy depressions of the dried film of finish.

CURES:

- Ambient conditions of the space must be at living conditions, and within the finish manufacturer recommendations prior to any repairs. Finish coats may require extended dry times dependent on many variables. Reference NWFA Wood Flooring Sand and Finish Guidelines for proper sanding and finishing procedures.
- Abrade and recoat following NWFA Wood Flooring Sand and Finish Guidelines and manufacturer instructions.
- In some cases, a resand may be necessary.
- For finish-related issues, follow the finish manufacturer recommendations for repair.

Crazing/Alligatoring

DEFINITION: A visible finish imperfection that appears as a network of very small, fine cracks or fissures in the surface of the finish film, which sometimes resembles the skin of an alligator or crocodile.

CAUSES:

- A previous condition left in a previous coat that was not effectively removed prior to subsequent coats, telegraphing through the top-coat.
- The moisture content of the wood floor was too high at the time the coating was applied.
- Internal stresses in the top coat caused during the drying process where the top of the finish dries too quickly, causing the surface to dry and shrink faster than the full depth of the finish.
- Expired finish or catalyst/hardener.
- A water-based sealer or finish issue, wherein the film does not coalesce properly (usually due to insufficient solvent or solvent efficiency). This may be from manufacturing, or due to using product that has been expired, stored, exposed, or used at temperatures or humidity levels outside of manufacturer recommendations.

Continued on pg. 60

Crazing/Alligatoring *(continued)*

- Improperly applied water-based finish:
  - Applying a water-based finish over a cold floor, in cold ambient conditions, or during very high relative humidity conditions. After the solvent has evaporated, the remaining water can become trapped water within the coating (also known as a coalescing problem/mud-cracking).
  - Finish application at high ambient temperatures causing the surface to dry too quickly.
  - A finish coat applied too heavy, outside of manufacturer recommended coverage rates.
  - Too many coats applied on the floor surface in too short of a time frame (the thicker the finish, the greater the stress).
  - Applying finish over a previous coat that hasn't dried enough to be recoated yet, trapping solvents within the coatings.
  - The coating ingredients were not thoroughly mixed or were used past its pot-life.
  - Too much, or the wrong catalyst or hardener added to the finish.
  - Adding improper solvents or additives to the finish.
- Improperly applied solvent-based finish:
  - Internal stresses in the top coat caused during the drying process when the solvents flash off (evaporate) too quickly, causing the surface of the finish to dry and shrink faster than the full depth of the finish.
  - A finish coat applied too heavy, outside of manufacturer recommended coverage rates.
  - Too many coats applied on the floor surface in too- short of a time frame (the thicker the finish, the greater the stress).
  - Applying finish over a previous coat that hasn't dried enough to be recoated yet, trapping solvents within the coatings.
  - The coating ingredients were not thoroughly mixed or were used past its pot-life.
  - Too much, or the wrong catalyst or hardener added to the finish.
  - Adding improper solvents or additives to the finish.

CURES:

- Address any jobsite conditions that may adversely affect the drying of the finish.
- Apply coatings at manufacturer spread rates and according to manufacturer instruction.
- Choose an abrasive to adequately remove the imperfections from the floor, then proceed through appropriate grit sequence for finish being used, and apply new coat(s) of finish.
- If the imperfections do not disappear, or if the problem is through the thickness of the coating film, it will likely require resanding the floor.

Wrinkling

DEFINITION: A visible film-finish imperfection that appears as the skin of a dried prune. Wrinkling may happen with all types of film-finish, but is most common with oil-based urethanes.

CAUSES:

- Wrinkling is a phenomenon that happens during the drying/curing process, caused by the top of a film drying before the bottom. As it dries, it contracts. Since the bottom is still liquid, it cannot prevent the contraction, resulting in wrinkling.
- Hot, dry air during the drying of the finish.
- A substrate that is too cold, accompanied with warmer air or air movement during finish application and drying.
- A finish coat applied too heavy, outside of manufacturer recommended coverage rates.
- Puddles or pools left in the finish coat often coincide with wrinkling of the finish.

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- A coat of finish applied over a previous coat that has not dried sufficiently for recoating.
- A "hotter" solvent in the newly applied top-coating than in the previous coat, softening the layer beneath, such that when the newly applied finish starts to dry, it begins to move along with the coat below.
- Improperly mixed finish. Flow, leveling, and flattening agents within the finish can separate within the container and, when improperly mixed, can leave a wrinkled effect in the film of finish (particularly in oil-based finishes).
- Problem with the finish itself, in which, with oil-based finish:
  - Too high of an amount of surface-driers were added to a particular batch.
  - Not enough through-driers were added to a particular batch.

CURES:

- Ambient conditions of the space must be at living conditions, and within the finish manufacturer recommendations prior to any repairs. Finish coats may require extended dry times dependent on many variables. Reference NWFA Wood Flooring Sand and Finish Guidelines for proper sanding and finishing procedures.
- Small affected areas should be scraped to a dry surface, allowed to dry, and recoated.
- When large areas are affected, it is best to resand the floor (be cautious of "hot finish" and the combustibility of the dust).

FINISH PERFORMANCE

Open-Grain Contamination

DEFINITION: An accumulation of contaminants in open voids or characters, such as in textured wood, the soft grain/springwood, open knots, splits/checks, etc., on the surface of the installed floor.

CAUSES:

- Any time drywall work has been scheduled post wood floor installation, the wood floor is susceptible to becoming exposed to drywall dust. Subsequent wetting/damp mopping of the surface will turn the drywall dust into a paste, which can be extremely difficult to remove from the exposed voids or characteristics of the flooring.
- Silt, salt residue, or other fine dust particles becoming embedded in the exposed voids or characteristics of the unprotected flooring.
- Paint, flooring adhesive, or other contaminants that have been spilled and subsequently cleaned from the surface, but remains in the exposed voids or characteristics of the flooring.
- Improper maintenance practices:
  - Using products and cleaning systems not recommended by the flooring or finish manufacturer.
  - Using old or soiled cleaning mop heads to clean the floor.

CURES:

- Vacuum the floor thoroughly using a horse-hair vacuum attachment.
- Deep-clean the floor using a wood floor scrubber with soft bristle brushes or Tampico brush that will not damage the wood floor or finish, but may be able to agitate the surface enough to loosen the contamination. (Check with the flooring and finish manufacturer first.)
- After the contaminate has been effectively removed, recoating the floor may be an option. (Check with the flooring and finish manufacturer first.)
- Where applicable, resanding affected areas may be necessary.
- Check with the flooring and finish manufacturer for recommended repairs.
- A preventative measure is to ensure that all drywall work is completed prior to any wood floor installation. (See NWFA Wood Flooring Installation Guidelines and Jobsite Checklist.)

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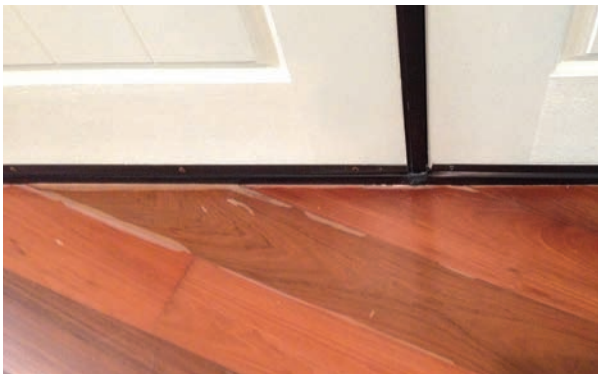
Finish Adhesion Failure

DEFINITION: The loss of film-finish adhesion to the flooring surface or between coating layers.

Chipping/Flaking Finish - The condition that occurs when a dried film of finish separates from the previously applied finish in the form of chips or flakes.



CAUSES:

- Poor adhesion between coats.
- Surface contamination between coats.
- Not abrading or using too-fine of a grit abrasive between finish coats.
- Recoating a cured floor without proper preparation (either chemical or mechanical).
- Applying a subsequent coat of finish after the window to do so without abrasion (hot coating) has elapsed.
- Applying a less-elastic finish on top of a more-elastic one.
- More-elastic finish systems that stretch, rather than break, along board seams can weaken the adhesion between finish layers resulting in chipping/flaking.
- With some more-brittle/less-elastic finishes used in the factory-finishing process, a gain or loss in moisture, and subsequent dimensional changes within the wood, can result in finish chipping or shearing away from the wood.
- Sculpted, distressed, scraped, wire brushed, indented, scratched, or floors with over/underwood may experience chipping or flaking away from the edges, corners, or high points.
- Excessive finish on the edge of factory-finished flooring not allowing the flooring to be installed properly without damaging the finish (also known as cornicing).
- Rough handling of factory-finished flooring during installation.
- Site applied or factory applied UV coating cured improperly.
- Vertical deflection within the flooring system (typically board-to-board deflection).
- Poor adhesion over knots or sappy areas in the wood. (See Sticky Board Syndrome.)
- Naturally occurring oils from various exotic wood species adversely affecting the drying process of the finish or sealer.
- Maintenance-related:
  - Maintenance product used to clean the floor that is incompatible with the new coat of finish.
  - Migration of contamination applied after the finish coats that may permeate the coating and destroy adhesion over time.
  - Excessive moisture or steam being used during maintenance.

CURES:

- If the chipping is isolated, spot repairs may be possible.
- Sand and refinish may be necessary to address widespread issues.
- For naturally occurring oils in exotic wood species, refer to the finish manufacturer for species-specific recommendations.
- With affected factory-finished floors, replacement of affected boards may be necessary.
- For maintenance-related issues, all causes must be addressed prior to any remedial action. Recoat, resand, or replacement may be necessary dependent on the severity of the issues.

Continued on pg. 64

Finish Adhesion Failure

(continued)

Peeling Finish - The condition that occurs when a dried film of finish separates from the underneath surface in the form of large pieces or sheets.

CAUSES:

- Finish-related:
  - Surface contamination below finish.
  - Poor adhesion between coats.
  - Not abrading or using too-fine of a grit abrasive between finish coats.
  - Recoating a cured floor without proper preparation (either chemical or mechanical).
  - Applying a subsequent coat of finish after the window to do so without abrasion (hot coating) has elapsed.
  - Applying a less-elastic finish on top of a more-elastic finish or paint.
  - Applying a more-elastic finish on top of a less-elastic finish or paint.
  - Finishes that are not compatible.
  - Poor adhesion of a water-based finish system over oil-based stain, or previous coatings, that have not dried/cured sufficiently.
  - Stain not sufficiently wiped up, multiple coats of stain applied, or improper application of stain applied prior to subsequent coats of sealer or finish.
  - Stain that is not suited for hardwood floor use, or has been modified or tinted with more-than-allowable amount of tint concentrate.
  - Finish systems that stretch, rather than break, along board seams and edges can weaken the adhesion of finish or finish layers at board edges, resulting in adhesion failure.
  - Poor adhesion over knots or sappy areas in the wood. (See Sticky Board Syndrome.)
  - Naturally occurring oils from various exotic wood species adversely affecting the adhesion of the finish or sealer.
  - Improper tacking solvent used between coats.
- Tape-related:
  - The tape used on the finished floor was not recommended to be used on wood floors.
  - The tape was adhered to the wood floor or a longer time than the tape manufacturer's recommendation.
  - Tape was applied to a newly coated wood floor finish.
  - Plasticizers in the tape have created a stronger bond to the finish than the finish has to the previous coatings or the floor.
- Factory-finished floor recoats:
  - Improperly prepared surface prior to application of new coat of finish.
  - Inadequate cleaning of floor surface prior to recoat.
  - Lack of abrasion in bevels or other low elevation areas.
  - Insufficient or incompatible finish and adhesion system selection (chemical or mechanical) used for the floor being recoated.
  - Existing finishes incompatible with the new finish being applied such as:
    - Perfluorooctane sulfonate (Teflon/Scotchgard) infused finishes that cannot be recoated.
    - Waxed finished with urethanes or oils.
    - Natural oils finished with incompatible urethanes.
- Maintenance-related:
  - Maintenance product used to clean the floor that is incompatible with the new coat of finish.
  - Migration of contamination applied after the finish coats that may permeate the coating and destroy adhesion over time.
  - Excessive moisture or steam being used during maintenance.

CURES:

- If the peeling is isolated, spot repairs may be possible.
- Sand and refinish of affected areas may be necessary to address widespread issues.
- For maintenance related issues, all causes must be addressed prior to any remedial action. Recoat, resand, or replacement may be necessary dependent on the severity of the issues.
- For incompatible finish systems, a resand is often necessary.
- For naturally occurring oils in exotic wood species, refer to the finish manufacturer for species-specific recommendations.
- If tape is used during painting procedures, only use a tape specifically recommended for wood flooring. Place the tape extremely carefully on the finished floor just prior to the painting process (only after applied finish has cured completely). Immediately remove the tape by carefully pulling it against itself at a 45º angle upon application of the paint. Do not leave the tape on any longer than needed to apply each coat of paint.

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Finish Wear Discrepancies

DEFINITION: The performance of the surface coat of finish not meeting expectations.

CAUSES:

- Maintenance-related:
  - Failure to fully remove grit from the floor's surface or shoe bottoms.
  - Worn, or inadequate floor protection under furniture.
  - Debris beneath floor protectors, furniture legs, rugs, or walk-off mats.
  - Unusual/excessive foot traffic or the type of footwear often isolated to confined traffic areas and pivot points.
  - Pet nails.
  - Missing or unsuitable area rugs, walk off mats, non-slip pads, or backing material on floor.
  - Vacuuming with carpet setting (beater bar) on wood floor surface.
  - Using too much water or steam cleaners to clean the floor.
  - Using cleaning products not recommended by the finish manufacturer on the floor.
  - Using cleaning products mixed at too-concentrated of dilutions.
  - Excessive or aggressive maintenance practices.
- New construction:
  - Inadequate or no floor protection during construction.
  - Grit, dirt, and construction debris under floor protection.
  - Maintenance company improperly cleaning floors.
- Finish-related:
  - Improper finish application.
  - Inadequate jobsite conditions, including low temperatures or high RH prior-to, during, or post-finish application, affecting the drying and curing of the finish.
  - Improperly mixed two-component finish (in which the components are improperly mixed, not added, or used beyond pot life).
  - Coating over a not-yet cured sealer or finish coat.
  - Bad batch or finish used at or beyond its expiration/best-use date.
  - Using finish that has been exposed to temperature and humidity conditions outside the range of manufacturer recommendations.
  - Floor use before finish manufacturer recommendation or before the finish has fully cured.
  - Floors covered/protected (area rugs, floor protection) too soon after finish application.
  - An incomplete or inconsistent sanding procedure accompanied with an inadequate abrasive grit selection for the floor being sanded and/or the finish being used. This often results in high points/peaks coated with less finish than the low points/valleys.
  - The high points/peaks of sculpted floors, distressed floors, overwood/underwood, etc., wear through faster than low points/valleys.
  - Inadequately cured site-cured UV finishes.
  - Finish selection used on the floor not properly matched to the use of the floor.
  - Inadequate film-build based on use of floor.
  - Customer expectations based on use of floor.
- Factory-finished flooring:
  - The high points/peaks of sculpted floors, distressed floors, overwood/underwood, etc., wear through faster than low points/valleys.
  - Inadequately cured or improperly applied factory finishes.
  - Specific finish batches.
  - Improper finish mixing in factory.
  - Improper finish application.
  - Improperly UV-cured finish.
  - Improper application of maintenance product or finish as required by flooring and/or finish manufacturer.
  - Customer expectations based on use of floor.

CURES:

- Institute proper maintenance procedures, including:
  - Regular vacuuming and cleaning with an approved cleaning product.
  - Keeping pet nails trimmed.
  - Use breathable throw rugs and approved non-skid backing pads.
  - Replace floor protectors regularly.
  - Use of manufacturer flooring/finish recommended renovation oils or maintenance products if required.
- If the cause is finish-related, a maintenance recoat may be appropriate. Consult the finish manufacturer for appropriate recommendations.
- If the cause is improper sanding, a resand may be necessary.
- With factory-finished wood floors, follow manufacturer recommendations for addressing finish-related issues. Some finishes may be recoatable with a like-finish, but may affect the warranty. Some types of factory-applied finishes (such as Teflon-infused finishes) cannot be recoated. Affected boards may need to be replaced.
- No remedy may be necessary.

Scuffing

DEFINITION: Marks or abrasions left on a wood floor surface or finish.

CAUSES:

- Maintenance-related:
  - Grit or debris rubbed across the floor's surface.
  - Non-manufacturer-recommended cleaning and maintenance products, which leave a residue or film on the surface of the wood floor, often have a tendency to scuff or become marred. These products are not designed to wear like a wood floor finish and can become unsightly with even the lightest foot traffic.
  - Residue left on the floor from adhesive cleaners/removers used during the installation process.
  - Tape residue left on the floor.
  - Inadequate, worn, or dirty floor protection under furniture.
  - Nylon, plastic, or metal tips on furniture leg, appliances, ladders, or any object dragged across the floor.
  - Inadequate or no floor protection during construction.
  - Excessive or aggressive maintenance practices, or abrasive cleaning pads used on the finished floor.
  - Vacuuming a wood floor with the carpet setting, allowing the brushes/beater bars to make contact with the wood floor surface.
  - Hard, stiff soles on shoes, boots, sports cleats, high heels that are not specifically designed to be "non-marking soles."
- Finish-related:
  - Early foot traffic or use of the floor prior to manufacturer recommendations on uncured finishes.
  - Finish that has been exposed to temperatures outside of manufacturer-recommended ranges, during storage or application.
  - Improper finish application (finish applied outside of manufacturer coverage rates or application methods).
  - Finish coats applied over previous coats that weren't adequately dried, resulting in improper or incomplete drying and curing.
  - Improperly mixed finish (improper or lack of hardener or catalyst) leaving a finish film more susceptible to marring and scuffing.
  - Bad batch or expired finish and/or hardener or or catalyst.
  - Inadequate UV curing for onsite UV finishes.
  - Inadequate UV cured factory finishes.
- Customer expectations.

CURES:

- Institute proper maintenance procedures, including regular vacuuming and cleaning with an approved cleaning product.
- When improper cleaning products have been used on the wood floor, consult the finish and/or flooring manufacturer to determine best practice for removal and maintenance practices.
- Check with the finish manufacturer and NWFA Wood Flooring Sand and Finish Guidelines for which solvent may be used with each finish type. Some solvents may effectively remove surface scuffs, but could also damage the finish.
- Replace floor protectors regularly.
- Use cleaning product as recommended by the finish manufacturer to safely remove scuffs.
- Lightly rub a tennis ball over the scuff until it disappears.
- If the cause is finish-related, abrade and recoat may be appropriate.

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Impact Damage - Scratches/ Indentations/Bruises

DEFINITION: A depression, mark, or wound on the surface of the finished wood flooring. All species of wood, types of wood flooring, and wood flooring finishes are prone to impact damage resulting in scratches, dents, and gouges.

CAUSES:

- **Scratches -** caused by applied horizontal and vertical forces.

  - Finish systems may be marred or scuffed, either from chemicals or from heat generated by sliding objects across them. These may look like scratches, but are not.
  - Surface scratches are typically only in the finish coats. A fingernail can't feel the ridge.
  - Deep scratches are typically through the finish coats and have torn the wood fibers.
  - Cross-grain scratches are deep scratches, and are oriented perpendicular to the direction of the flooring, often crossing multiple board widths and have a higher probability of exhibiting wood fiber tear. Deep scratches, usually termed "gouges," are typically through the finish coats and have torn the wood fibers.
  - As scratch damage increases in severity, so does the likelihood that the damage will also include denting.
- **Indentations -** notches, grooves or depressions on the surface of the flooring.

  - Indentations are caused by applied vertical and/or horizontal forces on the flooring surface.
  - When only vertical forces have been applied (dropping an object) these depressions are typically isolated to the shape of the portion of the dropped object that contacted the floor.
  - Indentations may not always be accompanied with finish tear/fracture.
- **Wood bruises -** from a previous force or trauma to the surface of the boards that is not normally noticeable during the installation or handling of the product. This damage can become exposed with an increase in moisture, such as with the introduction of water through water-popping, water-based finishes, water-based stains, or similar reactive conditioners.

- Common causes for scratches, indentations, and gouges on wood flooring include, but are not limited to:
  - High heels.
  - Sports cleats.
  - Pet nails.
  - Appliances such as refrigerators or stoves, particularly with rollers, wheels, or feet leaving tracks when moved in and out.
  - Furniture legs.
  - Piano feet.
  - Dropped objects.
  - Shipping or packaging damage.
  - Installation damage.
  - Construction damage.

CURES:

- Scratches may require isolation repairs, recoating, or resanding of the affected areas. Factory-finished flooring may require individual board replacement.
- Isolation of damaged areas may include use of wood putties, fillers, stains, colored markers, or other repair tools as a normal practice to dramatically reduce or eliminate their appearance.
- Indentations may require isolation repairs, recoating, or resanding of the affected areas. Factory-finished flooring may require individual board replacement.
- Gouges may require isolation repairs, which may include use of wood putties, fillers, stains, colored markers, or other repair tools as a normal practice to dramatically reduce or eliminate their appearance.
- Replacement of affected boards may be necessary in some cases.
- In some cases, as long as wood fiber is not compromised, light to medium-sized indentations in solid wood may be repaired by steam popping. This repair may minimize the effects of dents, but may also damage the finish or surrounding areas.

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Surface Impressions

DEFINITION: A shape or pattern imprinted on the face of the board, which resembles an item or object that had been in direct contact with it.

CAUSES:

- Various rug types or backing materials can leave an imprint in the floor finish system.
- Plasticizer migration from some non-slip backing pads used under area rugs can leave a waffle-like pattern etched into the finish system.
- Area rugs or non-slip area rug pads that are incompatible with the wood floor finish systems or have been placed over uncured finishes can leave discoloring stains, blushing of the finishes, or impressions in the finish as well as the wood.
- Floor protection systems (corrugated cardboard, paper, pads, etc.) laid over the wood floor prior to the finish being fully cured (per manufacturer instruction) can leave imprints within and on the finish system.
- Floor protection systems with any sort of grit or debris caught between the protection and floor can leave impressions in the finished floor.
- Factory-finished flooring packaging material transferring to the face of the flooring boards.

CURES:

- Use a solvent recommended by the finish and flooring manufacturer to safely remove any residue from the flooring surface.
- A recoat may be necessary to address surface issues.
- A resand is sometimes necessary to remove these imprints from the floor finish system.
- Replacement of affected factory-finished boards may be necessary.
- Check with the flooring manufacturer for recommendations on repair.

Slippery Floors

DEFINITION: The perception that the floor feels slippery. All wood floor finishes could be considered slippery with normal use. Most wood floor finishes are not usually considered to be slip-resistant, and some wood floor finishes feel slipperier than others.

CAUSES:

- The type of footwear, a person's weight, stride length, gait, speed, etc., can affect the degree to which one slides across any flooring surface.
- Customer expectations.
- Maintenance-related:
  - Dust or debris on the floor surface.
  - Using cleaning products on the floor not recommended by the finish or flooring manufacturer.
  - Using old or soiled cleaning mop heads.
  - Tracking of contaminates from one floor surface onto the wood floor.
  - Overspray from using cleaning products on fixtures on or near the wood floor.
- Over-application of wax on a waxed floor (using too much wax).
- Adding non-manufacturer-recommended substances to the finish.

CURES:

- Remove dust, debris, or improper cleaning products from the floor.
- For waxed floors, use solvent as recommended by the finish manufacturer to remove excessive wax.
- Coat the floor using a finish recommended by the flooring or finish manufacturer in such situations.
- No remedy may be necessary.

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SOURCES AND CREDITS

NWFA Technical Standards & Publications Committee

- Kevin Mullany, Benchmark Wood Floors, Chair
- Joe Audino, Rode Brothers Floors
- Brett Miller, NWFA Staff Liaison
- Tony Miraldi, Somerset
- Charlie Peterson, CP Hardwood Floors
- Mike Sundell, General Finishes

Problems, Causes and Cures Taskforce

- Gary Bittner, Mohawk Industries
- Johannes Boonstra, Rubio Monocoat USA
- Chad Bulen, Bostik Inc.
- Ethan Erickson, Antikythera Inc.
- Lenny Hall, Endurance Floor Company Inc.
- Evan C. Lauridsen, Shaw Industries Group Inc.
- Steven Lima, MAPEI
- Steve Marley, Johnson Premium Flooring
- Brett Miller, NWFA Staff Liaison
- Tim Moore, Moore & Neville Inc.
- Kevin Mullany, Benchmark Wood Floors
- Tim Nathan, P.A.W. Enterprises Inc.
- Kjell Nymark, NWFA Staff Liaison
- Michael Osborn, Start to Finish Hardwood Floors LLC
- Anthony Palandro, Anthony Palandro Flooring Inc.
- Tony Robison, Consult Inspect Design
- Don Sgroi, Dependable Floor Inspections
- Billy Simmons, ITAC International LLC

Publication Editors

- Stacy Brown, NWFA
- Anita Howard, NWFA
- Brett Miller, NWFA

Layout & Design

- Laura Boyle, NWFA

Photography

- Laura Boyle, NWFA
- Megan Lhamon, NWFA
- Brett Miller, NWFA
- Keith Troyer, NWFA\

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Other Contributors

- 2001-2002 Technical Manual Committee Members
- 2010-2011 Technical Manual Committee Members
- 2017 Problems, Causes and Cures Workshop Attendees — Las Vegas, NV
- Drew Kern, Infinity Claims Management Solutions
- Todd Schutte, Bona

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National Wood
Flooring Association

111 Chesterfield Industrial Boulevard, Chesterfield, Missouri 63005
[TOLL-FREE] 800.422.4556 [LOCAL] 636.519.9663 [WEB] www.nwfa.org